Act 129 Statewide Evaluator

Final Annual Report

Phase I: June 1, 2009 – May 31, 2013

Presented to

PENNSYLVANIA PUC
PUBLIC UTILITY COMMISSION

March 4, 2014

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Acknowledgements

The Pennsylvania Statewide Evaluator (SWE) Team thanks the Energy Association of Pennsylvania, Pennsylvania's Electric Distribution Companies (EDCs), and EDC evaluation contractors for their assistance in providing data for and reviewing drafts of this report. Seven EDCs assisted with the report: Duquesne Light Company; the FirstEnergy companies – Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), West Penn Power Company, and Pennsylvania Power Company (Penn Power); PECO Energy Company; and PPL Electric Utilities Corporation. The EDC evaluation contractors included ADM, Cadmus, Navigant, and TetraTech.

The SWE Team thanks the staff of the Pennsylvania Public Utility Commission's (PUC's) Bureau of Technical Utility Services (TUS) for their comprehensive assistance and support since 2009. Darren Gill, Joe Sherrick, Megan Good, Scott Gebhardt, Charles Covage, Greg Shawley, Wayne Williams, and Laura Edinger have been instrumental in helping develop the overall evaluation framework for Act 129 energy efficiency and demand response programs. The SWE Team also thanks the Commissioners' assistants who have reviewed and proofread the SWE annual reports to the Commission. Additionally, the SWE Team thanks the attorneys from the PUC's Law Bureau, Kriss Brown and Steven Bainbridge, for their legal expertise throughout Phase I of the Act 129 programs.

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ALJ: Administrative law judge

B/C Ratio: Benefit-cost ratio

Btu: British thermal unit

C&I: Commercial and industrial

CF: Coefficient factor

CFL: Compact fluorescent lightbulb

CMP: Custom measure protocol

Commission: Pennsylvania Public Utility Commission

CPITD: Cumulative savings program inception to-date

CSP: Conservation service provider

Cv: Coefficient of variation

DEER: Database for Energy Efficient Resources

DLC: Direct load control

DR: Demand response

DSM: Demand-side management

ECM: Energy conservation measure

EDC: Electric distribution company

EE: Energy efficiency

EE&C: Energy efficiency and conservation

EER: Energy Efficiency Ratio

EER: Energy efficiency resource

EFLH: Equivalent full load hours

EMIS: Energy efficiency management reporting system

EMS: Energy management system

EM&V: Evaluation, Measurement, and Verification

EUL: End of useful life

FCM: Forward capacity market

GT&D: Generation, transmission, and distribution

GNI: Government, non-profit, institutional

IQ: Incremental quarterly

ISO: Independent system operator

kW: Kilowatt

kWh: Kilowatt-hour

LED: Light-emitting diode

LLF: Line loss factor

LMP: Locational marginal pricing

MMP: Major market protocol

M&V: Measurement and verification

MW: Megawatt

MWh: Megawatt-hour

NP: Non-profit

NPV: Net present value

NTG: Net-to-gross

NTGR: Net-to-gross ratio

NYMEX: New York Mercantile Exchange

PA PUC, or PUC: Pennsylvania Public Utility Commission

PEG: Program evaluation group

PMRF: Project management reporting system

PY: Program year

PYTD: Program year- to-date

RFP: Request for proposal

RR: Realization rate

RTU: Rooftop unit

SEER: Seasonal energy efficiency ratio

SEM: Simple engineering model

SSMVP: Site specific monitoring and verification plan

SWE: Statewide Evaluator

SWE Team: Statewide Evaluator Team

GSHP: Ground source heat pump

HOU: Hours of use

HSPF: Heating seasonal performance factor

HVAC: Heating, ventilation, and air conditioning

IEF: Interactive efforts factor

IMP: Interim measure protocol

IPMVP: International performance measurement and verification protocol

T&D: Transmission and distribution

TOU: Time of use

TRC: Total resource cost

TRM: Technical Reference Manual

TUS: Technical Utility Services

VFD: Variable frequency drive

Glossary

ACCURACY: An indication of how close a value is to the true value of the quantity in question. The term can also be used in reference to a model or a set of measured data, or to describe a measuring instrument's capability.

ACHIEVABLE POTENTIAL: The amount of energy use that efficiency can realistically be expected to displace, assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.

ADJUSTMENTS: For M&V analyses, factors that modify baseline energy or demand values to account for independent variable values (conditions) in the reporting period.

ADMINISTRATOR: A person, company, partnership, corporation, association, or other entity selected by the EDC and any subcontractor that is retained by an aforesaid entity to contract for and administer energy efficiency programs under Act 129.

BASELINE DATA: The measurements and facts describing facility operations and design during the baseline period. This includes energy use or demand and parameters of facility operation that govern energy use or demand.

BASELINE FORECAST: A prediction of future energy needs that does not take into account the likely effects of new efficiency programs that have not yet been started.

BASELINE MODEL: The set of arithmetic factors, equations, or data used to describe the relationship between energy use or demand and other baseline data. A baseline model may also be a simulation process involving a specified simulation engine and set of input data.

BASELINE PERIOD: The period of time selected as representative of facility operations before retrofit.

BIAS: The extent to which a measurement or a sampling or analytic method systematically underestimates or overestimates a value.

BILLING DATA: Has multiple meanings. Metered data obtained from the electric or gas meter used to bill the customer for energy used in a particular billing period. Meters used for this purpose typically conform to regulatory standards established for each customer class. Also used to describe the data representing the bills customers receive from the energy provider and the customer billing and payment streams associated with customer accounts. This term is used to describe both consumption and demand, and account billing and payment information.

BILLING DEMAND: The demand used to calculate the demand charge cost. This is often the monthly peak demand of the customer, but it may have a floor of some percentage of the highest monthly peak of the previous several months (a demand "ratchet"). May have other meanings associated with customer account billing practices.

BUILDING ENERGY SIMULATION MODELS: Computer models based on physical engineering principals or standards used to estimate energy usage or savings. These models do not make use of billing or metered data, but usually incorporate site-specific data on customers and physical systems. The models usually require such site-specific data as square footage, weather, surface orientations, elevations, space volumes, construction materials, equipment use, lighting, and building occupancy. These models can usually account for interactive effects between end-uses (e.g., lighting and HVAC), part-load efficiencies, and changes in external and internal heat gains or losses. Examples of building energy simulation models include ADM2, BLAST, and DOE-2.

CAPACITY: The amount of electric power for which a generating unit, generating station, or other electrical apparatus is rated by the user or manufacturer. The term is also used for the total volume of natural gas that can flow through a pipeline over a given amount of time, considering such factors as compression and pipeline size.

COEFFICIENT OF VARIATION: The sample standard deviation divided by the sample mean (Cv = sd/y).

COINCIDENT DEMAND: The metered demand of a device, circuit, or building that occurs at the same time as the peak demand of the building or facility or at the same time as some other peak of interest, such as a utility's highest load during peak load hours. This should properly be expressed so as to indicate the peak of interest, e.g., "demand coincident with the building peak."

CONFIDENCE: An indication of how close a value is to the true value of the quantity in question. Confidence is the likelihood that the evaluation has captured the true impacts of a program within a certain range of values (i.e., precision).

CONSERVATION: Steps taken to cause less energy to be used than would otherwise be the case. Examples include improved efficiency, avoidance of waste, and reduced consumption. Related activities include installing equipment (e.g., a computer to ensure efficient energy use), modifying equipment (e.g., making a boiler more efficient), adding insulation, and changing behavior patterns.

CORRELATION COEFFICIENT: A measure of the linear association between two variables, calculated as the square root of the R_2 obtained by regressing one variable on the other and signed to indicate whether the relationship is positive or negative.

CORRELATION TABLE (CORRELATION MATRIX): A table or matrix giving the correlation between all pairs of data sets. Row headings are the scores on one variable, and column headings are the scores on the second variables. A cell shows how many times the score on a row was associated with the score in a column.

COST-EFFECTIVENESS: An indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice when compared with the costs of energy produced and delivered in the absence of such an investment. In the energy efficiency field, the terms refers to the present value of the estimated benefits produced by an energy efficiency program as compared with the estimated total program costs, from the perspective of either society as a whole or of individual customers, to determine if the proposed investment or measure is desirable from a variety of perspectives, e.g., whether the estimated benefits exceed the estimated costs. See also TOTAL RESOURCE COST (TRC) TEST. The 2008 Act 129 enacted by the Pennsylvania Legislature mandates use of the TRC Test for determining cost-effectiveness.

CUMULATIVE PROGRAM INCEPTION TO DATE: The period since date of program inception through the current reporting period (i.e., the reporting period of this report).

CUSTOMER: Any person or entity responsible for payment of an electric or gas bill and with an active meter serviced by a utility company.

CUSTOMER INFORMATION: Non-public information and data specific to a utility customer that the utility acquired or developed in the course of providing utility services.

Cv: See COEFFICIENT OF VARIATION.

DEEMED SAVINGS: An estimate of the reported energy savings or energy demand savings outcome for a single unit of an installed energy efficiency measure that (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) is applicable to the situation being evaluated.

DEMAND: The time rate of energy flow. Demand usually refers to electric power and is measured in kilowatts (kW; equals kWh/hr) but can also refer to natural gas, usually as Btus/hr, kBtus/hr, therms/day, or ccf/day. Example: Ten 100-watt lamps consume electricity at the rate of 1,000 watts, or 1 kilowatt (kW).

DEMAND BILLING: The electric capacity requirement for which a large user pays. It may be based on the customer's peak demand during the contract year, on a previous maximum, or on an agreed-upon minimum. Demand billing is measured in kilowatts (kW).

DEMAND CHARGE: The sum to be paid by a large electricity consumer for its peak usage level.

DEMAND RESPONSIVENESS: Activities or equipment that induce consumers to use energy at different (lower-cost) times of day or to interrupt energy use for certain equipment temporarily, usually in direct response to a price signal. Examples include interruptible rates, doing laundry after 7 p.m., and air conditioner recycling programs.

DEMAND SAVINGS OR DEMAND REDUCTION: The reduction in the demand from the pre-retrofit baseline to the post-retrofit demand, once independent variables (e.g., weather, occupancy) have been adjusted for. This term is usually applied to billing demand (to calculate cost savings) or to peak demand (for equipment sizing purposes).

DEMAND-SIDE MANAGEMENT (DSM): The methods used to manage energy demand, including energy efficiency, load management, fuel substitution, and load building. Also See LOAD MANAGEMENT.

DIRECT ENERGY SAVINGS (DIRECT PROGRAM ENERGY SAVINGS): The words “direct savings” and “direct program savings” refer to the savings from programs responsible for achieving specific energy efficiency goals. Typically these are thought of as resource acquisition programs or programs that install or expedite the installation of energy efficient equipment and that directly cause or help cause energy efficiency to be achieved. Rebate, incentive, and direct install programs provide direct energy savings.

DIRECT INSTALL or DIRECT INSTALLATION PROGRAMS: These programs provide free energy efficiency measures and their installation for qualified customers. Typical measures distributed by these programs include low-flow showerheads and compact fluorescent bulbs.

DISTRIBUTED GENERATION: A distributed generation system involves small amounts of generation located on a utility’s distribution system for the purpose of meeting local (substation level) peak loads or displacing the need to build additional (or upgrade) local distribution lines.

EDC PROPOSED SAVINGS: Energy savings and demand reductions proposed by EDCs and developed using alternative values or savings protocols to those in the TRM. EDC proposed savings can include savings based on research conducted by EDCs or their independent evaluators or from other data sources.

EFFECTIVE USEFUL LIFE: The assumed life expectancy, in years, of an energy efficiency measure.

EFFICIENCY: The ratio of the useful energy delivered by a dynamic system (e.g., a machine, engine, or motor) to the energy supplied to it over the same period or cycle of operation. The ratio is usually determined under specific test conditions.

EM&V: Evaluation, Measurement, and Verification. Evaluation involves retrospectively assessing the performance and implementation of an energy efficiency or demand response program. M&V refers to data collection, monitoring, and analysis used to calculate gross energy and demand savings from *individual sites or projects*. M&V can be a subset of program impact evaluation. Generally speaking, the differentiation between evaluation and project M&V is that evaluation is associated with programs and M&V with projects.

END-USE (MEASURES OR GROUPS): Refers to a broad or sometimes narrow category on which a program is concentrating efforts. Examples include refrigeration, food service, HVAC, appliances, envelope, and lighting.

ENERGY CONSUMPTION: The amount of energy consumed in the form in which it is acquired by the user. The term excludes electrical generation and distribution losses.

ENERGY COST: The total cost for energy, including such charges as base charges, demand charges, customer charges, power factor charges, and miscellaneous charges.

ENERGY EFFICIENCY: Using less energy to perform the same function. Programs designed to use energy more efficiently—doing the same with less. For the purposes of this report, energy efficiency programs are distinguished from DSM programs in that the latter are utility-sponsored and financed, whereas the former is a broader term not limited to a particular sponsor or funding source. The term "energy conservation" has also been used, but it has the connotation of doing without in order to save energy rather than using less energy to perform the same function and so is not used as much today. Many people use the two terms interchangeably.

ENERGY EFFICIENCY IMPROVEMENT: Reduced energy use for a comparable level of service, resulting from installation of an energy efficiency measure or adoption of an energy efficiency practice. Level of service may be expressed in such ways as the volume of a refrigerator, temperature levels, production output of a manufacturing facility, or lighting level per square foot.

ENERGY EFFICIENCY MEASURE: Installation of equipment, subsystems, or systems, or modification of equipment, subsystems, systems, or operations, on the customer side of the meter, for the purpose of reducing energy or demand (and hence energy or demand costs) at a comparable level of service.

ENERGY EFFICIENCY OF EQUIPMENT: The percentage of gross energy input that is realized as useful energy output of a piece of equipment.

ENERGY EFFICIENCY OF A MEASURE: A measure of the energy used to provide a specific service or to accomplish a specific amount of work (e.g., kWh/cubic foot of a refrigerator, therms/gallon of hot water).

ENERGY EFFICIENCY PRACTICE: The use of high-efficiency products, services, and practices or an energy-using appliance or piece of equipment, to reduce energy use while maintaining a comparable level of service when installed or applied on the customer side of the meter. Energy efficiency activities typically require permanent replacement of energy-using equipment with more efficient models. Examples include refrigerator replacement, light fixture replacement, and cooling equipment upgrades.

ENERGY EFFICIENCY RATIO (EER): The ratio of output cooling in Btus per hour to input electrical power in watts at a given operating point. EER is generally calculated using a 95°F outside temperature and an inside temperature of 80°F at 50% relative humidity. The higher a unit's EER rating, the more energy efficient it is.

ENERGY MANAGEMENT SYSTEM: A control system (often computerized) designed to regulate the energy consumption of a building by controlling the operation of energy-consuming systems (e.g., HVAC, lighting, and water-heating systems).

ENERGY SAVINGS OR ENERGY REDUCTION: The reduction in energy use from the pre-retrofit baseline to the post-retrofit energy use, once independent variables (e.g., weather, occupancy) have been adjusted for.

ENGINEERING APPROACHES: Methods using engineering algorithms or models to estimate energy or demand use.

ENGINEERING MODELS: Engineering equations used to calculate energy usage and savings. These models are usually based on a quantitative description of physical processes that transform delivered energy into useful work such as heat, lighting, or motor drive. In practice, these models may be reduced to simple equations in spreadsheets that calculate energy usage or savings as a function of measurable attributes of customers, facilities, or equipment (e.g., lighting use = watts × hours of use).

EVALUATION: The performance of studies and activities aimed at determining the effects of a program; any of a wide range of assessment activities associated with understanding or documenting program performance or potential performance, or with assessing program or program-related markets and market operations; any of a wide range of evaluative efforts, including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

EX-ANTE SAVINGS ESTIMATE: Also known as Reported Savings. Savings estimated by the program implementer (EDC/CSP). (From the Latin for “beforehand.”)

EX-POST EVALUATION ESTIMATED SAVINGS: Also known as Verified Savings. Savings estimates reported by the independent evaluator after the energy impact evaluation and the associated M&V efforts have been completed. If only the term “ex-post savings” is used, it will be assumed that it refers to the ex-post evaluation estimate, the most common usage. (From the Latin for “from something done afterward.”)

EX-POST (PROGRAM) ADMINISTRATOR-ESTIMATED SAVINGS: Savings estimates reported by the administrator after program implementation has begun (administrator-reported ex-post) (From the Latin for “from something done afterward.”)

EX-POST (PROGRAM) ADMINISTRATOR-FORECASTED SAVINGS: Savings estimates forecasted by the administrator during the program and portfolio planning process. (From the Latin for “from something done afterward.”)

FREE-DRIVER: A non-participant who adopts a particular efficiency measure or practice as a result of a utility program. See SPILLOVER for aggregate impacts.

FREE-RIDER: A program participant who would have implemented a program measure or practice in the absence of the program within the same timeframe .

GROSS REDUCTION OR GROSS SAVINGS: The change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated. Unless otherwise stated in this report, "gross reduction" and "gross savings" are used interchangeably.

HEATING SEASONAL PERFORMANCE FACTOR: Used to describe the heating efficiency of heat pumps. It is a measure of the estimated seasonal heating output in Btus divided by the amount of energy consumed in watt-hours.

HETEROSCEDASTICITY: Unequal error variance. In statistics, a sequence or a vector of random variables is heteroscedastic if the random variables in the sequence or vector may have different variances. This violates the regression assumption of constant variance (the variance of the errors is constant across observations, or homoscedastic). Typically, residuals are plotted to assess this assumption. Standard estimation methods are inefficient when the errors are heteroscedastic. A common example is when variance is expected to be greater on a variable measurement for larger firms than for smaller firms.

HOMOSCEDASTICITY: Constant error variance, an assumption of classical regression analysis. See also HETEROSCEDASTICITY.

IMPACT EVALUATION: Used to measure the program-specific induced changes in energy usage or demand (e.g., kWh, kW, or therms) or behavior attributed to energy efficiency and demand response programs.

IMPACT YEAR: Depending on the context, either (a) the 12 months subsequent to program participation used to represent program costs or load impacts occurring in that year, or (b) any calendar year after the program year in which impacts may occur.

INCENTIVES: Financial support (e.g., rebates, low-interest loans) to install energy efficiency measures. The incentives are solicited by the customer and based on the customer's billing history or customer-specific information.

INDEPENDENT VARIABLES: Factors that affect energy use and demand in a building but that cannot be controlled (e.g., weather, occupancy).

INDIRECT ENERGY SAVINGS (INDIRECT PROGRAM ENERGY SAVINGS): The words "indirect savings" and "indirect program savings" refer to programs that are typically information, education, marketing, or outreach programs that are expected to result in energy savings achieved through the actions of the customers exposed to the program's efforts, without direct enrollment in a program that has energy savings goals.

INTERNAL VALIDITY: The validity of (causal) inferences in scientific studies, usually based on experiments as experimental validity. Inferences are said to possess internal validity if a causal relation between two variables is properly demonstrated,

IPMVP OPTION A: PARTIALLY MEASURED RETROFIT ISOLATION: Savings are determined by partial field measurement of the energy use of the system to which the measure was applied; separate from the energy use of the rest of the facility. Measures are likely to be partially deemed, meaning that some, but not all, parameter(s) are stipulated in the Technical Reference Manual.

IPMVP OPTION B: RETROFIT ISOLATION: Savings are determined by field measurement of the energy use of the system to which the measure was applied; separate from the energy use of the rest of the facility. All key parameters are measured and not deemed.

IPMVP OPTION C: WHOLE BUILDING: Savings are determined by measuring energy use at the facility level. Values obtained either with short-term or continuous on-site measurement can be used in conjunction with billing analysis regression models to calibrate the savings estimated from program participation.

IPMVP OPTION D: CALIBRATED SIMULATION: Savings are determined through simulation of energy use of components or a whole facility. Simulation routines must be demonstrated to adequately model actual energy performance of the facility through calibration with utility billing data or end-uses metering.

LINE LOSS FACTOR: Factor used to describe energy loss due to heating of conductors caused by electrical resistance along the transmission and distribution lines of the electric grid.

LOAD MANAGEMENT: Utility demand management practices directed at reducing the maximum kilowatt demand on an electric system and/or modifying the coincident peak demand of one or more classes of service to better meet the utility system capability for a given hour, day, week, season, or year.

LOAD SHAPES: Representations such as graphs, tables, and databases that describe energy consumption rates as a function of another variable such as time or outdoor air temperature.

LOAD SHIFTING: Load shifting refers to moving electric load from one time period in a day to another time period. An example would be moving electric water heating load from peak hours to off-peak hours.

MARKET EFFECTS EVALUATION: The evaluation of the change in the structure or functioning of a market or the behavior of participants in a market that results from one or more program efforts. Typically the resultant market or behavior change leads to increased adoption of energy efficient products, services, or practices.

MARKET TRANSFORMATION: A reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced, or changed.

MEASUREMENT: A procedure for assigning a number to an observed object or event.

MEASUREMENT AND VERIFICATION (M&V): Data collection, monitoring, and analysis associated with the calculation of gross energy and demand savings from individual sites or projects. M&V can be a subset of program impact evaluation.

MEASUREMENT BOUNDARY: The boundary of the analysis for determining direct energy or demand savings.

METERING: The collection of energy consumption data, over time, through the use of meters. These meters may collect information with respect to an end-use, a circuit, a piece of equipment, or a whole building (or facility). Short-term metering generally refers to data collection for no more than a few weeks. End-use metering refers to separate data collection for one or more end-uses in a facility, such as lighting, air conditioning, or refrigeration. Spot metering is an instantaneous measurement (rather than over time) to determine an energy consumption rate.

MONITORING: Gathering of relevant measurement data, including but not limited to, energy consumption data over time to evaluate equipment or system performance; for example, chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

MULTI-COLINEARITY: A statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this situation the coefficient estimates may change erratically in response to small changes in the model or the data. Multi-colinearity does not reduce the predictive power or reliability of the model as a whole, at least within the sample data themselves; it only affects calculations regarding individual predictors.

NET SAVINGS: The total change in load that is attributable to an energy efficiency program. Net savings may include, implicitly or explicitly, the effects of free-drivers, free-riders, energy efficiency standards, changes in the level of energy service, participant and non-participant spillover, and other causes of changes in energy consumption or demand.

NET-TO-GROSS RATIO (NTGR): A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.

NON-PARTICIPANT: Any consumer who was eligible but did not participate in the subject efficiency program in a given program year. Each evaluation plan should provide a definition of a non-participant as it applies to a specific evaluation.

NON-RESPONSE BIAS: The effect of a set of respondents refusing or choosing not to participate in research; typically larger for self-administered or mail-out surveys.

NORMALIZED ANNUAL CONSUMPTION (NAC) ANALYSIS: A regression-based method that analyzes monthly energy consumption data.

PARTIAL FREE-RIDER: A program participant who would have implemented, to some degree, a program measure or practice in the absence of the program (i.e., a participant may have purchased an ENERGY STAR appliance in the absence of the program, but because of the program the participant purchased an appliance that is higher in efficiency or, purchased sooner than what he or she had planned).).

PARTICIPANT: A consumer who received a service offered through the subject efficiency program in a given program year. In this definition, “service” can refer to a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information, and other services, items, or conditions. Each evaluation plan should define “participant” as it applies to the specific evaluation.

PEAK DEMAND: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

PERSISTENCE STUDY: A study to assess changes in program impacts over time (including retention and degradation).

PORTFOLIO: Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).

PRECISION: The indication of the closeness of agreement among repeated measurements of the same physical quantity.

PROCESS EVALUATION: A systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination, and identifying and recommending improvements to increase the program’s efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

PROGRAM: A group of projects, with similar characteristics and installed in similar applications. Examples include a utility program to install energy efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, and a state residential energy efficiency code program.

PROGRAM YEAR: The twelve month period starting on June 1 and ending on May 31 of the next year.

PROGRAM YEAR THREE (PY3): The period between June 1, 2011 and May 31, 2012.

PROGRAM YEAR TO DATE: The period starting on June 1 of a program year and extending through the end of the current quarterly reporting period in the program year.

PROJECT: An activity or course of action involving one or more energy efficiency measures at a single facility or site.

REALIZATION RATE: A factor representing ex-post savings estimates divided by ex-ante savings estimates that is applied to gross savings to determine verified savings estimates.

REGRESSION ANALYSIS: Analysis of the relationship between a dependent variable (response variable) and specified independent variables (explanatory variables). The mathematical model of their relationship is known as regression equation.

RELIABILITY: Refers to the likelihood that observations can be replicated.

REPORTING PERIOD: The time following implementation of an energy efficiency activity during which savings are to be determined.

RETROFIT ISOLATION: The savings measurement approach defined in IPMVP Options A and B, and ASHRAE Guideline 14, that determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration. ASHRAE Guideline 14 provides guidelines for reliably measuring energy and demand savings of commercial equipment.

RIGOR: The level of expected confidence and precision. The higher the level of rigor, the more confident one can be that the results of the evaluation are both accurate and precise.

SEASONAL ENERGY EFFICIENCY RATIO (SEER): This rating of a unit is the cooling output in Btus during a typical cooling season divided by the total electric energy input in watt-hours during the same period. The higher a unit's SEER, the more energy efficient it is.

SPILLOVER: Reductions in energy consumption or demand resulting from the energy efficiency program, beyond the program-related gross savings of the participants. There can be participant and non-participant spillover.

STATISTICALLY ADJUSTED ENGINEERING (SAE) MODELS: Statistical analysis models that incorporate the engineering estimate of savings as a dependent variable.

STIPULATED VALUES: See DEEMED SAVINGS.

SYMMETRIC ADDITIVE ADJUSTMENT: A mathematical approach that incorporates pre-event usage trends into the baseline usage estimates for demand response customers.

TECHNICAL RESOURCE MANUAL: Standards for measuring and verifying applicable demand-side management or energy efficiency measures used by EDCs to meet the Act 129 consumption and peak demand reduction targets.

TOTAL RESOURCE COST (TRC) TEST: This test analyzes the costs and benefits of energy efficiency and conservation plans.

TRM VERIFIED SAVINGS: Savings estimated based on the Commission-approved Technical Reference Manual (TRM)

UNCERTAINTY: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall within some degree of confidence.

VALUE OF INFORMATION: A balance between the level of detail (rigor) and the level of effort required (cost) in an impact evaluation.

VARIABLE FREQUENCY DRIVE: A system for controlling the rotational speed of an alternating current electric motor by controlling the frequency of the electrical power supplied to the motor.

VERIFIED REDUCTION OR VERIFIED SAVINGS: A change in energy consumption or demand that has undergone rigorous evaluation, measurement, and verification to ensure its accuracy within a prescribed level of confidence and precision.

Executive Summary

The Pennsylvania Public Utility Commission (PA PUC, PUC, or Commission) was charged by the Pennsylvania General Assembly pursuant to Act 129 of 2008 (Act 129) with establishing an energy efficiency and conservation (EE&C) program. The seven electric distribution companies (EDCs) subject to Act 129 include Duquesne Light Company (Duquesne); PECO Energy Company (PECO); PPL Electric Utilities Corporation (PPL); and the FirstEnergy companies – Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), Pennsylvania Power Company (Penn Power), and West Penn Power Company (West Penn or West Penn Power). Stated below is the section of Act 129 that discusses the kWh and kW savings targets to be achieved by May 31, 2011 and by May 31, 2013:

> 66 Pa. C.S. §§ 2806.1 and 2806.2 – The EE&C program requires each Electric Distribution Company (EDC) with at least 100,000 customers to adopt a plan to reduce energy demand and consumption within its service territory. Each EDC, through its approved plan, is to reduce electric consumption by May 31, 2011, by at least 1% of its expected consumption for June 1, 2009 through May 31, 2010. By May 31, 2013, the total annual consumption is to be reduced by a minimum of 3% of its consumption for June 1, 2009 through May 31, 2010. Also, by May 31, 2013, each covered EDC's peak demand is to be reduced by a minimum of 4.5% of the EDC's annual system peak demand in the 100 hours of highest demand, measured against the EDC's peak demand during the period of June 1, 2007 through September 30, 2007.

In order to fulfill this obligation, on January 16, 2009 the Commission entered an Implementation Order at Docket No. M-2008-2069887. As part of the Implementation Order and Act 129, the Commission sought a statewide evaluator (SWE or SWE Team) to establish an evaluation framework for the EDCs' EE&C programs and to conduct oversight of the EDCs' impact and process evaluation activities. GDS Associates, partnered with Nexant and Mondre Energy, was retained as the PA SWE to fulfill requirements of the Implementation Order of Act 129. The SWE Team is contracted to monitor and verify EDC data collection, impact and process evaluations, quality assurance processes, and performance measures, by customer class. The SWE Team has many other contractual obligations, including reviewing the Technical Reference Manual (TRM) information and savings values and developing recommendations for possible revisions and additions. During Phase I of Act 129, each of the seven Pennsylvania EDCs also retained an independent evaluator to conduct impact and process evaluations of its Act 129 energy efficiency and demand response programs.

The SWE is also responsible for the identification of technical evaluation issues and coordinated their resolution through the Program Evaluation Group (PEG). The SWE coordinates these meetings and works collaboratively with the Commission's Technical Utility Staff (TUS), the EDCs, and the EDC independent evaluators to reach consensus on technical program evaluation issues. The SWE's evaluation activities (among other things) support annual updates to the TRM work and continual improvement of the accuracy and reliability of reported impacts.

The SWE completed an energy efficiency baseline study for residential and commercial sectors, an energy efficiency potential study, a demand response feasibility study, and a net-to-gross study during Phase I of Act 129. These studies are described in more detail in the Introduction, Section 1.6, and Appendix C of the report.

This report is the fourth and final annual report from the SWE to the PA PUC in Phase I. This report provides detailed information on the findings of the SWE's Program Year 4 (PY4) audit activities of the Act 129 EE&C programs implemented by seven EDCs in Pennsylvania, as well as a summary of PY1–PY4 results. Table I summarizes the SWE's assessment of each EDC's compliance with the various requirements. This report also presents the SWE's findings as to whether all EDCs met the mWh and mW savings and other targets established by Act 129 for the Phase I programs. Throughout this report the SWE has differentiated between savings estimated based on the Commission-approved TRM as verified and evaluated by the EDCs' independent evaluators (hereafter referred to as "TRM verified savings") and savings estimates as evaluated by the EDCs' independent evaluators and proposed by some EDCs based on alternative values that are different than those included in the TRM (hereafter referred to as "EDC proposed savings").

Table I: EDC Compliance Checklist

EDC	1% Energy Reduction Target (5/31/2011)	3% Energy Reduction Target (5/31/2013)	4.5% Peak Demand Reduction Target (5/31/2013)	Proportion of Measures Offered to Low Income	10% of Energy Savings Target Achieved from GNI	10% of Peak Demand Savings Target Achieved from GNI[1]	Total Resource Cost Test Ratio> 1?
Duquesne	✓	✓	✓	✓	✓	✓	✓
PECO	✓	✓	✓	✓	✓	✓	✓
PPL	✓	✓	✓	✓	✓	✓	✓
Met-Ed	✓	✓	✓	✓	✓	✓	✓
Penelec	✓	✓	✓	✓	✓	✓	✓
Penn Power	✓	✓	✓	✓	✓	✓	✓
West Penn Power	✗	✓	✓	✓	✓	✓	✓

[1] The EM&V conducted for the GNI program for Penn Power is based on a review of actual performance for a random sample of completed projects based on a 90% level of confidence and 6% margin of error (with a two-tailed test). The TRM verified gross demand savings achieved by Penn Power for the GNI sector for Phase I was 4.21 mW plus or minus 0.25 mW at a 90% confidence and 6% precision level. Because the GNI demand reduction target of 4.4 mW for Penn Power is within the 90% confidence interval for the estimated savings, the SWE has determined that Penn Power has met the GNI sector demand reduction savings target, as the measured 4.21 mW estimate is not statistically significantly different from the 4.4 mW target.

As of May 31, 2013 (end of PY4), the seven EDCs had collectively saved 5,403,370 mWh per year and 1,540.61 mW.[2] These savings are attributable to the EE&C programs implemented by the seven EDCs. Individually, all EDCs exceeded their 2013 compliance targets for energy savings and demand reductions as established by the Commission based on their reported Phase I CPITD TRM verified gross energy and demand savings, as can be seen in Tables II and III. Tables IV through VII show the EDCs' compliance with other Phase I targets.

Table II: Summary of Phase I EDC Targets and Compliance for 3% Energy Consumption Reduction by May 2013

	Statewide[3]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Target (mWh/yr)	**4,399,629**	422,565	1,181,550	1,146,431	445,951	431,784	143,188	628,160
CPITD TRM Verified Gross Energy Savings (mWh/yr)	**5,403,370**	556,282	1,399,242[4]	1,642,067	493,138	458,784	165,768	688,089
% of Target Achieved	**123%**	**132%**	**118%**	**143%**	**111%**	**106%**	**116%**	**110%**

Table III: Summary of Phase I EDC Targets and Compliance for 4.5% Demand Reduction in Top 100 Hours of 2012

	Statewide[5]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Target (mW) in Top 100 Hours	**1,193**	113	355	297	119	108	44	157
CPITD TRM Verified Gross Demand Reductions (mW) in Top 100 Hours	**1,349.92**	138.56	399.2	340.90	125.02	113.95	46.21	186.08
% of Target Achieved	**113%**	**123%**	**112%**	**115%**	**105%**	**106%**	**105%**	**119%**
CPITD TRM Verified Gross Demand Reductions (mW)	**1,540.61**	158.92	418.10[6]	409.98	136.92	128.22	51.30	237.17

[2] Savings represent CPITD TRM verified gross energy and demand savings achieved.
[3] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified program-year-to-date (PYTD) values by the sum of EDC compliance target values.
[4] Following the submittal of PECO's PY4 annual report, Navigant discovered that the final verified energy and demand savings from certain GNI projects had not been entered into its realization rate calculators. The result of adding the values to the correct realization rate calculators was an increase of 76 MWh and 0.1 MW for the Smart Equipment Incentives GNI program and total portfolio. This savings increase is reflected in the SWE Act 129 Phase I report but is not included in PECO's annual report.
[5] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[6] This number excludes 20.9 mW reported by PECO as it does not count toward PECO's compliance target.

Table IV: Summary of Phase I EDC Targets and Compliance for 10% GNI Consumption Reduction

	Statewide[7]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Target Energy Reduction (mWh/yr) in GNI Sector	**439,983**	42,257	118,155	114,643	44,595	43,198	14,319	62,816
CPITD TRM Verified Gross Energy Savings in GNI (mWh/yr)	**721,354**	49,979	194,033	206,786	51,025	53,919	14,577	151,035
% of Target Achieved	**164%**	**118%**	**164%**	**180%**	**114%**	**125%**	**102%**	**240%**
Target Demand Reduction (mW) in GNI Sector in Top 100 Hours	**119.4**	11.3	35.5	29.7	11.9	10.8	4.4	15.7
CPITD TRM Verified Gross Demand Reductions (mW) in Top 100 Hours in GNI	**179.12**	15.20	46.60[8]	31.23	22.73	20.60	4.21	38.55
% of Target Achieved	**150%**	**135%**	**131%**	**105%**	**189%**	**191%**	**96%**	**246%**

Table V: Summary of Phase I EDC Targets and Compliance for 1% Energy Consumption Reduction by May 2011

	Statewide[9]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Target (mWh/yr)	**1,466,618**	140,855	393,860	382,144	148,650	143,993	47,729	209,387
CPITD TRM Verified Gross Energy Savings (mWh/yr)	**2,073,981**	168,336	873,192	509,361	181,681	184,261	66,630	90,520
% of Target Achieved	**141%**	**120%**	**222%**	**133%**	**122%**	**128%**	**140%**	**43%**

[7] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[8] This number accounts for a portion of the 20.9 MW being excluded from PECO's demand compliance savings and is equal to the proportion of GNI to C&I programs in program year 4.
[9] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified PYTD values by the sum of EDC compliance target values.

Table VI: Summary of Phase I EDC Targets and Compliance with Low-Income Measure Proportion

	Statewide[10]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Target % of Low-Income Measures (based on % of low-income consumption)	**7.5%**	7.88%	8.05%[11]	8.64%	7.84%	9.51%	8.16%	8.50%
Total Electric Consumption (mWh/yr)	**145,114,052**	13,860,634	38,644,120	39,090,157	14,494,013	14,300,938	4,644,360	20,079,830
Total Number of Savings Measures Offered	**479**	51	124	139	41	41	41	42
Low-Income Electric Consumption (mWh/yr)	**10,866,236**	1,092,156	1,215,463	3,376,606	1,273,589	1,463,129	494,113	1,951,180
Total Number of Low-Income Measures Offered	**108**	8	17	52	7	7	7	10
Proportion of Low-Income Measures Offered	**18.6%**	**15.7%**	**14%**	**37%**	**17.1%**	**17.1%**	**17.1%**	**23.8%**

[10] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified PYTD values by the sum of EDC compliance target values.
[11] This target was adjusted by the SWE to correct the calculated percentage from the number used in the EDC's report.

Table VII: Phase I Budget Spending and Compliance by EDC

	Statewide[12]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
Budget	**$978,025,497**	$78,183,806	$341,580,634	$246,005,504	$99,467,568	$91,898,976	$26,639,136	$94,249,873
Phase I Spending	**$803,726,000**	$67,049,000	$221,106,000	$240,926,000	$90,656,000	$76,380,000	$21,869,000	$85,740,000
CPITD TRM Verified Gross Energy Savings (mWh/yr)	**5,403,370**	556,282	1,399,242	1,642,067	493,138	458,784	165,768	688,089
Savings Achieved as % of 2013 Targets	**123%**	**132%**	**118%**	**143%**	**111%**	**106%**	**116%**	**110%**
CPITD TRM Verified Gross Demand Reduction (mW)	**1,540.61**	158.92	418.10[13]	409.98	136.92	128.22	51.30	237.17
Savings Achieved as % of 2013 Targets	**113%**	**123%**	**112%**	**115%**	**105%**	**106%**	**105%**	**119%**

[12] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified PYTD values by the sum of EDC compliance target values.
[13] This number excludes 20.9 MW reported by PECO as it does not count toward PECO's compliance target.

The Phase I annual program-year-to-date (PYTD) savings for PY1–PY4 are shown in Figure I. The Phase I annual PYTD demand reductions for PY1–PY4 are shown in Figure II.

Figure I: Phase I TRM Verified Gross PYTD Energy Savings by EDC

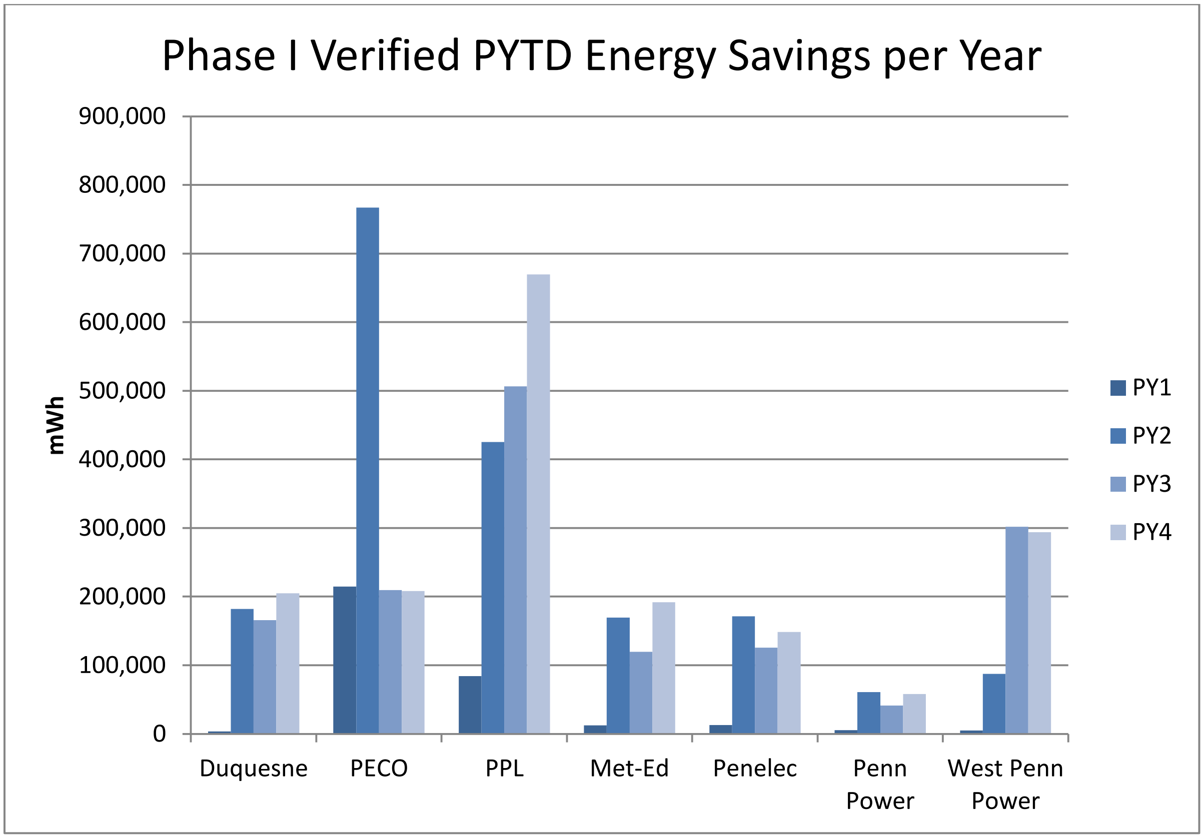
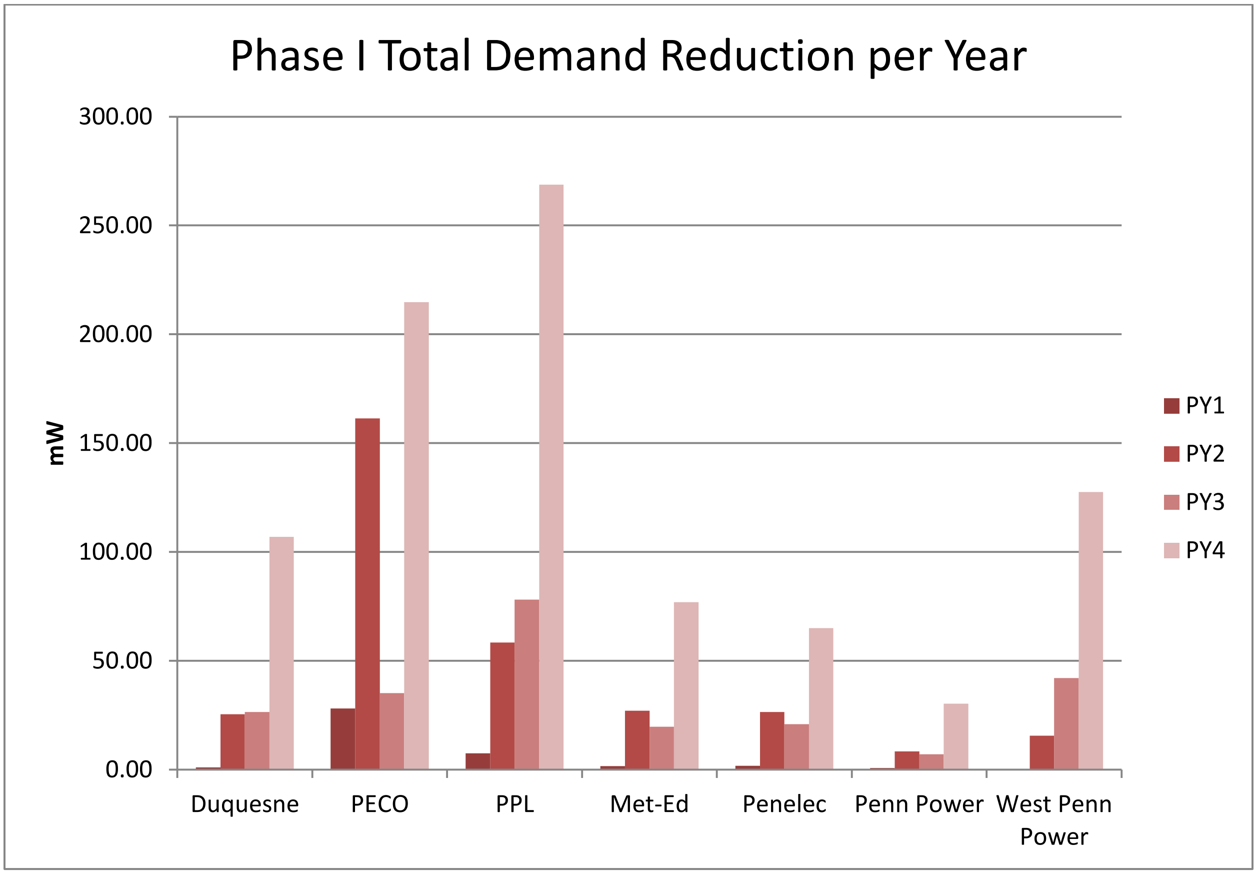


Figure II: Phase I TRM Verified Gross Total Demand Reduction by EDC[14]



TRM verified savings reflect the evaluation, measurement, and verification (EM&V) conducted by utility evaluators and reviewed and accepted by the SWE. These savings also reflect savings based on the Pennsylvania TRM for those measures included in the TRM. The SWE performed significant EM&V work to validate these TRM verified gross savings values, including both review and oversight of utility independent evaluator EM&V plans, reports, efforts, and activities, as well as performance of independent site work in various EDC territories supporting firsthand familiarity with EDC-specific findings by the EDC evaluators.

[14] PY4 was the peak load reduction compliance year, and the only year that EDCs implemented demand response programs.

1 Introduction

1.1 Act 129 and Summary of PUC Orders

On October 15, 2008, Governor Ed Rendell signed HB 2200 into law as Act 129 of 2008, with an effective date of November 14, 2008 (the "Act"). Among other provisions, the Act amends the Public Utility Code, Title 66 of the Pennsylvania Consolidated Statutes, by adding Section 2806.1,[15] which requires the Commonwealth's electric distribution companies (EDCs) with at least 100,000 customers to achieve reductions in retail electricity consumption by implementing energy efficiency and conservation (EE&C) plans. The Commission is charged with adopting an EE&C program, which provides the framework and standards for EE&C plan development and implementation, and for the Commission's review and performance of the EE&C plans' effectiveness at reducing energy consumption and demand and achieving the reduction goals.

The reduction goals and standards established by the Act through May 31, 2013 constitute Phase I of the Act, which is the primary focus of this report. The Commission is charged with evaluating the benefits and costs of the EE&C program and plans for Phase I by November 30, 2013 and for each subsequent phase of the Act every five years thereafter. In addition, beginning five years following the effective date of the Act and annually thereafter, the Commission shall submit a report to the Consumer Protection and Professional Licensure Committee of the Senate and the Consumer Affairs Committee of the House of Representatives. This report is the five year report as required under the Act.

The Act also requires the Commission to "adopt additional required incremental reductions in consumption" if the Commission determines that the EE&C program's benefits exceed its costs, using a total resource cost (TRC) test (or other analysis as determined by the Commission).[16] The Commission has determined that incremental consumption reduction benefits in excess of costs are achievable for the three-year period June 1, 2013 through May 31, 2016 and has issued an implementation order for Phase II of the Act establishing consumption reduction requirements for each EDC subject to the Act.[17]

1.1.1 Mandated Consumption Reductions

[15] 66 Pa. C.S §2806.1.

[16] 66 Pa. C.S §2806.1(c)(3). The Act defines the TRC test as a "standard test that is met if, over the effective life of each [EE&C plan] not to exceed 15 years, the net present value of the avoided monetary cost of supplying electricity is greater than the net present value of the monetary cost of energy efficiency conservation measures."

[17] *Energy Efficiency and Conservation Program*, Implementation Order, Docket Nos. M-2012-2289411 and M-2008-2069887, August 3, 2012 (the Phase II Implementation Order). The Commission reaffirmed its mandated reduction targets for each of the EDCs in separate Opinions and Orders issued in Docket Nos. P-2012-2320334 (Opinion and Order entered December 6, 2012); Docket No. P-2012-2320369 (Opinion and Order entered February 14, 2013); and Docket Nos. P-2012-2320450, P-2012-2320468, P-2012-2320480, and P-2012-2320484 (Opinion and Order entered December 5, 2012). See Section 6 of this report for a summary of the Phase II Implementation Order.

The Act imposes on each subject EDC the obligation to reduce, through its EE&C plan, the total annual weather-normalized consumption of its retail customers by a minimum of 1% by May 31, 2011 and by a minimum of 3% by May 31, 2013.[18] For each minimum goal, the reduction is to be

> measured against the [EDC's] expected load as forecasted by the Commission for June 1, 2009, through May 31, 2010, with provisions made for weather adjustments and extraordinary loads that the electric distribution company must serve.[19]

The Act also imposes on each subject EDC the obligation to reduce, through its EE&C plan, the weather-normalized demand of its retail customers by a minimum of 4.5% of "annual system peak demand in the 100 hours of highest demand," as measured against the EDC's peak demand for the period June 1, 2007 through May 31, 2008.[20]

The Act specifies penalties that can be imposed on an EDC for failure to achieve the minimum reduction requirements. The failure to meet the reduction mandates subjects the EDC to a civil penalty of at least $1 million and up to $20 million that cannot be recovered in rates, and grants the Commission the authority to implement the EE&C plan in lieu of the EDC, including contracting with conservation service providers (CSPs), at the EDC's expense, to achieve the mandated reductions.[21]

1.1.2 Annual Reporting Requirements

The Act requires the EDCs to submit annual reports to the Commission on the results of their EE&C plans. The reports must document program expenditures, measurement and verification of energy savings, cost-effectiveness of the expenditures, and any other information the Commission may require.

By Secretarial Letter issued May 25, 2011 in Docket No. M-2008-2069887, the Commission established a reporting schedule for Phase I of the Act. Each EDC is required to submit quarterly reports, and preliminary and final annual reports, on the results of and documentation on its EE&C plan. The

[18] 66 Pa. C.S §2806.1(c). Consumption as used in subsection (c) refers to electric energy consumed (the amount of power used) over an extended time interval, such as a month typically used for billing purposes, and is expressed and measured in watt-hours (Wh).

[19] ibid.

[20] 66 Pa. C.S §2806.1(d). Peak demand as used in subsection (d) refers to the maximum amount of power used during a billing period in a short time interval, such as an hour or less, and is expressed and measured in watts (W). The Commission has established the measurement period for peak demand to be the months of June through September for purposes of this subsection, and established the baseline to be the average demand of the 100 hours of highest demand during the period June 1, 2007 -- September 30, 2007. *Energy Efficiency and Conservation Program*, Implementation Order, Docket No. M-2008-2069887, January 16, 2009 (the Phase I Implementation Order), at 21, 29.

[21] 66. Pa. C.S §2806.1(f)(2). A conservation service provider (CSP) is an entity, unaffiliated with an EDC, that "provides information and technical assistance on measures to enable a person to increase energy efficiency or reduce energy consumption." 66. Pa. C.S §2806.1(m). CSPs must be authorized by and registered with the Commission to provide services. 66. Pa. C.S §2806.2. On February 5, 2009, in Docket No. M-2008-2074154, the Commission adopted a Final Order that established the CSP registry and the minimum experience and qualification requirements for registered CSPs.

Commission directed the filing of the EDCs' preliminary annual reports by July 15 and the filing of final annual reports by November 15 for each program year (PY), which spans the period June 1–May 31 of each of the four program years in Phase I, the first commencing June 1, 2009 (PY1) and the last ending May 31, 2013 (PY4).

1.1.3 EDC Cost Recovery

The Act allows an EDC to recover all prudent and reasonable costs relating to the provision or management of its EE&C plan through a reconcilable adjustment clause and approved by the Commission in a proceeding pursuant to Section 1307 of the Public Utility Code. The Commission required that the resulting tariff "mechanism shall be designed to recover, on a full and current basis from each customer class, all prudent and reasonable EE&C costs that have been assigned to each class."[22] The Commission provided for an annual proceeding, coinciding with the schedule for the EDCs' Act 129 annual report filings, to adjust the charge. The Act further provides that the total cost of an EE&C plan shall not exceed 2% of the EDC's total annual revenue as of December 31, 2006, excluding Low-Income Usage Reduction Programs established under 52 Pa. Code § 58.[23] The Act defines total annual revenues to be "[a]mounts paid to the electric distribution company for generation, transmission, distribution and surcharges by retail customers."[24]

In the Phase I Implementation Order, the Commission provided interpretation and guidance on EDC cost recovery. The Commission interpreted the 2% cost recovery cap to be on an annual basis.[25] The Commission interpreted "amounts paid to the [EDC] for generation, transmission, distribution and surcharges by retail customer" to "include all amounts paid to the EDC for generation service, including generation revenues collected by an EDC for an [electric generation supplier] that uses consolidated billing."[26] With respect to allowable costs, the Commission determined that

> [S]uch costs will include both capital and expense items relating to all program elements, equipment and facilities, as well as an analysis of all related administrative costs. More specifically, these costs would include, but not be limited to, capital expenditures for any equipment and facilities that may be required to implement the EE&C programs, as well as depreciation, operating and maintenance expenses, a return component based on the EDC's weighted cost of capital, and taxes. Administrative costs

[22] Phase I Implementation Order, p.38. The Commission required the allocation of EE&C program costs based on generally accepted cost of service principles used in base rate proceedings, including direct assignment of costs, and the allocation of joint and common costs, to and among those customer classes benefitted. The Commission also determined that low-income customers should not be exempt from contributing to the EDCs' cost recovery. ibid., pp. 36,37.
[23] 66 Pa.C.S. § 2806.1(g).
[24] 66 Pa.C.S. § 2806.1(m).
[25] Phase I Implementation Order, p. 34.
[26] ibid., p. 35.

would include, but not be limited to, costs relating to plan and program development, cost-benefit analysis, measurement and verification, and reporting.[27,28]

Revenue reductions resulting from reduced consumption are not recoverable in an adjustment clause, but "reduced energy consumption may be reflected in revenue and sales data used to calculate rates in a distribution-base rate proceeding" brought by an EDC under Section 1308 of the Public Utility Code.[29]

1.1.4 EE&C Program – Commission's 2009 Phase I Implementation Order

Following opportunities for interested parties' input and comments, the holding of an en banc hearing, and the convening of a working group meeting,[30] the Commission entered an Implementation Order developing and adopting an EE&C program for Phase I of the Act.[31]

As summarized by the Commission in the Phase I Implementation Order, the Act requires the EE&C program to address the following:[32]

1. A procedure for approving EE&C plans.
2. A process to evaluate and verify the results of each plan and the EE&C program as a whole.

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[27] ibid., p. 33. The Commission subsequently directed that the costs of net-to-gross (NTG) studies that it directed the EDCs to perform are recoverable above the 2% cap. *Implementation of Act 129 of 2008 – Total Resource Cost (TRC) Test 2011 Revisions*, Docket No. M-2009-2108610, August 2, 2011 ("2011 TRC Test Order"), p. 25.

[28] The Commission determined that each EDC's cost recovery for its respective share of the costs for the SWE was not within and subject to the two percent cap on the cost of the EDC's EE&C plan. The Commission also determined that the costs for the SWE are recoverable by the EDCs through the reconcilable surcharge authorized by Section 2806.1(k)(1) of the Act. *Re West Penn Power Company dba Allegheny Power*, Docket No M-2009-2093218, 2009 WL 3481832, October 23, 2009, p. 29; *Petition of Duquesne Light Company for Approval of its Energy Efficiency and Conservation and Demand Response Plan, Approval of Its Recovery of its Costs through a Reconcilable Adjustment Clause and Approval of Matters Relating to the Energy Efficiency and Conservation Plan*, Docket No. M-2009-2093217, 2009 WL 3637664, October 27, 2009, p. 29; *Petition of PECO Energy Company for Approval of Its Act 129 Energy Efficiency and Conservation Plan and Expedited Approval of Its Compact Fluorescent Lamp Program*, Docket No. M-2009-2093215, 2009 WL 3637663, October 28, 2009, p. 35; *Joint Petition of Metropolitan Edison Company, Pennsylvania Electric Company and Pennsylvania Power Company for Consolidation of Proceedings and Approval of Energy Efficiency and Conservation Plans*, Docket Nos. M-2009-2092222, M-2009-2112952, and M-2009-2112956, 2009 WL 3637665, October 28, 2008, p. 39; *Petition of PPL Electric Utilities Corporation for Approval of its Energy Efficiency and Conservation Plan*, Docket No. M-2009-2093216, 2009 WL 3531102, October 26, 2009, p. 21

[29] 66. Pa. C.S §2806.1(k).

[30] See, in Commission Docket No. M-2008-2069887, Secretarial Letters dated October 21, 2008 and October 28, 2008 establishing a comment period; Secretarial Letter dated October 29, 2008 announcing a special en banc hearing on November 19, 2008; press release dated November 14, 2008 convening a working group meeting on December 10, 2008; and Secretarial Letter dated November 26, 2008 circulating a draft proposal from Commission staff and additional questions for comment.

[31] *Energy Efficiency and Conservation Program*, Implementation Order, Docket No. M-2008-2069887, January 16, 2009 (the Phase I Implementation Order); The Commission also subsequently issued a Reconsideration Order, entered June 2, 2009

[32] ibid., pp. 2,3; 66 Pa. C.S §2806.1(a).

3. A process to analyze the costs and benefits of each plan in accordance with a TRC test.
4. A process to analyze how the program as a whole and each plan will enable the EDCs to meet or exceed the consumption reduction requirements.
5. Standards to ensure that each plan uses a variety of measures that are applied equitably to all customer classes.
6. A process through which recommendations can be made for the employment of additional consumption reduction measures.
7. A procedure to require and approve the competitive bidding of all contracts with conservation service providers (CSPs).
8. A procedure through which the Commission will review and modify, if necessary, all contracts with CSPs prior to execution.
9. A procedure to ensure compliance with the requirements of Sections 2806.1(c) & (d).
10. A requirement for the participation of CSPs in implementing all or part of a plan.
11. A cost recovery mechanism to ensure that measures approved are financed by the customer class that directly receives the energy and conservation benefits.

The following summarizes the Commission's findings and rulings on the foregoing aspects of the EE&C program and plans.[33]

1.1.4.1 *Plan Effectiveness Evaluation Process*

The Act requires the Commission to "establish an evaluation process that monitors and verifies data collection, quality assurance and the results of each [EE&C plan] and the [EE&C program] as a whole."[34] The Commission has determined that the Act requires monitoring and verification of data to be conducted annually.[35] To fulfill the evaluation process, the Commission ordered the periodic review, updating, and use of the Commonwealth's Technical Reference Manual (TRM), which was created and previously adopted by the Commission in Docket No. M-00051865, to fulfill the requirements of the Alternative Energy Portfolio Standards Act.[36] During Phase I of the Act, the Commission issued four annual orders updating the TRM, in each case providing opportunity for public input.[37]

1.1.4.2 *Cost-Benefit Analysis Approval Process*

As previously stated, the Act requires the Commission to approve an analysis of the costs and benefits of each EE&C plan in accordance with a TRC test, as defined in the Act. The Commission decided as an initial framework to use *The California Standard Practice Manual - Economic Analysis of Demand-Side*

[33] The EE&C plan approval process is discussed in Appendix B.
[34] Phase I Implementation Order, p. 13; 66 Pa. C.S §2806.1(a)(2).
[35] ibid.
[36] ibid.
[37] *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources*, Docket No. M-00051865, *Technical Reference Manual 2012 Update*, December 16, 2011; *Technical Reference Manual 2011 Update*, February 28, 2011 (errata issued via Secretarial Letter, July 21, 2011); *Technical Reference Manual Update*, June 8, 2010; *Technical Reference Manual Update*, June 1, 2009.

Programs and Projects ("California Manual"), and instituted a process to modify it as appropriate to take into account "any unique requirements of Act 129 and this Commonwealth's electric industry."[38] The Commission set forth several guidelines for the TRC test:[39]

- The TRC test will take into account the combined effects of a program on both participating and non-participating customers based on the costs incurred by the EDC and participating customers.
- The benefits calculated in the TRC test will include the avoided supply costs, such as the reduction in transmission, distribution, generation, and capacity costs valued at marginal cost for the periods when there is a consumption reduction.
- The avoided supply costs in the TRC test should be calculated using "net program savings, savings net of changes in energy use that would have happened in the absence of the program," and "the persistence of savings over time should also be considered in the net savings." [40]
- The costs calculated in the TRC test will include the program costs paid by the utility (excluding incentives) and the participants, plus the increase in supply costs for the periods in which consumption is increased.
- The TRC test will exclude environmental and societal costs that are not otherwise already embedded in the wholesale costs for the generation of electricity.[41]
- The results of the TRC test should be expressed as both a net present value (NPV) and a benefit-cost ratio (B/C ratio), using each EDC's post-tax weighted average cost of capital as the appropriate discount rate.

Section 4 of this report summarizes the Commission's TRC test orders issued in 2009 and 2011 for Phase I and the TRC test results in Phase I for the EDCs' respective EE&C plans.

1.1.4.3 *Rulings and Guidance on Other Aspects of the EE&C Program*

The Commission made the following determinations and provided guidance on other aspects of the EE&C program and EE&C plan implementation:

- To measure annual consumption reductions (energy savings), the Commission adopted a "savings approach," which reflects that "the statutory [reduction] targets are intended to reflect

[38] Phase I Implementation Order, pp. 14, 15.
[39] ibid., pp. 15, 16.
[40] Although the Commission set forth this guideline, avoided supply costs were ultimately calculated using gross savings, per the 2011 TRC Order. Net savings and net-to-gross ratios were solely used for forward-looking program planning.
[41] The Commission referred to the Act's definition of the TRC test to observe that the Act "specifically notes that environmental and societal benefits are not to be included in the TRC test by referencing only monetary costs."

energy savings, as opposed to absolute reductions in consumption," and which approach "will simplify everyone's tasks and reduce the likelihood of unnecessary litigation."[42]

- To determine the targets for the required peak demand savings each EDC must meet, the Commission adopted the use of 4.5% of the EDC's average of the 100 highest peak hours during the summer months of June, July, August, and September in 2007.[43]
- To meet the Act's requirement that each EE&C plan include a variety of energy conservation measures (ECMs) and provide them equitably to all customer classes, the Commission determined that the "driving principle should be the most cost effective use of resources so that benefits can accrue to all customers, even if only by virtue of more reasonable energy market prices." The Commission thus refrained from imposing a strict proportionality of distribution among customer classes but required that "each customer class be offered at least one energy efficiency and one demand response program," and expected each EDC to "provide a reasonable mix of energy efficiency and demand response programs for all customers."[44]
- To address the Act's requirements that EE&C plans may be modified by adding ECMs and terminating plan elements found to be non-cost-effective, the Commission adopted a public review and input process in conjunction with the Act's annual reporting requirements and the Commission's subsequently adopted annual report filing schedule.[45]
- To address the Act's requirements that the Commission establish procedures to require EDCs to competitively bid all contracts with CSPs and that the Commission review all proposed contacts with CSPs prior to execution, the Commission established standards for a request for proposals (RFP) process[46] and established procedures to review all proposed contracts with CSPs prior to contract execution.[47]

[42] Phase I Implementation Order, p. 18. The Commission noted that "[T]he absolute reduction approach . . . would, in effect, . . . penalize an EDC for economic growth in terms of new customers and businesses in its service territory."

[43] ibid., p. 21.

[44] ibid., pp. 22 ,23.

[45] ibid., p. 24.

[46] ibid., pp. 25, 26. Among the standards established were the requirement that only CSPs registered with the Commission were eligible for contract; the encouragement of efforts to obtain proposals from "disadvantaged businesses"; the obtaining of at least three bids; encouragement of the use of pay-for-performance contracts; and submittal of weighted criteria for selection of a CSP for contract award inclusive of several set forth by the Commission.

[47] ibid., p. 27. Among the review standards were protection of ratepayer funds for poor performance or noncompliance, adequate provisions and procedures for monitoring CSP and EDC performance quality and rate of progress, and certification that the proposed CSP is not an EDC affiliate. The Commission established a 45-day review process for Commission staff to comment on or disapprove the proposed contract; absent such timely comment or disapproval, the EDC was permitted to execute the contract without modification.

1.1.4.4 *EE&C Plan Requirements*

Each EDC subject to the Act must develop for public review and Commission approval a five-year EE&C plan for implementation in Phase I of the Act.[48] The plan is subject to continual review by the Commission and to modification if the Commission determines that "an energy efficiency or conservation measure included in the plan will not achieve the required reductions in consumption in a cost-effective manner."[49]

The Act requires the EE&C plans to include the following:[50]

- Specific energy conservation measures[51] to achieve or exceed the Act's requirements for reductions in energy consumption and peak demand.
- Obtaining a minimum of 10% of the required reductions from "units of federal, state and local government, including municipalities, school districts, institutions of higher education and nonprofit entities;"[52]
- An explanation of how quality assurance and performance will be measured, verified, and evaluated.
- A statement on the manner in which the plan will achieve the EE&C program requirements and achieve or exceed the Act's required reduction in energy consumption and peak demand.
- A statement on the manner in which the plan will achieve the requirements of the program under subsection (a) and will achieve or exceed the required reductions in energy consumption and peak demand.
- A contract with one or more CSPs selected by competitive bid to implement the plan or a portion thereof.
- Estimates of the cost of implementing the plan's ECMs.
- Specific energy efficiency measures for households at or below 150% of the federal poverty income guidelines, with the number of measures provided proportionate to those households' share of the total energy usage in the service territory.[53]

[48] 66 Pa. C.S §2806.1(b)(1)(ii).
[49] 66 Pa. C.S §2806.1(b)(2).
[50] 66 Pa. C.S §2806.1(b)(1)(i)(A) to (b)(1)(i)(K).
[51] The Act defines ECMs as "technologies, management practices or other measures employed by retail customers that reduce electricity consumption or demand" if installed at a retail customer's location on or after the effective date of the Act; if such measures reduce the retail customer's consumption of energy or peak load; and if the "cost of the acquisition or installation of the measure is directly incurred in whole or in part by the electric distribution company." 66 Pa. C.S. §2806.1(m).
[52] These entities are collectively referred to in this report as the government, non-profit, institutional ("GNI") sector.
[53] Expenditures for the low-income programs under the EE&C plans are in addition to expenditures made under 52 Pa. Code Ch. 58 (relating to residential low-income usage reduction programs). In orders approving the EE&C plans, the Commission directed the formation of a Low-Income Working Group (LIWG) to identify the standardized data used to determine the low-income households' share of total energy usage in each EDC's service territory. The Commission also gave the LIWG the discretion to address other matters that required clarification before the

- A proposed cost-recovery tariff mechanism in accordance with the rate adjustments provided under 66 Pa.C.S. §1307, to recover the approved, "prudent and reasonable" costs of the plan, including administrative costs (for which costs an analysis must be provided).
- Demonstration that the plan is cost-effective, using a TRC test approved by the Commission, and that it provides a diverse cross section of alternatives for customers of all rate classes.
- An annual independent evaluation, and "to the extent practical, how the plan will be adjusted on a going-forward basis as a result of the evaluation."

In the Phase I Implementation Order, the Commission addressed the plan approval process and specified filing requirements for each EE&C plan, in addition to the above-stated Act requirements, as follows:[54]

- Sufficient supporting documentation and verified statements or testimony, or both.
- Approved contract(s) with one or more CSPs.
- Description of the work and measures being performed by CSPs and the EDC, along with a justification for the allocation.
- A budget showing total planned expenditures by program and customer class.
- Tariffs and a Section 1307 cost-recovery mechanism.
- The Commission-approved consumption forecast for the period June 1, 2009 -- May 31, 2010.
- A weather-adjustment calculation that meets the requirements outlined in Section H of the Implementation Order.
- The Commission-approved average of the EDC's 100 highest peak hours during the period June 1, 2007 -- September 30, 2007.
- A description of the EDC's method for monitoring and verifying plan results.

Within the Act's mandated time frame for EE&C plan review, the Commission published notice of each EDC's EE&C plan filing in the Pennsylvania Bulletin for a 20-day public comment period, and referred each filing to an Administrative Law Judge (ALJ) for presiding over public input hearings and evidentiary hearings, for receiving parties' briefs, and for certifying the record to the Commission for a final decision on plan approval, or rejection in whole or in part.[55]

annual reconciliation process for Act 129 costs. At its April 22, 2010 Public Meeting, the Commission adopted a Secretarial Letter at Docket No. M-2009-2146801 that released the report of the LIWG, and adopted the recommendations contained therein. The LIWG report contained data to determine the number of low-income measures each EDC must implement to meet the "proportionate number" criteria of Act 129. The LIWG Report also stated that EDCs must report on a quarterly basis, actual energy reductions from each customer sector, including the low-income sector, and each sector's proportion of the total energy reductions.

[54] *Phase I Implementation Order*, pp. 11, 12.

[55] ibid., pp. 12, 13. The Act requires the Commission to rule on each plan within 120 days of submission. 66 Pa. C.S. §2806.1(e)(2). If the Commission disapproves a plan, it must describe in detail its reasons, after which the EDC has 60 days to submit a revised plan. 66 Pa. C.S §2806.1(e)(2). The Commission then has 60 days to rule on the revised plan. ibid. If necessary, the revision process repeats until a plan receives Commission approval.

In the Phase I Implementation Order, the Commission established procedures and time frames for the filing and review, including public input, of the EDCs' proposed changes to their EE&C plans.[56] However, the Commission noticed that "[R]ecent experience has revealed that this process can take more than four months to complete, regardless of the magnitude of the changes requested," and to ameliorate undue delays it issued a Final Order establishing an expedited review process to approve minor EE&C plan changes.[57] Therein, the Commission delegated to Commission staff the authority to issue via Secretarial Letters approval of the following plan modifications:

1. Elimination of a measure that is underperforming; no longer viable for reasons of cost-effectiveness, savings, or market penetration; or has met its approved budgeted funding, participation level, or amount of savings.
2. Transfer of funds from one measure or program to another measure or program within the same customer class.
3. Adding a measure or changing the conditions of a measure, such as its eligibility requirements, technical description, rebate structure or amount, projected savings, estimated incremental costs, projected number of participants, or other conditions so long as the change does not increase the overall costs to that customer class.[58]

The Commission directed that comments on proposed minor EE&C plan changes be filed within 15 days after the proposed changes have been filed with the Secretary; that reply comments be filed within 25 days after the filing of the proposed changes; and that staff issue a Secretarial Letter within 35 days after the filing of the proposed changes, "approving, denying, or transferring to the Office of Administrative Law Judge for hearings."[59]

[56] "[T]he Commission and any interested party can make a recommendation for plan improvement or object to an EDC's proposed plan revision within 30 days of the [EDC's] annual report filing. EDCs will have 20 days to file replies, after which the Commission will determine whether to rule on the recommended changes or refer the matter to an ALJ for hearings and a recommended decision." Phase I Implementation Order, p. 24.
[57] *Energy Efficiency and Conservation Program*, Docket No. M-2008-2069887, June 10, 2011 ("Expedited Process Order").
[58] ibid., p. 20.
[59] ibid., p. 19. The Commission further directed any party desiring to appeal the staff's decision to file within 10 days after service of the Secretarial Letter its petition for appeal from staff actions in accordance with 52 Pa. Code § 5.44.

During Phase I, the EDCs filed and the Commission approved the EDCs' respective EE&C plans and modifications thereto, as summarized in Table 1-1.

Table 1-1: Commission Orders Approving EE&C Plans and Modifications Thereto

EDC/Docket No.	EDC Filing	Commission Decision
Duquesne Light Co. Docket No. M-2009-2093217	Petition for Approval of EE&C Plan – Filed 6/29/09	Approval Granted in Part and Denied in Part - Opinion and Order Entered 10/27/09
	Revised EE&C Plan – Filed 12/24/09	Approval Granted - Opinion and Order Entered 02/17/10
	Modifications to EE&C Plan – Filed 9/15/10	Modifications Accepted – Opinion and Order Entered 1/28/11
	Petition for Approval of Modifications to EE&C Plan – Filed 05/09/11	Order Adopting Initial Decision and Approval of Joint Petition for Settlement – Entered 10/14/11
PECO Energy Co. Docket No. M-2009-2093215	Petition for Approval of EE&C Plan and Expedited Approval of Compact Fluorescent Lamp (CFL) Program – Filed 07/01/09	Approval Granted in Part and Denied in Part – Opinion and Order Entered 10/28/09
	Joint Petition for Partial Settlement (CFL Program) – Filed via ALJ Revised Certification Order 08/04/09	Approval of Joint Petition – Opinion and Order Entered 08/18/09
	Revised EE&C Plan – Filed 12/23/09	Approval Granted – Opinion and Order Entered 02/17/10
	Proposed Revisions to EE&C Plan – Filed 09/15/10	Approval Granted – Opinion and Order Entered 01/28/11
	Petition for Approval of Minor Changes to EE&C Plan – Filed 07/15/11	Staff Approval – Secretarial Letter Issued 08/18/11
	Compliance Filing of Minor EE&C Plan Changes – Filed 09/09/11	
	Petition Requesting Amendment	Approval Granted – Order

EDC/Docket No.	EDC Filing	Commission Decision
	to Orders Approving Phase I EE&C Plan – Filed 04/04/13	Entered 05/09/13
PPL Electric Utilities Corp. Docket No. M-2009-2093216	Petition for EE&C Plan Approval – Filed 07/01/09	
	Amended EE&C Plan – Filed 07/31/09	Approval Granted in Part and Rejected in Part– Opinion and Order Entered 10/26/09
	Amended EE&C Plan – Filed 12/17/09	Approval Granted – Opinion and Order Entered 02/17/ 10
	Petition for Approval to Changes to EE&C Plan – Filed 09/15/10	Approval Granted with Direction for Additional Filing- Opinion and Order Entered 01/28/11
	Petition for Expedited Approval of Changes to EE&C Plan – Filed 02/28/11	Approval Granted – Opinion and Order Entered 05/06/11
	Petition for Approval of Changes to EE&C Plan – Filed 02/02/12	Approval Granted in Part and Denied in Part – Opinion and Order Entered 05/25/12
	Joint Petition for Settlement of Petition – Filed 04/30/12	Approval Granted – Opinion and Order Entered 05/25/12
	Revised EE&C Plan (Pursuant to 05/25/12 Opinion and Order) – Filed 06/14/12	
FirstEnergy Legacy Companies (Met-Ed, Penelec, Penn Power) Docket Nos. M-2009-2092222; M-2009-2112952; M-2009-2112956	Joint Petition for Approval of EE&C Plans – Filed 07/01/09	
	Revised EE&C Plans – Filed 09/21/09	Approval Granted in Part and Denied in Part – Opinion and Order Entered 10/28/09
	Revised EE&C Plans – Filed 12/02/09 ; Corrected Versions Filed 12/23/09 and 01/19/10	Approval Granted in Part and Rejected in Part – Opinion and Order Entered 01/28/10

EDC/Docket No.	EDC Filing	Commission Decision
	Second Revised EE&C Plans – Filed 02/05/10	Approval Granted – Opinion and Order Entered 02/26/10
	Joint Petition for Amendment of Orders Approving EE&C Plans and Petition for Approval of First Amended EE&C Plans – Filed 02/18/11	Approval for Amendment of Orders Granted ("Expedited Petition") – Opinion and Order Entered 03/18/11
		Approval of Joint Petition for Consolidation of Proceedings and Approval of Energy Efficiency and Conservation Plans, as Approved in Order Adopting Recommended Decision Issued 12/05/11, and Approval of First Amended EE&C Plans ("Main Petition") – Opinion and Order Entered 01/12/12
	Met-Ed Request for Expedited Approval of Proposed Minor EE&C Plan Changes – Filed 05/18/12	Staff Approval – Secretarial Letter Issued 06/14/12
	Met-Ed Compliance Filing of Minor EE&C Plan Changes – Filed 07/13/12	
	Met-Ed Request for Expedited Approval of Proposed Minor EE&C Plan Changes – Filed 02/13/13	Staff Approval – Secretarial Letter Issued 03/24/13
	Met-Ed Compliance Filing of Minor EE&C Plan Changes – Filed 04/12/13	
	Met-Ed Request for Expedited Approval of Proposed Minor EE&C Plan Changes – Filed 05/03/13	Staff Approval – Secretarial Letter Issued 05/30/13

EDC/Docket No.	EDC Filing	Commission Decision
	Met-Ed Compliance Filing of Minor EE&C Plan Changes – Filed 06/25/13	
West Penn Power Co. Docket No. M-2009-2093218	Petition for Approval of EE&C Plan – Filed 06/30/09	Approval Granted in Part and Denied in Part – Opinion and Order Entered 10/23/09
	Amended EE&C Plan – Filed 12/21/09	Approval Granted in Part and Rejected in Part – Opinion and Order Entered 03/01/10
	Amended EE&C Plan – Filed 04/30/10	Approval Granted - Opinion and Order Entered 06/23/10
	Petition to Amend EE&C Plan – Filed 09/10/10	Approval of Joint Stipulations, as Approved in Order Adopting Recommended Decision Issued 12/17/10 Approving Joint Stipulations – Order Entered 01/13/11
	Petition for Amendment of Orders Approving EE&C Plans and Petition for Approval of Amended EE&C Plans – Filed 08/09/11	Approved in Part – Interim Opinion and Order Entered 10/28/11
		Approved in Order Adopting Recommended Decision Issued 04/17/12 Approving Joint Petition for Settlement of All Issues – Order Entered 05/10/12
	Petition for Expedited Approval of Proposed Minor EE&C Plan Changes – Filed 05/15/12	Staff Approval – Secretarial Letter Issued 06/14/12
	Compliance Filing of Minor EE&C Plan Changes – Filed 07/13/12	
	Petition - Request for Expedited Approval of Proposed Minor EE&C Plan Changes – Filed	Staff Approval – Secretarial Letter Issued 03/14/13

EDC/Docket No.	EDC Filing	Commission Decision
	02/13/13 Compliance Filing of Minor EE&C Plan Changes – Filed 04/12/13	

Section 2.3 and Appendix A of this report provide substantive summary descriptions of the EDCs' respective Phase I EE&C plans and programs.

1.1.5 Statewide Evaluator (SWE)

In the Phase I Implementation Order, the Commission stated its intent

> to issue a request for proposal to retain the services of an evaluation vendor or vendors to perform the annual and five year independent evaluation of the cost-effectiveness of each EDC plan, as well as to develop the measurement and evaluation protocols, standard data collection formats, and data bases for the evaluation of program benefits and results to be used across all EDC service territories.[60]

On April 29, 2009 the Commission issued an RFP for the engagement of a SWE, which included, among other scope-of-service requirements, provision for an audit plan development; four annual audits (including verification of claimed consumption reductions as verified and evaluated by EDC independent evaluators) of the EDCs' EE&C plans and programs; a 2013 review of the entire EE&C program; evaluation of and improvements to the EDCs' EE&C plans and programs in their initial, critical four years of implementation; and assessments and recommendations to policymakers for potential programs beyond the initial 2013 EE&C program implementation period.

At its June 25, 2009 public meeting, the Commission awarded the SWE contract to a vendor team comprising prime contractor GDS Associates, Inc., with substantive work provided by subcontractors Nexant, Inc. and Mondre Energy, Inc., a Commonwealth-certified women's business enterprise (WBE). This report has been prepared by the SWE for the Commission, and its responsibilities, work product, analyses, and findings and recommendations in Phase I of Act 129 are summarized and described throughout this report.

1.2 Summary of Phase I Results

This section summarizes the results for Phase I of Act 129, statewide and by EDC. In this and other sections of this report, the SWE presents savings estimated based on the Commission-approved TRM ("TRM Verified Savings") and savings estimates proposed by some EDCs based on alternative values ("EDC Proposed Savings").

[60] Phase I Implementation Order, p. 30. The Commission also directed that the costs of such vendor(s) would be recovered from the EDCs pursuant to 66 Pa. C.S. §2806.1(h) (providing for Commission recovery of EE&C program costs from the EDCs). ibid., p. 31..

1.2.1 Statewide Results

Table 1-2 summarizes the Phase I TRM Verified Savings achieved pursuant to Act 129. The data below show that overall, the EDCs as a group exceeded the Phase I total energy and demand reduction compliance targets.

Table 1-2: Summary of Statewide TRM Verified Savings

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	5,567,257	5,403,370	123%
Top 100 Hours Demand Reduction (MW)	1,405.12	1,349.92[i]	113%
Total Demand Reduction (MW)	1,608.64	1,540.61[i]	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$4,192,389	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$1,755,384	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.4	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	3,535,208	3,431,140	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the EDC evaluators and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact. Statewide savings for informational purposes only.

[i] This value excludes 20.9 MW of demand reductions which the SWE believes should not count towards PECO's Phase I Target. See Section 3.2 for details.

Table 1-3 summarizes the Phase I TRM Verified Savings achieved pursuant to Act 129 for the 2011 1% compliance target.

Table 1-3: 2011 1% Energy Reduction Target - Compliance Summary by EDC, TRM Verified Energy Savings

EDC	Phase I – 2011 1% Energy Reduction Target (MWh/yr)	CPITD TRM Verified Gross Energy Reductions (MWh/yr)	% of 2011 Target
Duquesne	140,855	168,336	120%
PECO	393,860	873,192	222%
PPL	382,144	509,361	133%
Met-Ed	148,650	181,681	122%
Penelec	143,993	184,261	128%
Penn Power	47,729	66,630	140%
West Penn Power	209,387	90,520	43%

Table 1-4 and Table 1-5 summarize the Phase I TRM Verified Savings achieved pursuant to Act 129 for the 2013 3% energy reduction and 4.5% demand reduction targets.

Table 1-4: 2013 3% Energy Reduction Target – Compliance Summary by EDC, TRM Verified Savings

EDC	Phase I – 2013 3% Energy Reduction Target (MWh/yr)	CPITD TRM Verified Gross Energy Reductions (MWh/yr)	% Phase I Target
Duquesne	422,565	556,282	132%
PECO	1,181,580	1,399,242[61]	118%
PPL	1,146,431	1,642,067	143%
Met-Ed	445,951	493,138	111%
Penelec	431,979	458,784	106%
Penn Power	143,188	165,768	116%
West Penn Power	628,160	688,089	110%

[61] Following the submittal of PECO's PY4 annual report, Navigant discovered that the final verified energy and demand savings from certain GNI projects had not been entered into its realization rate calculators. The result of adding the values to the correct realization rate calculators was an increase of 76 MWh and 0.1 MW for the Smart Equipment Incentives GNI program and total portfolio. This savings increase is reflected in the SWE Act 129 Phase I report but is not included in PECO's annual report.

Table 1-5: 2013 4.5% Demand Reduction Target – Compliance Summary by EDC, TRM Verified Savings

EDC	Phase I - 4.5% Demand Reduction Target (MW)	Top 100 Hours CPITD TRM Verified Gross Demand Reductions (MW)	Percentage of Phase I Target
Duquesne	113	138.56	123%
PECO	355	399.2[1]	112%
PPL	297	340.90	115%
Met-Ed	119	125.02	105%
Penelec	108	113.95	106%
Penn Power	44	46.21	105%
West Penn Power	157	186.08	119%

[1] This number excludes 20.9 MW reported by PECO because the SWE does not believe it should count toward PECO's demand reduction compliance target. See section 3.2 for details.

Table 1-6 and

Table 1-7 summarize the Phase I TRM Verified Savings for energy and demand reductions achieved pursuant to Act 129 for the EE&C plan requirement that 10% of the Phase I compliance targets be achieved in the GNI sector.

Table 1-6: CPITD GNI TRM Verified Savings - Energy Reductions

EDC	Phase I - 10% GNI Sector Energy Reduction Target (MWh/yr)	CPITD GNI Sector TRM Verified Gross Energy Reductions (MWh/yr)	% of Phase I Target
Duquesne	42,257	49,979	118%
PECO	118,155	194,032	164%
PPL	114,643	206,786	180%
Met-Ed	44,595	51,025	114%
Penelec	43,198	53,919	125%
Penn Power	14,319	14,577	102%
West Penn Power	62,816	151,035	240%

Table 1-7: CPITD GNI TRM Verified Savings - Demand Reductions

EDC	Phase I 10% GNI Sector Demand Reduction Target (MW)	CPITD GNI Sector Top 100 Hours TRM Verified Gross Demand Reductions (MW)	Percentage of Phase I Target
Duquesne	11.3	15.20	135%
PECO	35.5	46.6	131%
PPL	29.7	31.23	105%
Met-Ed	11.9	22.73	191%
Penelec	10.8	20.60	191%
Penn Power	4.4	4.21	96%[62]
West Penn Power	15.7	38.55	246%

The Act also requires that each EE&C plan "include specific energy efficiency measures for households at or below 150% of the federal poverty income guidelines. The number of measures shall be proportionate to those households' share of the total energy usage in the service territory."[63] In orders approving the EE&C plans, the Commission directed the formation of a Low-Income Working Group (LIWG) to identify the standardized data used to determine the low-income households' share of total energy usage in each EDC's service territory. At its April 22, 2010 Public Meeting, the Commission adopted a Secretarial Letter at Docket No. M-2009-2146801 that released the March 19, 2010 report of the LIWG, and adopted the recommendations contained therein. The report stated that "…all EDCs have sufficient specific measures for low-income households to satisfy the 'proportionate number' criteria in the statute. This is the sole methodology for determining compliance with Act 129 through 2013."[64]

Table 1-8 summarizes the Phase I EDC Proposed Savings achieved pursuant to Act 129. EDC Proposed Savings are based on values for parameters that have not been approved by the Commission through the TRM updating process. The values used for the EDC Proposed Savings that differed from the values used for TRM Verified Savings are summarized as follows:

- PECO, Met-Ed, Penn Power, Penelec, and West Penn Power used alternative coincidence factors and included interactive effects in their residential CFL bulb demand reduction estimations for

[62] The EM&V conducted for the GNI program for Penn Power is based upon a review of actual performance for a random sample of completed projects based upon a 90% level of confidence and 6% margin of error (with a two-tailed test). The TRM Gross Verified Demand Savings achieved by Penn Power for the GNI sector for Phase I was 4.21 MW plus or minus 0.25 MW at a 90% confidence and 6% precision level. Because the GNI demand reduction target of 4.4 MW for Penn Power is within the 90% confidence interval for the estimated savings, the SWE has determined that Penn Power has met the GNI sector demand reduction savings target, as the measured 4.21 MW estimate is not significantly different from the 4.4 MW target from a statistical point of view.
[63] 66 Pa.C.S. §2806.1(b)(i)(G).
[64] Report of the Low-Income Working Group, Docket No. M-2009-2146801, March 19, 2010, p. 7.

some programs. PECO additionally included interactive effects in its residential CFL energy savings estimations for some programs.

- PPL used an alternative methodology to estimate demand reductions from its Load Curtailment Program.

The SWE notes that overall, the EDC Proposed Savings for Phase I energy reductions are only slightly higher than the TRM Verified Savings for energy reductions. The EDC Proposed Savings for demand reductions, however, are 7% higher than the Phase I TRM Verified Savings for demand reductions.

Table 1-8: Summary of Statewide EDC Proposed Savings

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	5,567,257	5,411,085	123%
Top 100 Hours Demand Reduction (MW)	1405.12	1,475.46[j]	124%
Total Demand Reduction (MW)	1,608.64	1,685.49[j]	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$4,293,579	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$1,755,384	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.4	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	3,535,208	3,436,039	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the EDC evaluators and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact. Statewide savings for informational purposes only.

[j] Duquesne did not report EDC Proposed Savings for demand reductions. Statewide values include Duquesne TRM Verified demand reductions.

The remainder of Section 1.2 presents a detailed comparison of the Phase I energy and demand reductions achieved versus the energy and demand reduction targets for each of the seven EDCs.

1.2.2 Duquesne

Table 1-9 summarizes the savings achieved by Duquesne during Phase I of Act 129. The table shows that overall, Duquesne exceeded the Phase I energy and demand reduction targets.

Table 1-9: Duquesne Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	582,858	556,282	132%
Top 100 Hours Demand Reduction (MW)	135.49	138.56	123%
Total Demand Reduction (MW)	156.77	158.91	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$345,847	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$110,617	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	3.1	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	370,115	353,239	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to TRC Order.
[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.
[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.
[g] Defined as the energy savings that have been verified by the Duquesne evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.
[h] Savings achieved based on CPITD Verified Gross Impact.

1.2.3 PECO

Table 1-10 summarizes the savings achieved by PECO during Phase I of Act 129. The table shows that overall, PECO exceeded the Phase I energy and demand reduction targets.

Table 1-10: PECO Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	1,472,811	1,399,242[i]	118%
Top 100 Hours Demand Reduction (MW)	423.3	399.2[j]	112%
Total Demand Reduction (MW)	447.5	418.1[j]	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$1,287,541	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$448,186	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.9	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	935,235	888,519	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the PECO evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

[i] Following the submittal of PECO's PY4 annual report, Navigant discovered that the final verified energy and demand savings from certain GNI projects had not been entered into its realization rate calculators. The result of adding the values to the correct realization rate calculators was an increase of 76 MWh and 0.1 MW for the Smart Equipment Incentives GNI program and total portfolio. This savings increase is reflected in the SWE Act 129 Phase I report but is not included in PECO's annual report.

[j] This value excludes 20.9 MW of demand reductions which the SWE believes should not count towards PECO's Phase I Target. See Section 3.2 for details.

In addition to the TRM Verified Savings above, PECO reported EDC Proposed Savings for energy savings and demand reductions using alternative evaluation results relative to those supported by protocols specified in the TRM. PECO proposed alternative values for the coincidence factor and interactive effects factors for residential CFL light bulbs, affecting its Smart Lighting Discounts and Low-Income Energy Efficiency Programs.[65] PECO proposed a coincidence factor of 11.7% (5% in the TRM) and energy and demand interactive effects factors of 1.02 and 1.19, respectively (both unaccounted for in the TRM and therefore equal to 1.00). PECO's Phase I results using these alternative savings estimates are shown in Table 1-11.

Table 1-11: PECO Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	1,472,811	1,406,957	119%
Top 100 Hours Demand Reduction (MW)	423.3	461.1	130%
Total Demand Reduction (MW)	447.5	482.3	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$1,385,375	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$448,186	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	3.1	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	935,235	893,418	Not Applicable

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to TRC Order.
[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.
[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.
[g] Defined as the energy savings that have been verified by the PECO evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.
[h] Savings achieved based on CPITD Verified Gross Impact.

[65] See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.

1.2.4 PPL

Table 1-12 summarizes the savings achieved by PPL during Phase I of Act 129. The table shows that overall, PPL exceeded the Phase I energy and demand reduction targets.

Table 1-12: PPL Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	1,590,087	1,642,067	143%
Top 100 Hours Demand Reduction (MW)	314.87	340.90	115%
Total Demand Reduction (MW)	376.27	409.98	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$1,304,636	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$597,221	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.2	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	1,009,705	1,042,713	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the PPL evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

In addition to the TRM Verified Savings above, PPL reported EDC Proposed Savings using an alternative methodology to estimate the demand reduction from its Load Curtailment Program.[66] PPL did not report alternative energy savings estimates. PPL's Phase I results using these alternative savings estimates are shown in Table 1-13.

Table 1-13: PPL Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	Not Applicable	Not Applicable	Not Applicable
Top 100 Hours Demand Reduction (MW)	314.87	356.56	120%
Total Demand Reduction (MW)	376.27	425.64	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$1,305,177	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$597,221	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.2	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	Not Applicable	Not Applicable	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the PPL evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

[66] See PPL Final Annual Report to the Pennsylvania Public Utility Commission, November 15, 2013, Section 11.2.4, p. 137.

1.2.5 Met-Ed

Table 1-14 summarizes the savings achieved by Met-Ed during Phase I of Act 129. The table shows that overall, Met-Ed exceeded the Phase I energy and demand reduction targets.

Table 1-14: Met-Ed Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	531,111	493,138	111%
Top 100 Hours Demand Reduction (MW)	146.63	125.02	105%
Total Demand Reduction (MW)	163.43	136.92	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$374,502	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$235,084	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	1.6	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	337,255	313,143	Not Applicable

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to TRC Order.
[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.
[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.
[g] Defined as the energy savings that have been verified by the Met-Ed evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.
[h] Savings achieved based on CPITD Verified Gross Impact.

In addition to the TRM Verified Savings above, Met-Ed reported EDC Proposed Savings for demand reductions using alternative evaluation results relative to those supported by protocols specified in the TRM. Met-Ed proposed an alternative coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small Commercial and Industrial (C&I)[67] programs. The product of these two factors, CF x IEF, was capped at 15%.[68] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%. Met-Ed did not report alternative

[67] Some kits distributed to small C&I customers included CFLs which ended up in residential households.
[68] See Met-Ed Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

energy savings estimates. Met-Ed's Phase I results using these alternative savings estimates are shown in Table 1-15.

Table 1-15: Met-Ed Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	Not Applicable	Not Applicable	Not Applicable
Top 100 Hours Demand Reduction (MW)	146.63	137.11	115%
Total Demand Reduction (MW)	163.43	154.49	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$375,429	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$235,084	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	1.6	Not Applicable
CO_2 Emissions Reduction (Tons) [d]	Not Applicable	Not Applicable	Not Applicable

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to TRC Order.
[d] 6.35 x10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.
[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.
[g] Defined as the energy savings that have been verified by the Met-Ed evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.
[h] Savings achieved based on CPITD Verified Gross Impact.

1.2.6 Penelec

Table 1-16 summarizes the savings achieved by Penelec during Phase I of Act 129. The table shows that overall, Penelec exceeded the Phase I energy and demand reduction targets.

Table 1-16: Penelec Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	508,134	458,784	106%
Top 100 Hours Demand Reduction (MW)	136.96	113.95	106%
Total Demand Reduction (MW)	153.73	128.22	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$341,200	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$140,894	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.4	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	322,665	291,328	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the Penelec evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

In addition to the TRM Verified Savings above, Penelec reported EDC Proposed Savings for demand reductions using alternative evaluation results relative to those supported by protocols specified in the TRM. Penelec proposed an alternative coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small Commercial and Industrial (C&I)[69] programs. The product of these two factors, CF x IEF, was 14.3%.[70] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%. Penelec's Phase I results using these alternative savings estimates are shown in Table 1-17.

[69] Some kits distributed to small C&I customers included CFLs which ended up in residential households.

[70] See Penelec Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

Table 1-17: Penelec Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	Not Applicable	Not Applicable	Not Applicable
Top 100 Hours Demand Reduction (MW)	136.96	125.63	116%
Total Demand Reduction (MW)	153.73	145.06	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$342,065	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$140,894	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.4	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	Not Applicable	Not Applicable	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the Penelec evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

1.2.7 Penn Power

Table 1-18 summarizes the savings achieved by Penn Power during Phase I of Act 129. The table shows that overall, Penn Power exceeded the Phase I energy and demand reduction targets.

Table 1-18: Penn Power Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	181,553	165,768	116%
Top 100 Hours Demand Reduction (MW)	49.08	46.21	105%
Total Demand Reduction (MW)	55.30	51.30	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$122,724	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$40,668	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	3.0	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	115,286	105,263	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the Penn Power evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

In addition to the TRM Verified Savings above, Penn Power reported EDC Proposed Savings for demand reductions using alternative evaluation results relative to those supported by protocols specified in the TRM. Penn Power proposed an alternative coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small Commercial and Industrial (C&I)[71] programs. The product of these two factors, CF x IEF, was capped at 15%.[72] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%. Penn Power's Phase I results using these alternative savings estimates are shown in Table 1-19.

Table 1-19: Penn Power Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	Not Applicable	Not Applicable	Not Applicable
Top 100 Hours Demand Reduction (MW)	49.08	51.07	116%
Total Demand Reduction (MW)	55.30	58.22	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$123,070	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$40,668	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	3.0	Not Applicable
CO_2 Emissions Reduction (Tons) [d]	Not Applicable	Not Applicable	Not Applicable

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to TRC Order.
[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.
[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.
[g] Defined as the energy savings that have been verified by the Penn Power evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.
[h] Savings achieved based on CPITD Verified Gross Impact.

[71] Some kits distributed to small C&I customers included CFLs which ended up in residential households.
[72] See Penn Power Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

1.2.8 West Penn Power

Table 1-20 summarizes the savings achieved by West Penn Power during Phase I of Act 129. The table shows that overall, West Penn Power exceeded the Phase I energy and demand reduction targets.[73]

Table 1-20: West Penn Power Phase I TRM Verified Savings Summary

	CPITD Reported Gross Impact[e]	CPITD TRM Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	700,703	688,089	110%
Top 100 Hours Demand Reduction (MW)	198.79	186.08	119%
Total Demand Reduction (MW)	255.64	237.17	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$415,939	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$182,714	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.3	Not Applicable
CO_2 Emissions Reduction (Tons)[d]	444,946	436,937	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the West Penn Power evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

[73] West Penn Power did not meet the 2011 1% energy reduction target.

In addition to the TRM Verified Savings above, West Penn Power reported EDC Proposed Savings for demand reductions using alternative evaluation results relative to those supported by protocols specified in the TRM. West Penn Power proposed an alternative coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting the Residential Energy Efficient Products, Home Performance, and Small Commercial and Industrial (C&I)[74] programs. The product of these two factors, CF x IEF, was capped at 15%.[75] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%. West Penn power's Phase I results using these alternative savings estimates are shown in Table 1-21.

Table 1-21: West Penn Power Phase I EDC Proposed Savings Summary

	CPITD Reported Gross Impact[e]	CPITD EDC Proposed Verified Gross Impact[g]	Savings Achieved as % of 2013 Targets[h]
Total Energy Savings (MWh/yr)	Not Applicable	Not Applicable	Not Applicable
Top 100 Hours Demand Reduction (MW)	198.79	205.43	131%
Total Demand Reduction (MW)	255.64	260.86	Not Applicable
TRC Benefits ($1,000)[a]	Not Applicable[f]	$416,616	Not Applicable
TRC Costs ($1,000)[b]	Not Applicable[f]	$182,714	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[f]	2.3	Not Applicable
CO_2 Emissions Reduction (Tons) [d]	Not Applicable	Not Applicable	Not Applicable

NOTES:

[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. Subject to TRC Order.

[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.

[c] Subject to TRC Order.

[d] 6.35 x 10-1 metric tons of CO_2 per MWh. Based on PJM Executive Report (dated October 24, 2013) 2012 Marginal Off-Peak rate of 1,400 lbs per MWh. One metric ton = 2,204.63 lbs.

[e] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[f] TRC benefits and costs are calculated only for verified savings, which reflect actual program results.

[g] Defined as the energy savings that have been verified by the West Penn Power evaluator and audited by the SWE, and since the date of program implementation through the end of PY4.

[h] Savings achieved based on CPITD Verified Gross Impact.

[74] Some kits distributed to small C&I customers included CFLs which ended up in residential households.

[75] See West Penn Power Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

1.3 Brief Summary of EDC EE&C Plans and Programs

The following sections list each EDC's Phase I EE&C programs and the years in which each program reported savings. Not all programs in each EDC's portfolio were active during each program year and thus some programs did not report savings in all years of Phase I of Act 129. Appendix A provides detailed descriptions of each program.

1.3.1 Duquesne

Nineteen programs reported savings in Duquesne's annual reports during Phase I of Act 129. Table 1-22 lists the programs and the years in which they reported savings. Descriptions of Duquesne's energy efficiency programs can be found in Section 2.5.1, and descriptions of its demand reduction programs can be found in Section 3.4.1.

Table 1-22: Duquesne Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Residential EE Program: Rebate Program	•	•	•	•
Residential EE Program: Upstream Lighting		•	•	•
Residential: School Energy Pledge	•	•	•	•
Residential: Appliance Recycling	•	•	•	•
Residential: Low-Income EE	•	•	•	•
Residential: Low-Income EE, Upstream Lighting[76]		•	•	•
Commercial Sector Umbrella	•	•	•	•
Commercial Sector Umbrella: Upstream Lighting[77]				•
Healthcare	•	•	•	•
Office Building – Large	•	•	•	•
Office Building – Small	•	•	•	•
Government/Non-Profit/Institutional	•	•	•	•
Retail Stores	•	•	•	•
Industrial Sector Umbrella	•	•	•	•
Chemical Products		•	•	•
Mixed Industrial	•	•	•	•
Primary Metals	•	•	•	•
Residential Demand Response[1]				•
Large Curtailable Demand Response[1]				•

[76] While not a separate program, a portion of the Upstream Lighting Program is allocated to the low-income sector based on the portion of Duquesne's households that are low-income.
[77] While not a separate program, a portion of the Upstream Lighting Program is allocated to the commercial sector based on the quantity of bulbs purchased by commercial customers.

[1] Demand savings only.

1.3.2 PECO

Thirteen programs reported savings in PECO's annual reports during Phase I of Act 129. Table 1-23 lists the programs and the years in which they reported savings. Descriptions of PECO's energy efficiency programs can be found in Section 2.5.2, and descriptions of its demand reduction programs can be found in Section 3.4.2.

Table 1-23: PECO Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Low-Income Energy Efficiency Program	•	•	•	•
Smart Lighting Discounts Program	•	•	•	•
Smart Appliance Recycling Program	•	•	•	•
Smart Home Rebates Program	•	•	•	•
Smart Equipment Incentives– C&I	•	•	•	•
Smart Equipment Incentives – Government, Non-Profit, Institutional	•	•	•	•
Conservation Voltage Reduction	•	•		
Smart Construction Incentives		•	•	•
Residential Smart AC Saver[1]				•
Commercial Smart AC Saver[1]				•
Permanent Load Reduction				•
Demand Response Aggregators[1]				•
Distributed Energy Resources[1]				•

[1] Demand Savings Only

1.3.3 PPL

Twelve programs reported savings in PPL's annual reports during Phase I of Act 129. Table 1-24 lists the programs and the years in which they reported savings. Descriptions of PPL's energy efficiency programs can be found in Section 2.5.3, and descriptions of its demand reduction programs can be found in Section 3.4.3.

Table 1-24: PPL Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Appliance Recycling	•	•	•	•
Residential Lighting [1]	•	•	•	•
Custom Incentive	•	•	•	•
Energy Efficiency Behavior and Education		•	•	•
Efficient Equipment Incentive	•	•	•	•
E-Power Wise		•	•	•
Low-Income WRAP	•	•	•	•
Renewable Energy	•	•	•	•
HVAC Tune-Up Program		•	•	•
Home Energy Assessment and Weatherization Program		•	•	•
Load Curtailment[2]				•
Direct Load Control[2]				•

[1] Called the Compact Fluorescent Lighting Campaign in PY1 and PY2.

[2] Reported demand savings only.

1.3.4 FirstEnergy Legacy Companies

Met-Ed, Penn Power, and Penelec each had the same portfolio of programs during Phase I of Act 129 and are therefore discussed together in this section.

Twenty programs reported savings in the FirstEnergy Legacy companies' annual reports during Phase I of Act 129. Table 1-25 through Table 1-27 lists these programs and the years in which they reported savings. Descriptions of the FirstEnergy Legacy companies' energy efficiency programs can be found in Section 2.5.4 and descriptions of their demand reduction programs can be found in Section 3.4.4.

Table 1-25: Met-Ed Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	•
C&I Small Sector Energy Audit and Technical Assessment		•		
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs		•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•	•	•
Government/Non-Profit		•	•	•
Government/Remaining Non-Profit	•	•	•	•

Table 1-26: Penn Power Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	
C&I Small Sector Energy Audit and Technical Assessment		•		
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs		•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•		
Government/Non-Profit		•		
Government/Remaining Non-Profit		•	•	•

Table 1-27: Penelec Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	•
C&I Small Sector Energy Audit and Technical Assessment		•		
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs	•	•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•	•	•
Government/Non-Profit	•	•	•	•
Government/Remaining Non-Profit	•	•	•	•

1.3.5 West Penn Power

Twenty-four programs reported savings in West Penn Power's annual reports during Phase I of Act 129. In February 2011, West Penn Power was incorporated into the FirstEnergy family of companies and experienced a significant EE&C plan revision, to offer programs consistent with the other FirstEnergy EDCs in Pennsylvania. Table 1-28 lists each West Penn Power program and the years in which it reported savings. Descriptions of West Penn Power's energy efficiency programs can be found in Section 2.5.5, and descriptions of its demand reduction programs can be found in Section 3.4.5.

Table 1-28: West Penn Power Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Compact Fluorescent Lighting Rewards Program	•	•		
Residential ENERGY STAR and High Efficiency Appliance Program	•	•		
Residential Home Performance Program	•	•	•	•
Residential HVAC Efficiency Program	•			
Residential Low-Income Home Performance Check-Up Audit and Appliance Replacement Program	•	•		
Government/Non-Profit Lighting Efficiency Program	•	•		
Commercial Lighting Efficiency Program	•			
Residential Whole Home Appliance Efficiency Program		•		
Residential Low-Income Joint Utility Usage Management Program		•	•	•
Commercial HVAC Efficiency Program		•		
Commercial Products Efficiency Program		•		
Custom Technology Applications Program		•		
Custom Applications Program		•		
Commercial and Industrial Drives Program		•		
Residential Appliance Turn-In Program			•	•
Residential Energy Efficient Products Program			•	•
Residential Energy Efficient HVAC Equipment Program			•	•
Limited Income Energy Efficiency Program			•	•
Commercial & Industrial Equipment Program – Small			•	•
Commercial & Industrial Equipment Program – Large			•	•
Government and Institutional Program			•	•
Conservation Voltage Reduction				•
Critical Peak Rebate[1]				•
Customer Resources Demand Response[1]				•
Customer Load Response Program[1] [2]				

[1] Reported demand savings only.

[2] Impacts reported as part of Customer Resources Demand Response Program.

1.4 SWE Contract, Function, and Summary of Activities

In order to achieve the required kWh and KW savings targets as dictated by Act 129, on January 16, 2009 the Commission entered an Implementation Order at Docket No.: 2008-2069887. As part of the Implementation Order and Act 129, the Commission sought a SWE to evaluate the EDCs' EE&C programs. GDS Associates Inc., partnered with Nexant, Inc. and Mondre Energy, Inc. was retained to fulfill these requirements. The SWE's scope of work was defined by three stages: development of an audit plan, annual progress reviews, and a final five-year EE&C program assessment report.

In stage I, according to the revised December, 2011 SWE contract, the SWE was responsible for:

- Developing an audit plan supporting verification of EDC plans and reports.
- Specifying EDC reporting requirements.
- Reviewing EDC plans and evaluation, measurement, and verification (EM&V) review processes.
- Developing a plan for evaluation activities, including coordination of EDC evaluation.
- Providing and maintaining a public web-accessible database and reporting system for the Commission's website.

Stage II required the SWE to, in accordance with the approved audit plan developed in stage I, monitor and verify data collection, quality assurance, and the results of each EDC plan on an annual basis. Specific activities include, but are not limited to, the following:

- Maintaining an evaluation and management database.
- Conducting random spot verification of EDC EM&V measurements and data.
- Primary data collection to support random spot verifications.
- Acquiring data from EDCs and other sources and verifying EDC-supplied data.
- Reviewing EDC plans to determine whether EDCs are meeting energy savings and load reduction targets.
- Conducting limited spot field inspections using trained personnel, in coordination with EDCs and Commission staff.
- Spot verification, in coordination with EDCs and Commission staff, using short-term and long-term metering equipment on participating customer property.
- Auditing EDC survey instruments.
- Conducting customer and trade-ally satisfaction surveys and reports.
- Conducting limited market baseline studies for the impact evaluations of specific programs.
- Collecting and analyzing verification data.
- Interfacing and coordinating with Commission staff and EDCs.
- Critiquing reported energy and demand savings using field verification, TRM Verified Savings, measurement and verification, and large-scale billing analyses.
- Verifying cost-effectiveness of EDC plans using the Commission-adopted TRC test.
- Reviewing and monitoring EDC EM&V plans and execution of said plans.

The findings of these activities are to be presented in an annual report, which will include, but not be limited to, the following:

- An analysis of each EDC's plan expenditures and an assessment of the programs' expenditures.
- An analysis of each EDC's protocol for measurement and verification of energy savings attributable to its plan, in accordance with the Commission- adopted TRC Manual.
- Identification of best practices.
- A review of TRM information and savings values, with suggestions for possible revisions and additions.
- A review of the TRM, with suggestions for possible revisions and additions.
- A review of any proposed revisions and updates to EDC plans.

Stage III of the SWE's Phase I contract requires the SWE to provide a final five-year EE&C program assessment report to the Commission analyzing the EE&C program's effectiveness up to May 31, 2013, providing suggestions for improving the program as a whole, and suggesting whether the benefits of the program have exceeded its costs and whether additional incremental reduction requirements should be imposed. More specifically, the report will include, but not be limited to, the following:

- An analysis of the energy and load reductions achieved by EDC EE&C plans up to May 31, 2013.
- An analysis of energy and load reductions achieved by customer class over the entire program period.
- An analysis of overall costs incurred to obtain the energy and load reductions by customer class over the entire program period.
- Identification of best practices.
- Suggestions for improvements to the program as a whole.
- Updating any relevant information beyond the information included in the 2012 Market Potential Study.

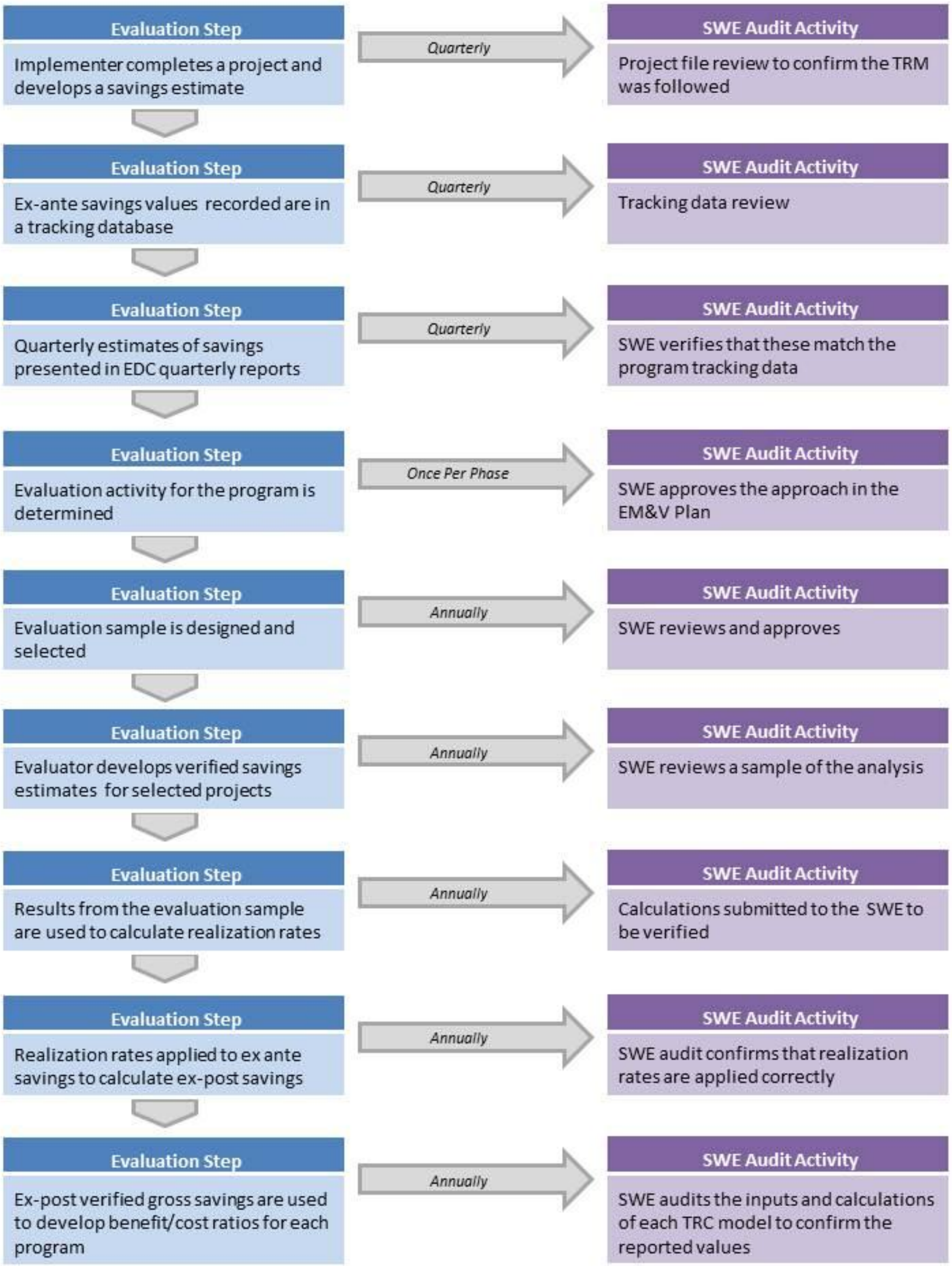
1.5 Brief Discussion of SWE Audit Program and Process

SWE audit activities are intended to give the Commission confidence in the accuracy and reliability of the verified energy and demand savings reported by each of the Pennsylvania EDCs toward the mandated consumption reduction targets. Moreover, the SWE audit activities ensure proper implementation of EE&C programs and evaluation of such programs in a manner consistent with the 2009 and 2011 updated SWE Audit Plan. The Audit Plan enabled the establishment of common metrics that were used to make accurate comparisons among EDC programs. Each step of the program implementation and evaluation process was individually audited by the SWE and is diagramed in Figure A-1. The tasks captured in the diagram can be grouped into six general activities:

- Desk reviews of project files to verify that TRM algorithms and values were used in the reported savings calculations.

- Review of program tracking data to confirm that the data matched both (a) the savings impacts in the project files' supporting documentation and (b) the ex-ante impacts reported in the EDC quarterly and annual reports.
- Review and approval of sample designs submitted by the EDCs' evaluation contractors.
- Performing ride-along and independent site inspections.
- Audit of the M&V approaches used by the EDCs' evaluation contractors to determine verified savings estimates for sampled projects.
- Verifying the inputs and calculations of program and portfolio TRC ratios.

Figure A-1: SWE Audit Activities of Program Implementation and Evaluation Process



1.6 Summary of Key Studies Performed during Phase I

During Phase I, the SWE produced five major studies:

- Residential End-Use and Saturation Study, dated 2012 ("SWE Residential Baseline Study").
- Commercial and Industrial End Use and Saturation Study, dated April 18, 2012 ("SWE C&I Baseline Study").
- Electric Energy Efficiency Potential for Pennsylvania, dated May 10, 2012 ("SWE Energy Efficiency Potential Study").
- Act 129 Demand Response Study, dated May 16, 2013 ("SWE DR Study").
- Net-to-Gross Study Methods: Review and Recommendations, dated February 27, 2012 ("SWE NTG Study").

1.6.1 SWE Residential Baseline Study

The purpose of the SWE Residential Baseline Study was to establish baseline energy usage characteristics for the residential sector served by the seven EDCs subject to the consumption and demand reduction mandates of Act 129.[78] The Study documented the findings of that sector's end- use energy usage and saturation,[79] and served to provide baseline energy using characteristics for the subsequent SWE Energy Efficiency Potential Study, which supported the Commission's establishment of energy consumption reduction targets for Phase II of Act 129.[80] Primary data was collected for the Study during fall 2011.[81]

This Study evaluated the characteristics of the energy using equipment and efficient electric equipment stock present in the residential sector of Pennsylvania for the seven EDC service territories. SWE Team member GDS used its experience working with the Pennsylvania EDCs (as part of the SWE Team evaluating their current energy efficiency programs) and performing previous energy efficiency potential studies to help identify the critical data collection needs from the on-site surveys that are be integral to future resource planning and energy efficiency activities in Pennsylvania.

While the Study aimed to assess current residential electric equipment stock and estimate the saturation of key energy efficiency and conservation measures as eventual inputs to the SWE Energy Efficiency Potential Study, it is also designed to serve as a stand-alone residential baseline study

[78] The SWE did not collect primary data as part of its onsite survey for PECO, but rather relied on data collected during spring 2010 and published as part of the 2011 Baseline Report for PECO published by Navigant Consulting prepared February 7, 2011.

[79] Saturation refers to the average number of units across all homes (except lighting). For instance, a computer saturation of 149% in an EDC's territory indicates that, on average, there are 1.49 computers in residential households. Lighting saturation refers to the proportion of lighting composed of the given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding "penetration." Penetration refers to the proportion of homes assigned a given equipment type or characteristic. For instance, if computers in an EDC's service area have a penetration of 84%, it means that 84% of all homes have at least one PC (though they could have more than one).

[80] See, Phase II Implementation Order, p. 11.

[81] Primary data was collected for the PECO study during the spring of 2010.

presenting contemporary information across the seven largest EDCs in Pennsylvania. These results can supply information that is useful for future energy efficiency and demand response program development, system planning, and obtaining a general understanding of the energy consuming equipment located throughout the Commonwealth of Pennsylvania.

The SWE performed on-site surveys during fall 2011 to collect detailed and accurate inventories of residential appliance, equipment, and housing characteristics for residential consumers throughout the Commonwealth. This Study captured a variety of energy-related data, including the penetration of electric and non-electric equipment and appliances, energy efficiency levels of electric equipment and appliances, building shell characteristics, lighting socket counts, and other relevant information.

A total of 488 site surveys (including data from the 2011 PECO Baseline Study) stratified by EDC, housing segment, and annual kWh consumption were conducted. The desired level of precision for EDC specific results, ±10% precision, with 90% confidence, necessitated a total of 70 on-site visits per EDC. The data for all EDCs were then aggregated to the statewide level, and these estimates carry precision of ±5% precision, with 95% confidence. The sample size was not large enough, nor was it intended, to provide housing segment specific results within each EDC.[82]

1.6.2 SWE C&I Baseline Study

The purpose of the SWE C&I Baseline Study was to establish baseline energy usage characteristics for the commercial and industrial (C&I) sectors served by the seven EDCs subject to the consumption and demand reduction mandates of Act 129.[83] The Study documented the findings of those sectors' end- use energy usage and saturation,[84] and served to provide baseline energy using characteristics for the subsequent SWE Energy Efficiency Potential Study, which supported the Commission's establishment of energy consumption reduction targets for Phase II of Act 129.[85] Primary data was collected for the Study from October 2011 to February 2012.[86]

The Study evaluated the characteristics of the energy using equipment and building stock present in Pennsylvania for the seven subject EDC service territories. SWE Team member Nexant used its experience working with the Pennsylvania EDCs in the evaluation of their current EE&C Plan programs,

[82] At the statewide level, there were a significant number of observations to make statistically valid conclusions in excess of ±10% precision, with 90% confidence for single family-detached housing. For single family-attached and multifamily housing segments, however there were only enough observations to make assumptions at ±15% precision, with 90% confidence, and the number of manufactured housing observations was significantly small enough that the SWE did not recommend using for statistically reasonable conclusions.

[83] The SWE did not collect primary data as part of its on-site survey for PECO, but rather relied on data collected as part of the 2011 Baseline Report for PECO published by Navigant Consulting prepared February 7, 2011.

[84] The term "saturation" refers to the percentage of buildings with a given end use present, and in some cases saturation is also given for equipment types, in which case it refers to the percentage of buildings that have a specific equipment type present in buildings with the relevant end use.

[85] See, Phase II Implementation Order, p. 11.

[86] Primary data was collected for the PECO study during the spring of 2010.

and performing previous energy efficiency potential studies to identify output parameters integral to future resource planning and energy efficiency activities in Pennsylvania.

While a number of end use studies have been conducted on national and broad regional levels, at the time the Study was conducted there was a notable absence of data specific to Pennsylvania. To overcome this hurdle, Nexant conducted a survey of Pennsylvania C&I customers to gather accurate data specific to Pennsylvania and the six EDC service territories included for which the SWE collected primary on-site data (primary on-site data for PECO from Navigant's study was included where possible).

In order to maximize the reliability of the survey, Nexant gathered information through customer site visits. Therefore, the results of the Study relied mainly upon primary research conducted in the form of on-site customer surveys. A review of available secondary sources was also performed in an effort to streamline and compliment primary research efforts in addition to filling in gaps – either in the presence or quality of data.

To accurately meet the objectives of the Study, Nexant designed an approach that successfully melded the results of both primary and secondary data sources. The Study began by analyzing the EDC customer billing data to provide a framework in which to gather additional primary and secondary data. The Study evaluated the characteristics of Pennsylvania's building stock by performing 418 C&I on-site customer surveys in six EDC territories (Nexant did not perform site surveys in the PECO territory, but rather incorporated results from a recent baseline study in its territory where possible). These surveys were designed to inventory the current energy using equipment with regards to type, fuel, efficiency, saturations and operating conditions, as well as document the characteristics of the buildings themselves.

In part serving as a primary data source for the energy efficiency potential assessment, Nexant designed the study parameters and survey instruments around the anticipated structure and content of the SWE Energy Efficiency Potential Study. On-site surveys were targeted at the customer segments which provide a representative sample of Pennsylvania businesses. Likewise, the energy end uses included in this study were selected to encompass typical building energy-using equipment. Moreover, the end uses encompass the typical energy efficiency measures in typical energy efficiency programs.

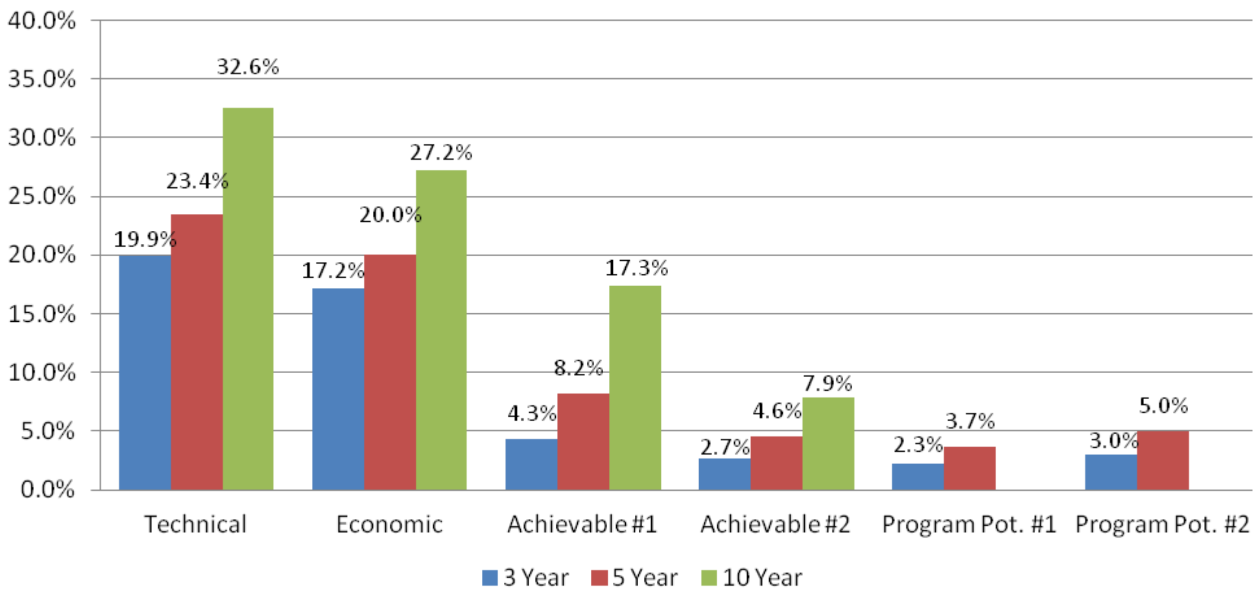
1.6.3 SWE Energy Efficiency Potential Study

In support of the Commission's evaluation and determinations, the SWE prepared an Energy Efficiency Potential Study to determine the remaining opportunities for cost effective electricity savings in the service areas of the seven EDCs in Pennsylvania that are subject to the energy efficiency requirements of Act 129. The Study examined the potential to reduce electric consumption and peak demand through the implementation of energy efficiency technologies and practices in residential, commercial, and industrial facilities in Pennsylvania. The Study assessed electric energy efficiency potential throughout the Pennsylvania EDC service areas over ten years, from 2013 through 2023.

This Study examined over 579 energy efficiency measures in the residential, commercial and industrial sectors combined**.** Three hundred and seventeen measures were included in the residential sector energy efficiency potential analysis. For the non-residential sector, there were 262 total measures included in the potential energy savings analysis. Of these 262 measures, 95 were considered in the industrial model and 167 were included in the commercial model. The 262 is a count of the individual measures included; many measures had overlap between different segments and were counted as one measure, such as CFLs and various ENERGY STAR appliances, which are applicable to many different segments.

Figure A-1 shows that cost effective electric energy efficiency resources can play a significantly expanded role in the Pennsylvania energy resource mix over the next 10 years.

Figure A-1: SWE Energy Efficiency Potential Study Findings



For the region of Pennsylvania served by the seven electric distribution companies covered by Act 129, the technical potential in 2016 and in 2018 for energy efficiency is 19.9% and 23.4%, respectively, of forecasted energy sales for the 2010 baseline period for this study.[87] The energy efficiency savings for economic potential and achievable potential scenario #2 in 2016 are 17.2% and 2.7% of forecasted energy sales for the 2010 baseline period. The energy efficiency savings for economic potential and achievable potential scenario #2 in 2018 are 20% and 4.6% of forecasted kWh sales for the 2010 baseline period.

The Study had the following main objectives:

[87] For purposes of this Study, the baseline period sales are forecast kWh sales for each EDC for the period June 1, 2009 through May 31, 2010. Forecasted 2009/2010 energy sales were used to allow the same baseline to establish compliance targets on a cumulative basis from Phase 1 to Phase 2, which also allows adding energy savings from Phase 1 to Phase 2. All energy and demand savings presented in this report are at the end-consumer (meter) level unless specifically noted otherwise in this report.

- Evaluate the electric energy efficiency technical, economic, achievable and program potential savings in the overall Commonwealth of Pennsylvania, as well as in seven specific EDC service areas; and
- Calculate the TRC benefit-cost ratio for the achievable potential savings for electric energy efficiency measures and programs and determine the electric energy efficiency economic potential savings for Pennsylvania homes and businesses.

The Study distinguished among four types of energy efficiency potential; (1) technical, (2) economic, (3) achievable, and (4) program potential. The definitions used in the Study for energy efficiency potential estimates were obtained directly from a National Action Plan for Energy Efficiency (NAPEE) report and are as follows:

- **Technical Potential** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a "snapshot" in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.[88]
- **Economic Potential** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration, etc.) that would be necessary to capture them.[89]
- **Achievable Potential** is the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.[90] The Study considered two main scenarios of achievable potential for analysis:
    - Achievable Potential Scenario #1 was based on paying incentives equal to 100% of measure incremental costs.

[88] National Action Plan for Energy Efficiency, "Guide for Conducting Energy Efficiency Potential Studies" (November 2007), page 2-4. For purposes of the Study, the SWE used the definitions exactly as listed in the 2007 NAPEE report without making any modifications.
[89] Ibid.
[90] ibid.

  - Achievable Potential Scenario #2 was based on EDCs paying incentive levels comparable to those in effect during Program Year 2 of Phase I.
- **Program Potential** refers to the efficiency potential possible given specific program funding levels and designs. Often, program potential studies are referred to as "achievable" in contrast to "maximum achievable." In effect, they estimate the achievable potential from a given set of programs and funding. Program potential studies can consider scenarios ranging from a single program to a full portfolio of programs. A typical potential study may report a range of results based on different program funding levels. The Study considered two main scenarios of program potential for analysis:
  - Program Potential Scenario #1 was based on funding levels of 2% of 2006 utility electric revenues (this is the funding cap specified in Act 129 legislation).
  - Program Potential Scenario #2 was based on annual savings equal to 1% of aggregate 2011 actual retail kWh sales.

1.6.4 SWE Demand Response Study

Act 129 required the subject EDCs to reduce, by May 31, 2013, total annual weather-normalized energy consumption by at least 3%, and peak demand by 4.5% over the 100 hours of highest demand. By enacting a demand reduction target greater than the required reduction for energy consumption, the Commission encouraged EDCs to implement peak shaving programs. The Commission approved, through the EE&C plan proceedings, the EDCs' implementation of Demand Response (DR) programs during the summer 2012 performance period to achieve the Act 129 peak demand reduction target.[91] The Commission also directed the SWE to conduct a DR study to evaluate the effectiveness of Act 129 DR programs in Phase I and inform decisions about whether peak load reduction targets can be justified in future phases of Act 129.[92] Demand reduction goals, like the 4.5% peak demand reduction target in Pennsylvania, can be achieved by DR programs or energy efficiency programs because most energy efficiency measures permanently reduce equipment power consumption during periods of peak demand over the life of the measure. A DR goal is achieved solely by reducing peak demand temporarily through dispatched peak shaving resources or pricing signals and does not include the permanent reduction in demand resulting from energy efficiency programs.

Most energy efficiency measures produce percent peak demand reductions that are comparable to the percent energy savings they achieve. Because the Act 129 peak demand reduction target was greater than the energy reduction target, each of the seven Pennsylvania EDCs elected to offer multiple DR programs in 2012 in an effort to meet the mandated demand reduction goals. Approximately 2.5% of the 4.5% peak demand reduction goal established by Act 129 was achieved through the coincident peak

[91] In support thereof, the Commission approved protocols in the 2012 TRM Order for determining demand reductions from DR programs. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Docket No. M-00051865, December 16, 2011, pp. 61-65.
[92] Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program Secretarial Letter*, served March 4, 2011, at Docket No. M-2008-2069887.

demand reduction produced by energy efficiency measures, effectively presenting a 2.0% DR goal to be achieved in a single summer.

Meeting Act 129's demand reduction target for the 100 hours of highest demand required EDCs to predict when the highest 100 hours would occur over the course of the summer season. These predictive difficulties are less common for DR programs in the other states and in the ISOs examined, where DR programs are used only when necessary based on reliability triggers or market pricing conditions. The SWE recommended that the top 100 hour definition be discontinued in subsequent Phases of Act 129.

The Commission's March 4, 2011 Secretarial Letter in Docket No. M-2008-2069887 directed the SWE to "collect data and documentation from the EDCs to aid in performing an analysis of the cost-effectiveness of compliance with the current legislative demand response requirements and of potential improvements to the demand response program design."[93] The responsive SWE DR Study provided the Commission with findings and recommendations for the potential design and implementation of Act 129 demand response programs during Phase III,[94] supporting a Commission decision on any demand response targets it determines are appropriate, which would commence following the three-year Phase II period ending on May 31, 2016.[95]

In a Final Order released February 20, 2014, the Commission directed the SWE to "to perform a Demand Response Potential Study using the proposed residential direct load control and commercial and industrial load curtailment models included herein."[96] The Commission chose not to direct the SWE to perform a wholesale price suppression study.[97]

1.6.5 SWE Net-to-Gross Study

The SWE Net-to-gross (NTG) Study established guidelines for the EDCs' conduct of their NTG studies as required by the Commission pursuant to the 2011 TRC Test Order.[98] Details of this Study can be found in Appendix B, Section B.5.2 of this report. The methodologies and results of the EDCs' NTG studies conducted during Phase I are summarized in Section 6.4 and Appendix E of this Report.

[93] Phase II Implementation Order, pp. 32, 33. The Commission also directed the SWE to review the top 100 hours methodology when performing its demand response study, as Act 129, at 66 Pa. C.S. §2806.1(d)(2), grants the Commission discretion to identify an alternative reduction methodology. ibid., p. 44.
[94] ibid., p. 23
[95] ibid., p. 22.
[96] *Final Order*, Docket M-2012-2289411, February 20, 2014, p. 76.
[97] ibid., p. 42.
[98] *Implementation of Act 129 of 2008 – Total Resource Cost (TRC) Test 2011 Revisions*, Docket No. M-2009-2108610, August 2, 2011 (2011 TRC Test Order), p. 25. The Commission also determined that "NTG ratios will not be used to determine whether the EDCs met their energy and demand reduction targets" for Phase I, and reserved its position on the use of NTG ratios for determining compliance with savings targets in Phase II. ibid., p. 26.

1.7 Summary Layout of this Report

Section 2 of this report provides a summary of EDC energy savings results for PY4 and Phase I. It also provides in-depth descriptions of each EDC's EE&C plans, exclusive of demand response programs.

Section 3 summarizes the demand reductions achieved through energy efficiency and demand response programs throughout Phase I and provides descriptions of each EDC's demand response programs contained in the EDC's Phase I EE&C plan.

Section 4 summarizes the Pennsylvania TRC test, including TRC test results by each EDC, which addresses the benefits and costs of implementing Phase I of Act 129.

Section 5 discusses the SWE's analysis of Phase I, including process evaluation, best practices and lessons learned, and recommendations for subsequent phases of Act 129.

Section 5.4.2 discusses Phase II of Act 129 and the baseline and market potential studies that informed the targets for this phase. This section also briefly describes the EDCs' Phase II EE&C plans and programs.

Section 7 describes the SWE's findings, conclusions, and recommendations for Phase I of Act 129.

Appendix A provides detailed program descriptions for each EDC program implemented pursuant to its EE&C plan during Phase I of Act 129.

Appendix B discusses the process behind the development, implementation, and evaluation, measurement, and verification of Phase I EE&C plans and programs.

Appendix C is a compendium of all studies, reports, and memos prepared by the SWE during Phase I of Act 129.

Appendix D discusses process evaluation recommendations made by EDC evaluators throughout Phase I and the actions taken by the EDC's in response to the recommendations.

Appendix E discusses the net-to-gross ratio estimation methods used by the EDCs and summarizes the SWE audit of each EDCs' net-to-gross ratio (NTGR) calculations.

Appendix F discusses specific audit activities and findings for the SWE audit of PY4 of Act 129.

2 Energy Savings – Phase I

This section of the report discusses the mandated consumption reduction goals under Act 129, and the EDCs' compliance with the goals in Phase I of the Act. This section also presents the results of consumption reductions realized in PY4, and descriptions of the EDCs' EE&C programs contained in their EE&C plans.

2.1 Restatement of Act 129 Targets

Act 129 required that EDCs with at least 100,000 customers adopt a plan, approved by the Commission, to reduce electric consumption by at least 1% of its expected consumption for June 1, 2009 through May 31, 2010, adjusted for weather and extraordinary loads. The 1% reduction was to be accomplished by May 31, 2011. By May 31, 2013, the total annual weather-normalized consumption was to be reduced by a minimum of 3%. Table 2-1 shows each EDC's mandated targets.

Table 2-1: Act 129 Mandated Targets by EDC

EDC	1% Consumption Reduction (MWh/year)	3% Consumption Reduction (MWh/year)
Duquesne	140,855	422,565
PECO	393,860	1,181,580
PPL	382,144	1,146,431
Met-Ed	148,650	445,951
Penelec	143,993	431,979
Penn Power	47,729	143,188
West Penn	209,387	628,160
Total	**1,466,618**	**4,399,854**

The energy reduction targets were established by order of the Commission using "[t]he EDCs … historical system demand associated with retail sales customers… for the period of June 1, 2007 through September 30, 2007." [99]

The consumption reduction (i.e., energy savings) targets for each EDC were established based on each EDC's expected load forecasted to the Commission in 2009. Each EDC was required to provide the Commission its forecasts as well as the methodology used for its respective forecasts in early 2009. The Commission then used these forecasts to establish the 1% and 3% consumption reduction targets for each of the EDCs using the "sales approach" as outlined in the Phase I Implementation Order.[100] Each EDC was required to demonstrate its plan to conserve the reduction targets in its respective EE&C plan.

[99] *Energy Consumption and Peak Demand Reduction Targets*, Docket No. M-2008-2069887, [99] Order entered March 30, 2009, p. 3.
[100] 66 Pa. C.S. § 2806.1(c)(2), line 19-27.

The Commission's order entered March 30, 2009 in Docket No. M-2008-2069887 states that "upon consideration of the key assumptions used by the EDCs in preparing their individual forecasts of sales to retail customers for the period of June 1, 2009 through May 31, 2010, we find the forecasts to be reasonable and are, therefore, accepted by the Commission for the purpose of developing plans for attaining the 1% and 3% consumption reduction targets."[101] As the consumption reduction targets are based on a forecast of sales from the EDCs, these targets are considered to occur at the customer meter level as opposed to the system level. Therefore, all energy savings achieved by the EDCs are to be reported at the meter level to properly assess if EDCs have met their consumption reduction targets.

2.2 Compliance Summary by EDC

Table 2-2 shows each EDC's 2011 1% energy reduction target, the TRM Verified Savings achieved by May 31, 2011 (end of PY2), and the percentage of the 2011 1% energy reduction target achieved.

Table 2-2: 2011 1% Reduction Target - Compliance Summary by EDC, TRM Verified Energy Savings

EDC	Phase I – 2011 1% Energy Reduction Target (MWh/yr)	CPITD TRM Verified Gross Energy Reductions (MWh/yr)	% of 2011 Target
Duquesne	140,855	168,336	120%
PECO	393,860	873,192	222%
PPL	382,144	509,361	133%
Met-Ed	148,650	181,681	122%
Penelec	143,993	184,261	128%
Penn Power	47,729	66,630	140%
West Penn Power	209,387	90,520	43%

As indicated, each EDC other than West Penn Power exceeded its 2011 1% energy reduction target.

[101] *Energy Consumption and Peak Demand Reduction Targets*, Docket No. M-2008-2069887,[101] Order entered March 30, 2009, p. 4.

Table 2-3 shows each EDC's 2013 3% energy reduction target, the TRM Verified Savings achieved, and the percentage of the Phase I energy reduction target achieved.

Table 2-3: TRM Verified Energy Savings Compliance Summary by EDC

EDC	Phase I – 2013 3% Energy Reduction Target (MWh/yr)	CPITD TRM Verified Gross Energy Reductions (MWh/yr)	% Phase I Target
Duquesne	422,565	556,282	132%
PECO	1,181,580	1,399,242[102]	118%
PPL	1,146,431	1,642,067	143%
Met-Ed	445,951	493,138	111%
Penelec	431,979	458,784	106%
Penn Power	143,188	165,768	116%
West Penn Power	628,160	688,089	110%

PECO reported alternative, EDC Proposed Savings,[103] which were based on values for parameters differing from those specified in the TRM. PECO's EDC Proposed Savings for energy reduction are 1,406,957 MWh/yr, or 119% of the Phase I energy reduction target. The difference (7,715 MWh/yr) between PECO's CPITD TRM Verified Savings and its EDC Proposed Savings is a result of PECO using a different interactive effects factor ("IEF") for residential CFL bulbs to derive its EDC Proposed Savings. The TRM does not account for interactive effects for residential lighting (i.e., IEF equal to 1.00), whereas PECO proposed an alternative value of 1.02 for residential CFLs in its Smart Lighting Discounts and Low-Income Energy Efficiency Programs to calculate the EDC Proposed Savings.

In addition, Act 129 requires the EDCs to achieve at least 10% of their energy and demand reductions from units of federal, state, and local governments, including municipalities, school districts, institutions of higher education, and non-profit entities (the government, non-profit, institutional [GNI] sector). As shown in Table 2-4, all of the EDCs achieved their respective Phase I energy reduction targets for the GNI sector.

[102] Following the submittal of PECO's PY4 annual report, Navigant discovered that the final verified energy and demand savings from certain GNI projects had not been entered into its realization rate calculators. The result of adding the values to the correct realization rate calculators was an increase of 76 MWh and 0.1 MW for the Smart Equipment Incentives GNI program and total portfolio. This savings increase is reflected in the SWE Act 129 Phase I report but is not included in PECO's annual report.
[103] See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.

Table 2-4: CPITD GNI TRM Verified Energy Reductions

EDC	Phase I - 10% GNI Sector Energy Reduction Target (MWh/yr)	CPITD GNI Sector TRM Verified Gross Energy Reductions (MWh/yr)	% of Phase I Target
Duquesne	42,257	49,979	118%
PECO	118,155	194,033	164%
PPL	114,643	206,786	180%
Met-Ed	44,595	51,025	114%
Penelec	43,198	53,919	125%
Penn Power	14,319	14,577	102%
West Penn Power	62,816	151,035	240%

Furthermore, the Act requires that each EE&C plan "include specific energy efficiency measures for households at or below 150% of the federal poverty income guidelines. The number of measures shall be proportionate to those households' share of the total energy usage in the service territory."[104] In orders approving the EE&C plans, the Commission directed the formation of a Low-Income Working Group (LIWG) to identify the standardized data used to determine the low-income households' share of total energy usage in each EDC's service territory. At its April 22, 2010 Public Meeting, the Commission adopted a Secretarial Letter at Docket No. M-2009-2146801 that released the March 19, 2010 report of the LIWG, and adopted the recommendations contained therein. The report stated that "…all EDCs have sufficient specific measures for low-income households to satisfy the 'proportionate number' criteria in the statute. This is the sole methodology for determining compliance with Act 129 through 2013."[105]

[104] 66 Pa.C.S. §2806.1(b)(i)(G).
[105] Report of the Low-Income Working Group, Docket No. M-2009-2146801, March 19, 2010, p. 7.

2.3 Results for Program Year 2012/2013 (PY4)

This section summarizes the energy savings reported by the EDCs for PY4 (June 1, 2012 – May 31, 2013) of Act 129.

2.3.1 Summary of Energy Savings Statewide and by EDC

Table 2-5 summarizes the TRM Verified Savings, reported gross and verified gross energy savings, achieved in PY4 by each EDC.

Table 2-5: Summary of PY4 EDC Energy Savings – TRM Verified Savings

	Statewide	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
PY4 Reported Gross Energy Savings(MWh/yr)	**1,830,477**	226,994	253,744	584,358	209,743	175,124	66,392	314,122
PY4 Verified Gross Energy Savings (TRM Verified) (MWh/yr)	**1,567,006**	204,981	208,290[a]	669,671[b]	191,740	148,807	57,956	293,851

[a] For the reasons explained in Section 2.4 PECO's EDC Proposed Verified Gross Energy Savings reported for PY4 are 208,365 MWh/yr.
[b] PPL's Verified Gross Energy Savings are signigicantly larger than PPL's Reported Gross Energy Savings because they include 101,550 MWh/yr for cross-sector sales adjustment.

2.3.2 Summary of Energy Savings by Sector

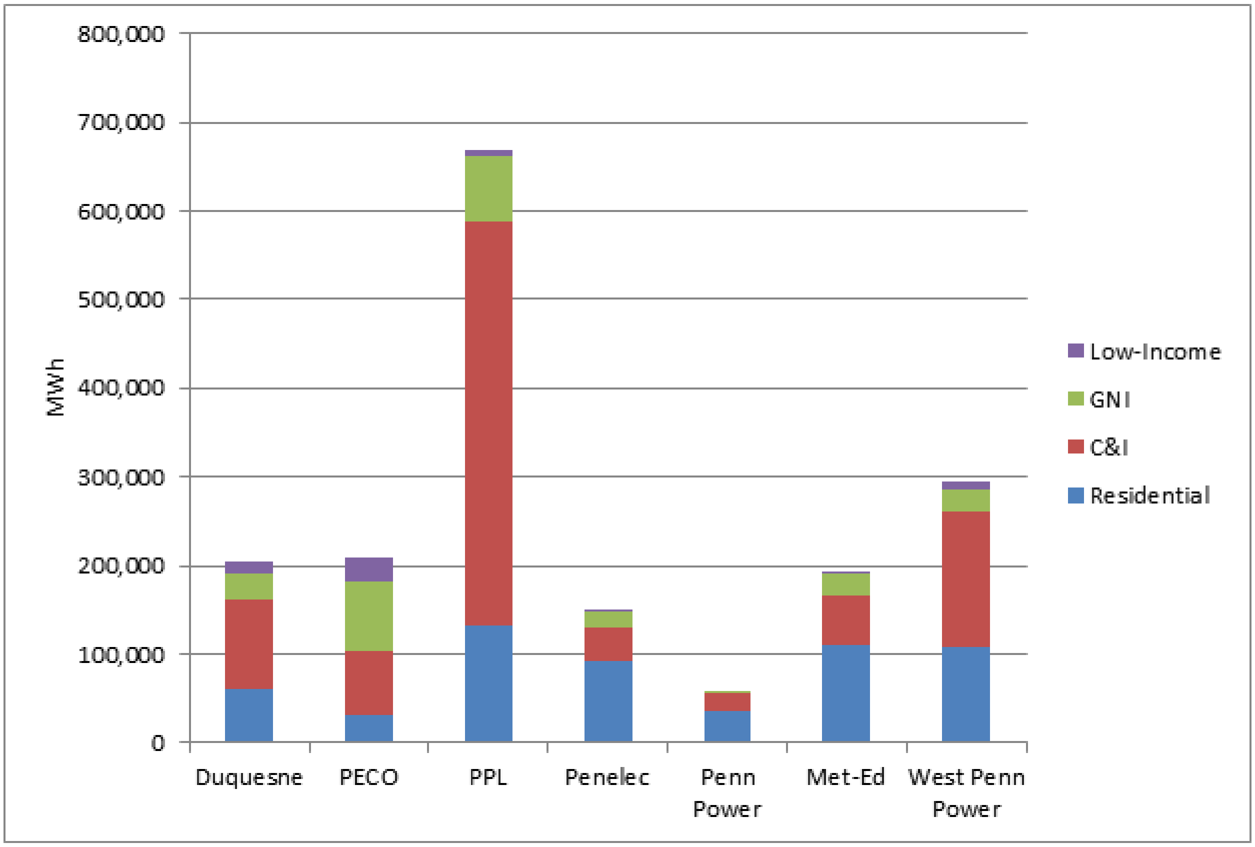
Table 2-6 summarizes the TRM Verified Savings for PY4 for each EDC by sector.

Table 2-6: Summary of PY4 Energy Savings by Sector - TRM Verified Savings

	Statewide	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
PY4 Residential Verified Gross Energy Savings (MWh/yr)	**547,698**	59,458	30,485	133,474	104,249	90,276	33,966	95,790
PY4 Low-Income Verified Gross Energy Savings (MWh/yr)	**53,569**	13,713	26,876	6,772	1,096	1,324	0	3,788
PY4 Commercial and Industrial Verified Gross Energy Savings (MWh/yr)	**936,101**	112,406	73,024	455,191	62,769	39,528	20,742	172,441
PY4 Government/ Non-Profit/ Institutional (GNI) Verified Gross Energy Savings (MWh/yr)	**237,928**	19,404	77,905	74,234	23,626	17,679	3,248	21,832
PY4 Total TRM Verified Gross Energy Savings (MWh/yr)	**1,775,296**	**204,981**	**208,290**	**669,671**	**191,740**	**148,807**	**57,956**	**293,851**

Figure A-1 is a graphical representation of the above data for the seven Pennsylvania EDCs.

Figure A-1: Summary of PY4 TRM Verified Energy Savings by Sector



Program Year Four Energy Impacts[106]

- The statewide PY4 reported gross energy savings are 1,830,477 MWh/yr.
- The statewide PY4 TRM Verified Savings (gross verified savings) are 1,567,006 MWh/yr.

Low-Income Sector PY4 Energy Impacts

- The statewide number of measures offered to the low-income sector comprises approximately 22% of the total number of measures offered through all programs.
- The statewide PY4 TRM Verified Savings (gross energy savings) for low-income sector programs are 53,569 MWh/yr.

Government/Non-Profit/Institutional (GNI) Sector Energy Impacts

- The statewide PY4 TRM Verified Savings (gross energy savings) for GNI programs are 237,928 MWh/yr. This is 13% of total portfolio verified savings.

2.4 Results for Phase I of Act 129

This section presents the energy savings reported by the EDCs for Phase I of Act 129.

2.4.1 Statewide Summary

Table 2-7 summarizes each EDC's gross reported energy savings and TRM Verified Savings (verified gross energy savings) in energy consumption for Phase I of Act 129.

Table 2-7: Summary of EDC Energy Savings

	Statewide	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Reported Gross[107] Energy Savings (MWh/yr)	**5,567,257**	582,858	1,472,811	1,590,087	531,111	508,134	181,553	700,703
CPITD Verified Gross Energy Savings (TRM Verified) (MWh/yr)	**5,403,370**	556,282	1,399,242[a]	1,642,067	493,138	458,784	165,768	688,089

[a] For the reasons explained in Section 2.2, PECO's EDC Proposed Verified Gross Energy Savings reported for Phase I are 1,406,957 MWh/yr.

At the time of the EDCs' PY4 annual report filings for Act 129, not all projects had been evaluated. Therefore, some EDCs reported gross, non-verified savings in their PY4 reports. Additionally, EDCs were allowed to carry over extra savings above their compliance targets to Phase II. Table 2-8 shows the EDCs TRM Verified Savings for Phase I, non-verified gross savings, and carry-over savings for Phase II.

Table 2-8: Summary of EDC Energy Savings: TRM Verified Savings, Non-verified Savings, and Carry-Over Savings

	Statewide[108]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD TRM Verified Gross[109] Energy Savings (MWh/yr)	**5,403,370**	556,282	1,399,242	1,642,067	493,138	458,784	165,768	688,089
CPITD Non-verified Gross Energy Savings (MWh/yr)	**42,499**	15,436	27,063	143	0	0	0	0
Savings Carried into Phase II (MWh/yr)	**1,030,609**	133,717	244,755	495,636	47,187	26,805	22,580	59,929

[107] Gross savings represent change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

[108] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified PYTD values by the sum of EDC compliance target values.

[109] Gross savings represent change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Table 2-9 contains a summary by sector of the TRM Verified Savings in energy consumption in Phase I for each EDC.

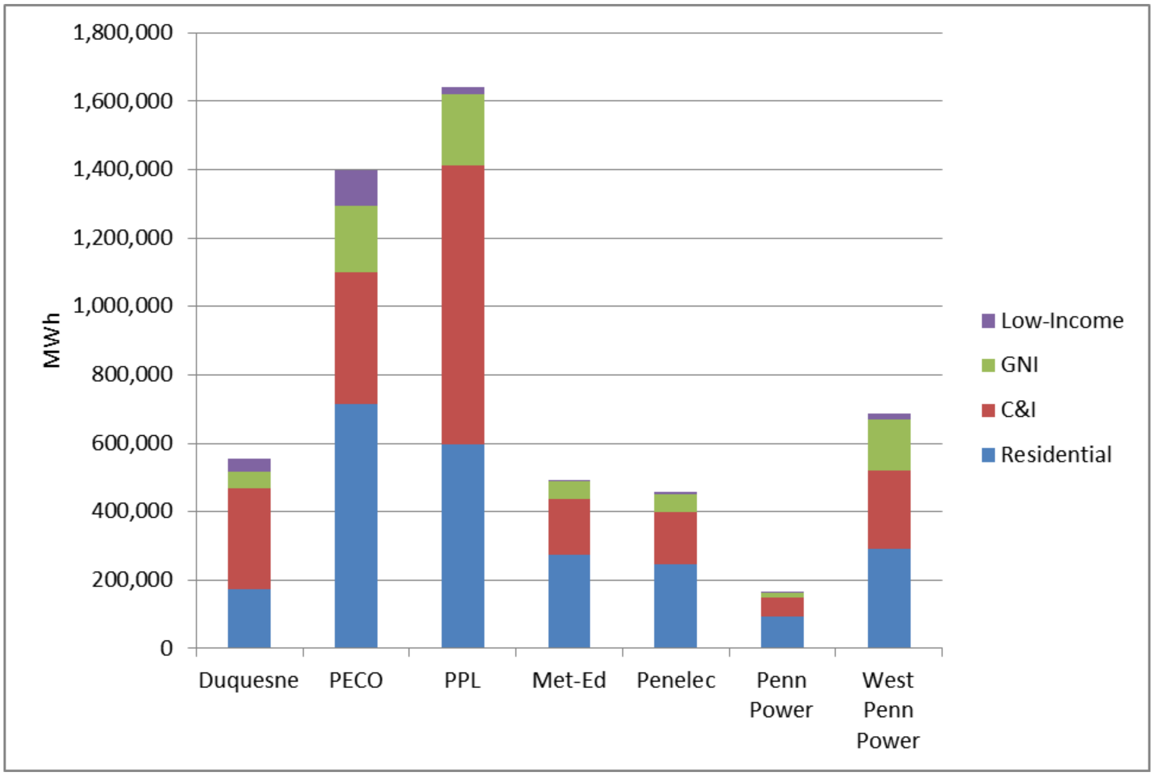
Table 2-9: Summary of TRM Verified Savings by Sector

	Statewide[110]	Duquesne[111]	PECO[112]	PPL[113]	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Residential Verified Gross[114] Energy Savings (MWh/yr)	**2,387,994**	173,310	714,283	597,896	273,375	247,102	92,120	289,908
CPITD Low-Income Verified Gross Energy Savings (MWh/yr)	**201,072**	39,589	104,558[115]	23,180	5,728	7,375	2,271	18,371
CPITD Commercial and Industrial Verified Gross Energy Savings (MWh/yr)	**2,092,950**	293,404	386,370	814,204	163,010	150,387	56,800	228,775
CPITD Government and Non-Profit Verified Gross Energy Savings (MWh/yr)	**721,354**	49,979	194,033	206,786	51,025	53,919	14,577	151,035
CPITD Total Verified Gross Energy Savings (MWh/yr)	**5,403,370**	**556,282**	**1,399,242**	**1,642,067**	**493,138**	**458,784**	**165,768**	**688,089**

[110] Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC-verified PYTD values by the sum of EDC compliance target values.
[111] Sector totals were calculated by sorting program CPITD's from Table 1-4 in Duquesne's PY4 Annual Report.
[112] Due to rounding, total may not equal sum of sectors. Sector totals were calculated by sorting program CPITD's from Table 1-7 in PECO's PY4 Annual Report.
[113] From PPL PY4 Annual Report, Table 1-6.
[114] CPITD verified = sum of verified savings from PY1 through PY4. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.
[115] 3,107 MWh from residential programs can be attributed to the low-income sector, which would bring the low-income total to 107,665 MWh and the residential down to 711,176 MWh.

Figure A-1 summarizes the TRM Verified Savings for energy consumption by sector for Phase I for each EDC.

Figure A-1: Phase I CPITD TRM Verified Savings by Sector by EDC



Phase I Energy Impacts

- The statewide CPITD reported gross energy savings are 5,567,257 MWh/yr.
- The statewide CPITD TRM Verified Savings (gross energy savings) are 5,403,370 MWh/yr.[116]

Low-Income Sector

- The number of measures offered to the low-income sector comprises approximately 23% of the total number of measures offered through all programs.
- The statewide TRM Verified Savings for low-income sector programs are 201,072 MWh/yr.[117]

[116] This value is the sum of all EDC's TRM verified gross savings values. Using the alternative values provided by PECO in sum with all other EDCs' TRM verified values, the statewide Phase I verified gross energy savings is **5,411,085** MWh/yr.

[117] This value is the sum of all EDCs' TRM verified gross energy savings for low-income sector programs. Using the alternative values provided by PECO in sum with all other EDCs' TRM verified values, the statewide Phase II verified gross energy savings for low-income sector programs is **206,593** MWh/yr.

GNI Sector

- The statewide TRM Verified Savings for GNI programs are 721,354 MWh/yr. This is 13.4% of total portfolio verified savings.

2.4.2 Duquesne

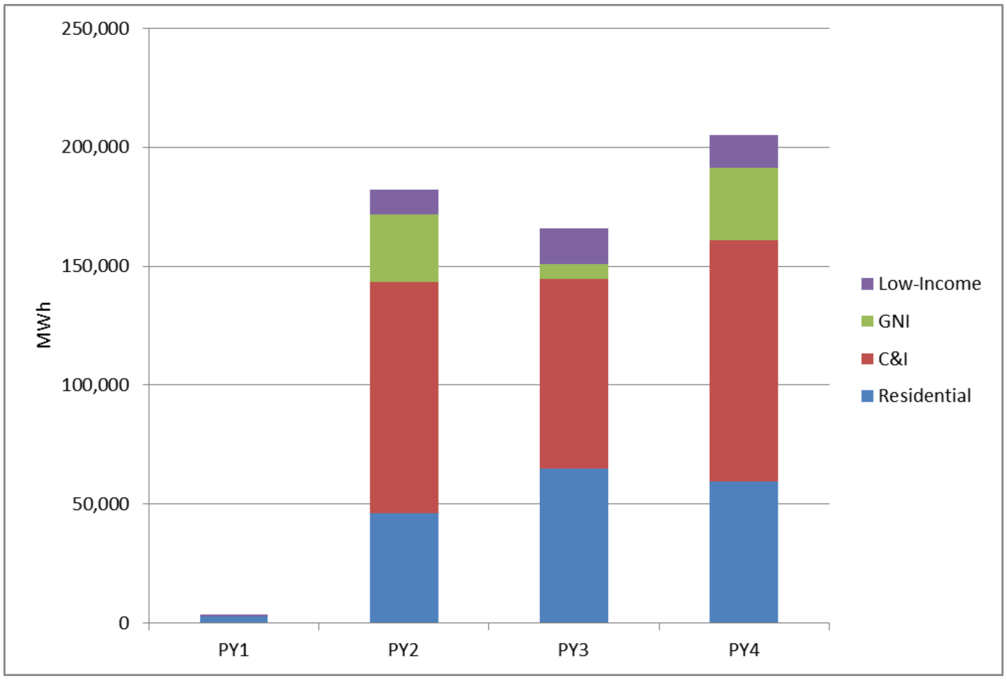
Table 2-10 shows the CPITD TRM Verified Savings for energy consumption for each program in Duquesne's Phase I EE&C plan.

Table 2-10: Duquesne Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Residential EE Program (REEP): Rebate Program	23,422	4%
Residential EE Program (Upstream Lighting)	129,472	23%
Residential School Energy Pledge	5,004	1%
Residential Appliance Recycling	15,412	3%
Residential Low-income EE	6,408	1%
Residential Low-income EE (Upstream Lighting)	33,181	6%
Commercial Sector Umbrella EE	6,646	1%
Commercial Sector Umbrella EE (Upstream Lighting)	82,733	15%
Healthcare EE	15,012	3%
Industrial Sector Umbrella EE	3,305	0.6%
Chemical Products EE	17,845	3%
Mixed Industrial EE	23,015	4%
Office Building – Large EE	60,650	11%
Office Building – Small EE	9,501	2%
Primary Metals EE	36,224	7%
Public Agency / Non-Profit	49,979	9%
Retail Stores – Small EE	22,020	4%
Retail Stores – Large EE	16,454	3%
Residential Demand Response	0	0%
Large Curtailable Demand Response	0	0%
TOTAL	**556,282**	**100%**

Figure A-1 shows the TRM Verified Savings by Phase I program year and sector for Duquesne.

Figure A-1: Duquesne Phase I TRM Verified Savings by Program Year and Sector



2.4.3 PECO

Table 2-11 shows the CPITD TRM Veriifed Savings and EDC Proposed Savings for energy consumption for each program in PECO's Phase I EE&C plan.

In addition to its TRM Verified Savings, PECO reported EDC Proposed Savings for energy savings using alternative evaluation results relative to those supported by protocols in the TRM. The difference between PECO's TRM Verified Savings and EDC Proposed Savings is the inclusion of an interactive effects factor (IEF) for residential CFLs. The TRM does not account for interactive effects for residential lighting (interactive effects factor equal to 1.00), whereas PECO proposed an alternative value of 1.02 for residential CFLs in its Smart Lighting Discounts and Low-Income Energy Efficiency Programs.[118]

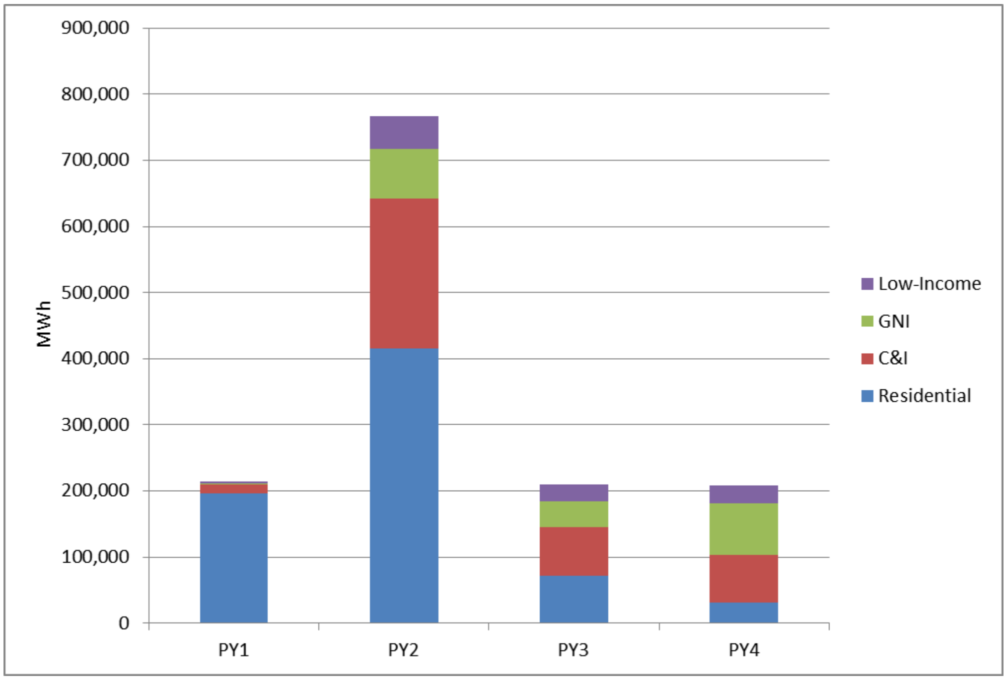
Table 2-11: PECO Phase I CPITD TRM Verified Savings and EDC Proposed Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	% of Portfolio CPITD TRM Verified Gross MWh/yr Savings	CPITD EDC Proposed Verified Gross MWh/yr Savings	% of Portfolio CPITD EDC Proposed Verified Gross MWh/yr Savings
Smart Lighting Discounts Program	487,813	35%	494,640	35%
Smart Appliance Recycling Program	46,628	3%	46,628	3%
Smart Home Rebates Program	74,119	5%	74,119	5%
Residential Conservation Voltage Reduction	105,723	8%	105,723	8%
Low-Income Energy Efficiency Program	78,928	6%	79,892	6%
Low-Income Conservation Voltage Reduction	25,630	2%	25,630	2%
Smart Equipment Incentives -- C&I	222,366	16%	222,366	16%
Smart Construction Incentives	13,341	1%	13,341	1%
C&I Conservation Voltage Reduction	150,575	11%	150,575	11%
Smart Equipment Incentives GNI	155,588	11%	155,588	11%
GNI Conservation Voltage Reduction	38,445	3%	38,445	3%
Residential Smart A/C Saver	0	0%	0	0%
Commercial Smart A/C Saver	0	0%	0	0%
Permanent Load Reduction	88	0.01%	88	0.01%
Demand Response Aggregators	0	0%	0	0%
Distributed Energy Resources	0	0%	0	0%
TOTAL	1,399,242	100%	1,407,033	100%

[118] See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.

Figure A-1 shows the TRM Verified Savings by Phase I program year and sector for PECO.

Figure A-1: PECO Phase I TRM Verified Savings by Program Year and Sector



2.4.4 PPL

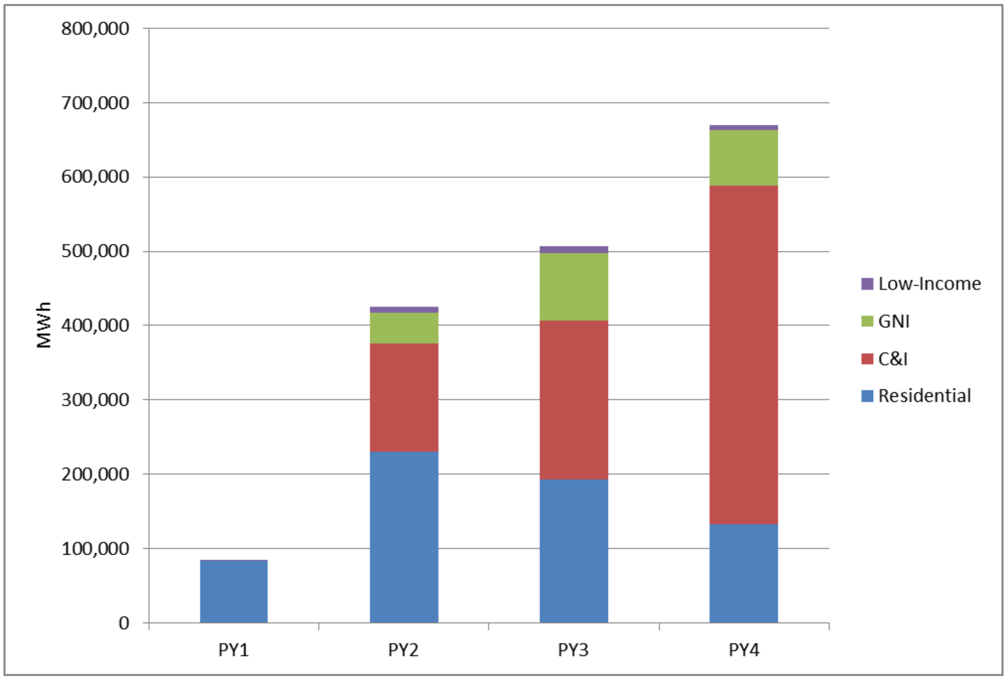
Table 2-12 shows the CPITD TRM Verified Savings for energy consumption for each program in PPL's Phase I EE&C plan.

Table 2-12: PPL Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Appliance Recycling	75,372	5%
Custom Incentive	188,924	12%
Direct Load Control	0	0%
Efficient Equipment Incentive	738,277	45%
Energy Efficiency Behavior and Education	36,470	2%
E-Power Wise	3,707	0.2%
Home Energy Assessment and Weatherization	8,025	0.5%
HVAC Tune-Up	1,649	0.1%
Load Curtailment	0	0%
Renewable Energy	17,537	1%
Residential Lighting	553,094	34%
WRAP	19,473	1%
TOTAL	**1,642,067**	**100%**

Figure A-1 shows the TRM Verified Savings by Phase I program year and sector for PPL.

Figure A-1: PPL Phase I TRM Verified Savings by Program Year and Sector[119]



[119] Some of PPL's programs straddled multiple sectors. In annual reports where no verified savings by sector were provided, SWE used reported gross savings by sector scaled to total verified program savings. These graphs are presented for illustration purposes only.

2.4.5 Met-Ed

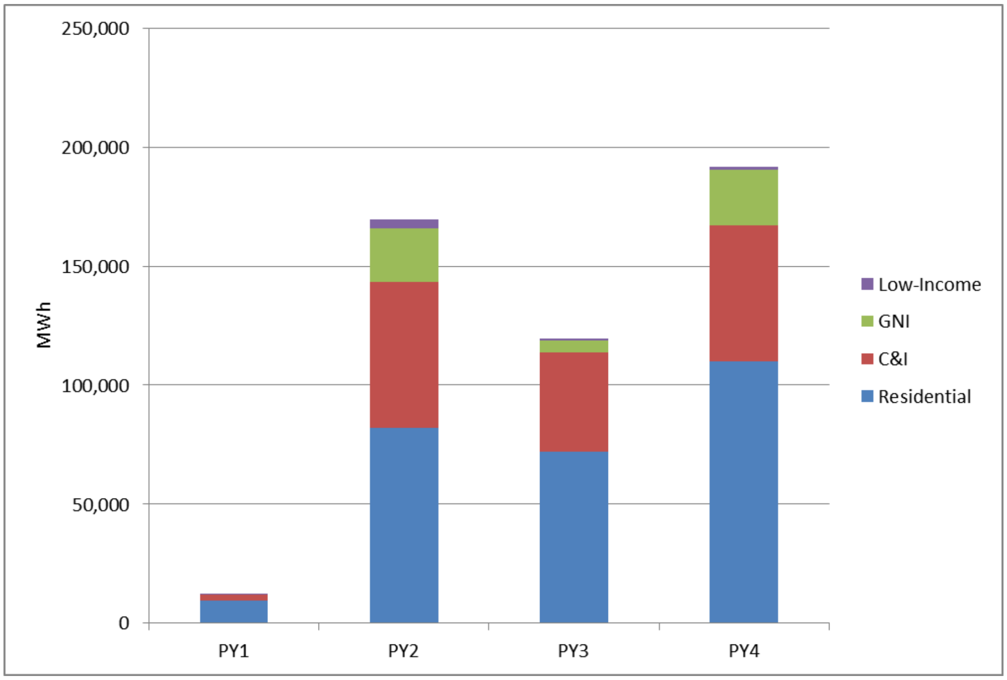
Table 2-13 shows the CPITD TRM Verified Savings for energy consumption for each program in Met-Ed's Phase I EE&C plan.

Table 2-13: Met-Ed Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Home Energy Audits and Outreach	75,998	15%
Appliance Turn-In	34,334	7%
EE HVAC	17,251	3%
EE Products	122,030	25%
New Construction	2,537	0.5%
Behavior Modification and Education	17,565	4%
Multiple Family	3,660	0.7%
WARM Programs	5,728	1%
C&I Small Sector Energy Audit and Tech Assessment	21,537	4%
C&I Large Sector Performance Contracting and Equipment	41,149	8%
C&I Large Sector Industrial Motors and VSDs	1,362	0%
C&I Small Sector Equipment	53,699	15%
C&I Large Sector Equipment	45,261	18%
PJM Demand Response	0	0%
Government/Non-Profit Street Lighting	4,978	1%
Government/Non-Profit	1,191	0.2%
Government/Remaining Non-Profit	44,858	9%
TOTAL	**493,138**	**100%**

Figure A-1 shows the TRM Verified Savings by Phase I program year and sector for Met-Ed.

Figure A-1: Met-Ed Phase I TRM Verified Savings by Program Year and Sector



2.4.6 Penelec

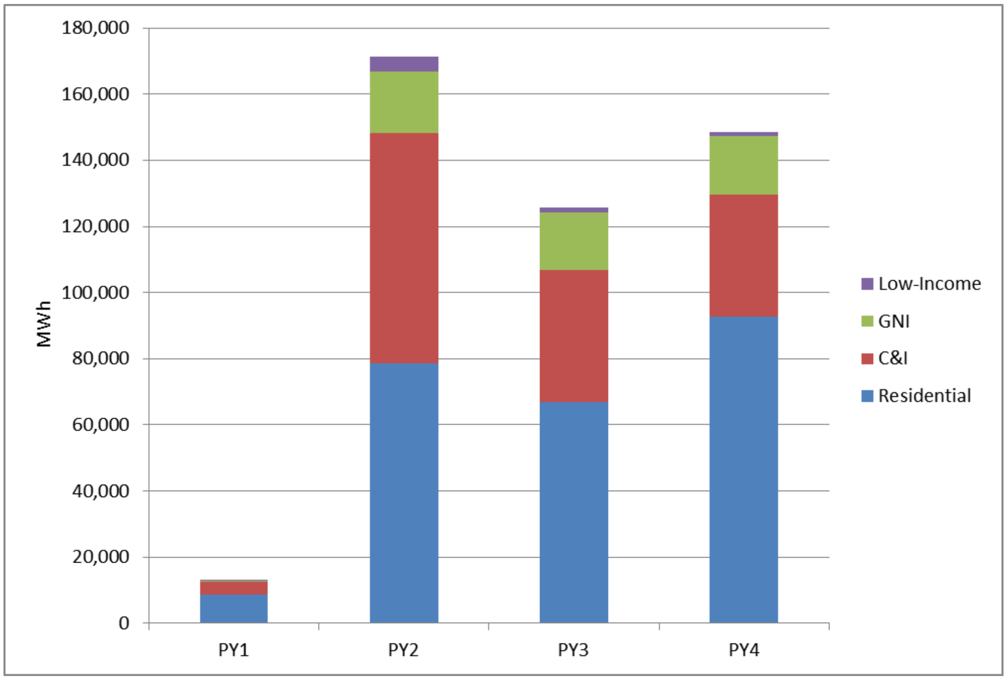
Table 2-14 shows the CPITD TRM Verified Savings for energy consumption for each program in Penelec's Phase I EE&C plan.

Table 2-14: Penelec Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Home Energy Audits and Outreach	68,256	15%
Appliance Turn-In	33,373	7%
EE HVAC	5,771	1%
EE Products	122,244	27%
New Construction	878	0.2%
Behavior Modification and Education	10,965	2%
Multiple Family	5,616	1%
WARM Programs	7,375	2%
C&I Small Sector Equipment	74,136	16%
C&I Large Sector Equipment	76,251	17%
PJM Demand Response	0	0%
Government/Non-Profit Street lighting	2,319	0.5%
Government/Non-Profit	1,418	0.3%
Government/Remaining Non-Profit	50,182	11%
TOTAL	**458,784**	**100%**

Figure A-1 shows the TRM Verified Savings by Phase I program year and sector for Penelec

Figure A-1: Penelec Phase I CPITD TRM Verified Savings – Energy Savings by Program



2.4.7 Penn Power

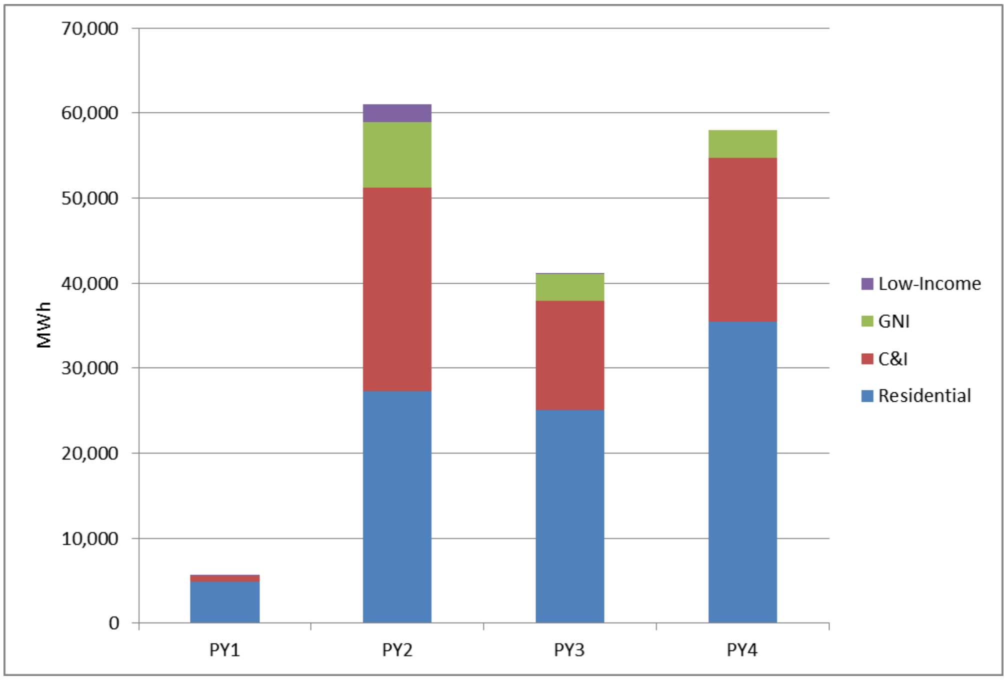
Table 2-15 shows the CPITD TRM Verified Savings for energy consumption for each program in Penn Power's Phase I EE&C plan.

Table 2-15: Penn Power Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Home Energy Audits and Outreach	21,770	13%
Appliance Turn-In	9,272	6%
EE HVAC	3,282	2%
EE Products	53,236	32%
New Construction	1,344	0.8%
Behavior Modification and Education	2,680	2%
Multiple Family	1,072	0.6%
WARM Programs	2,271	1%
C&I Small Sector Equipment	34,214	21%
C&I Large Sector Equipment	22,586	13%
PJM Demand Response	0	0%
Government/Non-Profit Street Lighting	246	0.1%
Government/Non-Profit	37	0.02%
Government/Remaining Non-Profit	13,758	8%
TOTAL	**165,768**	**100%**

Figure A-1 shows the TRM Verified Savings by program year and sector for Penn Power.

Figure A-1: Penn Power Phase I TRM Verified Savings by Program Year and Sector



2.4.8 West Penn Power

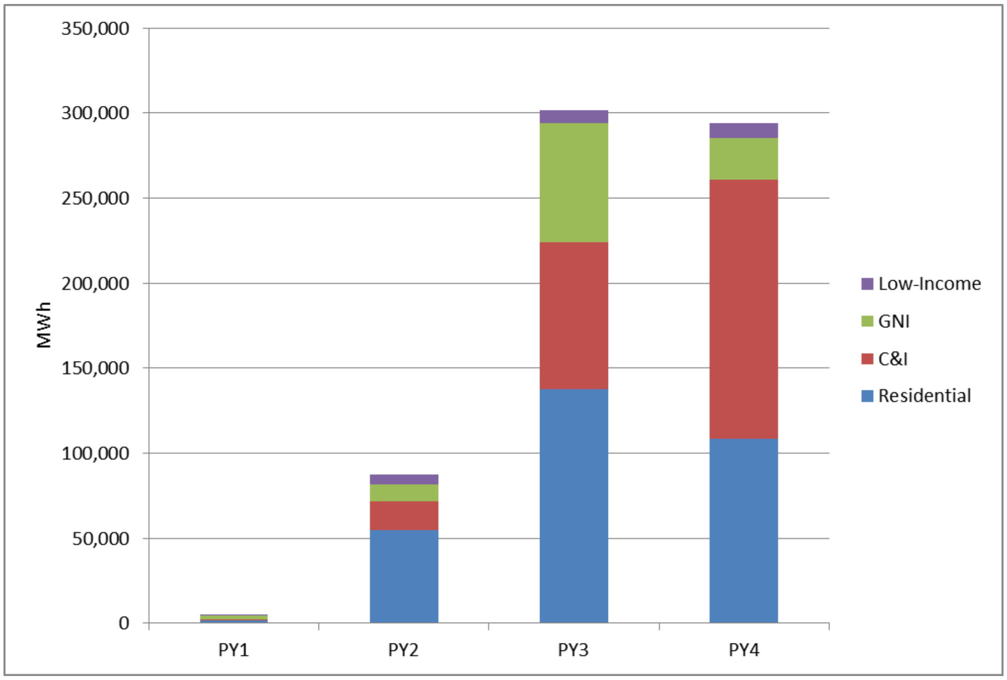
Table 2-16 shows the CPITD TRM Verified Savings for energy consumption for each program in West Penn Power's Phase I EE&C plan.

Table 2-16: West Penn Power Phase I CPITD TRM Verified Savings – Energy Savings by Program

Program:	CPITD TRM Verified Gross MWh/yr Savings	Percent of Portfolio CPITD TRM Verified Gross MWh/yr Savings
Residential Appliance Turn-In	15,255	2%
Residential Energy Efficient Products	114,344	17%
Residential Energy Efficient HVAC Equipment	9,396	1%
Residential Home Performance	150,130	22%
Critical Peak Rebate (CPR)	783	0.1%
Limited Income Energy Efficiency Program (LIEEP)	11,578	2%
Joint Utility Usage Management Program (JUUMP)	6,793	1%
C&I Equipment -- Small	154,530	22%
Time of Use (TOU) with Critical Peak Pricing (CPP)	0	0%
C&I Equipment -- Large	74,245	11%
Conservation Voltage Reduction (CVR)	46,980	7%
Governmental and Institutional	104,055	15%
TOTAL	**688,089**	**100%**

Figure A-1 shows the TRM Verified Savings by program year and sector for West Penn Power.

Figure A-1: West Penn Power Phase I TRM Verified Savings by Program Year and Sector



2.5 Description of EDC EE&C Plans and Programs

Act 129 requires that by July 1, 2009 each EDC with over 100,000 customers must develop and file an EE&C plan with the Commission for approval.[120] On May 7, 2009, the Commission served a Secretarial Letter[121] that provided the EDCs with a template for their EE&C plans. The template included the following chapters:

1. Overview of Plan
2. Energy-Efficiency Portfolio/Program Summary Tables and Charts
3. Program Descriptions
4. Program Management and Implementation Strategies
5. Reporting and Tracking Systems
6. Quality Assurance and Evaluation, Measurement, and Verification Activities
7. Cost Recovery Mechanism
8. Cost-Effectiveness
9. Plan Compliance Information and Other Key Issues

[120] 66 Pa. C.S. §§ 2806.1(b)(1).
[121] *Implementation of Act 129 of 2008 Energy Efficiency and Conservation Plan Template*, at Docket No. M-2008-2069887.

Within each chapter of the template, the Commission included subsections to help guide the EDCs in providing all the necessary information for the Commission to approve each plan. Additionally, the Commission provided template tables to be filled out by each EDC, to allow for consistency in how each EDC's plan was presented to the Commission.

This section of the report provides summaries of the programs implemented as part of each EDC's EE&C plan during Phase I of Act 129. Not all programs in each EDC's portfolio were active during each program year and thus some programs did not report savings in all years of Phase I of Act 129. Specific details regarding each program can be found in Appendix A.

2.5.1 Duquesne

On June 29, 2009, Duquesne filed its initial EE&C plan with the Commission. This plan was partially approved and partially rejected, and Duquesne filed a revised EE&C plan in December 2009. This plan was approved in February 2010 and became Duquesne's first approved EE&C plan for Phase I of Act 129.

As Phase I implementation continued, Duquesne submitted further revisions to its EE&C plan. Table 2-17 shows the initial submission date, compliance filing date, and approval date of Duquesne's initial EE&C plan and the subsequent plan updates that affected its programs and the measures offered by its programs. Minor EE&C plan changes that affected program budgets are not included in the table as they did not affect the program structures or offered measures, but they are listed in Table 1-1.

Table 2-17: Duquesne EE&C Plan Submission and Approval Dates

Initial Submittal	Compliance Filing	Approved by Commission
June 2009	December 2009	February 2010
September 2010	September 2010[122]	January 2011
May 2011[123]	May 2011	October 2011[124]

Note: All EE&C plans are referenced by their compliance filing date except where noted.

[122] No additional iterations were required.
[123] This filing was a petition to modify demand response programs.
[124] Approval of the May 2011 petition included issues resolved in the Joint Petition for Settlement that Duquesne Light Company, the Office of Consumer Advocate, Duquesne Industrial Intervenors, and Comverge, Inc. submitted on August 26, 2011.

Nineteen programs, listed in Table 2-18, reported savings in Duquesne's annual reports during Phase I. A list of the sectors to which each program was available follows the table.

Table 2-18: Duquesne Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Residential EE Program: Rebate Program	•	•	•	•
Residential EE Program: Upstream Lighting		•	•	•
Residential: School Energy Pledge	•	•	•	•
Residential: Appliance Recycling	•	•	•	•
Residential: Low-Income EE	•	•	•	•
Residential: Low-Income EE, Upstream Lighting[125]		•	•	•
Commercial Sector Umbrella	•	•	•	•
Commercial Sector Umbrella: Upstream Lighting[126]				•
Healthcare	•	•	•	•
Office Building – Large	•	•	•	•
Office Building – Small	•	•	•	•
Government/Non-Profit/Institutional	•	•	•	•
Retail Stores	•	•	•	•
Industrial Sector Umbrella	•	•	•	•
Chemical Products		•	•	•
Mixed Industrial	•	•	•	•
Primary Metals	•	•	•	•
Residential Demand Response[1]				•
Large Curtailable Demand Response[1]				•

[1] Demand Savings Only

<u>Residential Sector</u>

- Residential Energy Efficiency Program: Rebate Program
- Residential Energy Efficiency Program: Upstream Lighting
- Residential School Energy Pledge Program
- Residential Appliance Recycling Program
- Watt Choices Direct Load Control Program

[125] While not a separate program, a portion of the Upstream Lighting Program is allocated to the low-income sector based on the portion of Duquesne's households that are low-income.
[126] While not a separate program, a portion of the Upstream Lighting Program is allocated to the commercial sector based on the quantity of bulbs purchased by commercial customers.

Residential Low-Income Sector

- Low Income Energy Efficiency Program
- Low Income Energy Efficiency Program: Upstream Lighting

Commercial/Industrial Small Sector

- Commercial Sector Umbrella
- Commercial Sector Umbrella: Upstream Lighting
- Office Buildings – Small
- Retail Stores
- Industrial Sector Umbrella
- Mixed Industrial

Commercial/Industrial Large Sector

- Commercial Sector Umbrella
- Commercial Sector Umbrella: Upstream Lighting
- Office Buildings – Large
- Healthcare
- Retail Stores
- Industrial Sector Umbrella
- Primary Metals
- Chemicals
- Watt Choices Curtailable Load Program

Government/Non-Profit Sector

- Public Agency/Non-Profit Program

Details on the Duquesne programs listed above can be found in Appendix A, section A.1 of this report.

Some of these programs offered prescriptive measures that had approved savings protocols listed in the TRM. Table 2-19 and Table 2-20 show, respectively, the residential and non-residential 2012 TRM measures offered in Duquesne programs. These tables focus on prescriptive programs and do not include custom programs. The plan date given for each program in the tables is the compliance filing date of the first plan in which the TRM measure was included in the specific program.

Table 2-19: Residential TRM Measures Offered in Duquesne's Programs

TRM Measures (as of 2012 TRM)		Duquesne Residential Program Offerings
2.1	Electric HVAC	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.2	Electric Clothes Dryer with Moisture Sensor	
2.3	Efficient Electric Water Heaters	-Residential Energy Efficiency Program (Sep 2010 Plan)
2.4	Electroluminescent Nightlight	-School Energy Pledge Program (Dec 2009 Plan) -Residential Energy Efficiency Program (Sep 2010 Plan)
2.5	Furnace Whistle	-Residential Energy Efficiency Program (Sep 2010 Plan) -School Energy Pledge Program (Dec 2009 Plan)
2.6	Heat Pump Water Heaters	-Residential Energy Efficiency Program (Sep 2010 Plan)
2.7	Home Audit Conservation Kits	
2.8	LED Nightlight	-Residential Energy Efficiency Program (Sep 2010 Plan) -School Energy Pledge Program (Dec 2009 Plan)
2.9	Low Flow Faucet Aerators	-Residential Energy Efficiency Program (Dec 2009 Plan) -School Energy Pledge Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.10	Low-Flow Showerheads	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.11	Programmable Thermostat	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.12	Room AC (RAC) Retirement	
2.13	Smart Strip Plug Outlets	-Residential Energy Efficiency Program (Sep 2010 Plan)
2.14	Solar Water Heaters	-Residential Energy Efficiency Program (Dec 2009 Plan)
2.15	Electric Water Heater Pipe Insulation	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)

	TRM Measures (as of 2012 TRM)	Duquesne Residential Program Offerings
2.16	Residential Whole House Fans	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.17	Ductless Mini-Split Heat Pumps	
2.18	Fuel Switching: Domestic Hot Water Electric to Gas	
2.19	Fuel Switching: Heat Pump Water Heater to Gas Water Heater	
2.20	Fuel Switching: Electric Heat to Gas Heat	
2.21	Ceiling/Attic and Wall Insulation	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.22	Refrigerator/Freezer Recycling and Replacement	-Residential Energy Efficiency Program (Dec 2009 Plan) -Residential Refrigerator Recycling Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.23	Refrigerator/Freezer Retirement (and Recycling)	-Residential Energy Efficiency Program (Dec 2009 Plan) -Residential Refrigerator Recycling Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.24	Residential New Construction	
2.25	ENERGY STAR Appliances	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.26	ENERGY STAR Lighting	-Residential Energy Efficiency Program (Dec 2009 Plan) -School Energy Pledge Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.27	ENERGY STAR Windows	-Low Income Energy Efficiency Program (Dec 2009 Plan)
2.28	ENERGY STAR Audit	
2.29	Home Performance with ENERGY STAR	
2.30	ENERGY STAR Televisions (Versions 4.1 and 5.1)	
2.31	ENERGY STAR Office Equipment	-Low Income Energy Efficiency Program (Dec 2009 Plan)

TRM Measures (as of 2012 TRM)		Duquesne Residential Program Offerings
2.32	ENERGY STAR LEDs	
2.33	Residential Occupancy Sensors	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.34	Holiday Lights	
2.35	Low-Income Lighting (FirstEnergy)	
2.36	Water Heater Tank Wrap	
2.37	Pool Pump Load Shifting	
2.38	High-Efficiency Two-Speed Pool Pump	-Residential Energy Efficiency Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.39	Variable-Speed Pool Pumps (with Load Shifting Option)	

Table 2-20: Non-Residential TRM Measures Offered in Duquesne's Programs

TRM Measures (as of 2012 TRM)		Duquesne Non-Residential Program Offerings
3.1	Baselines and Code Changes	
3.2	Lighting Equipment Improvements	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.3	Premium Efficiency Motors	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.4	Variable Frequency Drive (VFD) Improvements	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.5	Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.6	HVAC Systems	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.7	Electric Chillers	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.8	Anti-Sweat Heater Controls	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.9	High-Efficiency Refrigeration/Freezer Cases	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.10	High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.11	High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.12	ENERGY STAR Office Equipment	-Commercial Umbrella Program (Dec 2009 Plan)
3.13	Smart Strip Plug Outlets	
3.14	Beverage Machine Controls	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)

TRM Measures (as of 2012 TRM)		Duquesne Non-Residential Program Offerings
3.15	High-Efficiency Ice Machines	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.16	Wall and Ceiling Insulation	
3.17	Strip Curtains for Walk-In Freezers and Coolers	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.18	Geothermal Heat Pumps	
3.19	Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons	
3.20	ENERGY STAR Electric Steam Cooker	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.21	Refrigeration – Night Covers for Display Cases	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.22	Office Equipment – Network Power Management Enabling	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.23	Refrigeration – Auto Closers	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.24	Refrigeration – Door Gaskets for Walk-In Coolers and Freezers	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.25	Refrigeration – Suction Pipes Insulation	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.26	Refrigeration – Evaporator Fan Controllers	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.27	ENERGY STAR Clothes Washer	-Commercial Umbrella Program (Dec 2009 Plan)
3.28	Electric Resistance Water Heaters	-Commercial Umbrella Program (Dec 2009 Plan)
3.29	Heat Pump Water Heaters	

TRM Measures (as of 2012 TRM)		Duquesne Non-Residential Program Offerings
3.30	LED Channel Signage	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.31	Low-Flow Pre-Rinse Sprayers	
3.32	Small C&I HVAC Refrigerant Charge Correction	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.33	Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case	-Commercial Umbrella Program (Dec 2009 Plan) -Industrial Umbrella Program (Dec 2009 Plan)
3.34	ENERGY STAR Room Air Conditioner	-Commercial Umbrella Program (Dec 2009 Plan)

2.5.2 PECO

On July 1, 2009, PECO filed its initial EE&C plan with the Commission. This plan was partially approved and partially rejected, and PECO filed a revised EE&C plan in December 2009. This plan was approved and became PECO's first approved EE&C plan for Phase I of Act 129.

As Phase I implementation continued, PECO submitted further revisions to its EE&C plan. Table 2-21 shows the initial submission date, compliance filing date, and approval date of PECO's first approved EE&C Plan and subsequent EE&C plan updates that affect PECO's programs and the measures offered by its programs. Minor EE&C plan changes that affected program budgets are not included in this table as they did not affect the program structures or offered measures, but they are included in Table 2-21.

Table 2-21: PECO EE&C Plan Submission and Approval Dates

Initial Submittal	Compliance Filing	Approved by Commission
July 2009	December 2009	February 2010
September 2010	September 2010[127]	January 2011
July 2011	August 2011[128]	August 2011[129]

Note: All EE&C plans are referenced by their compliance filing date except where noted.

In the August 2011 plan update, measures were removed from programs if participation for the measure or program had exceeded targets or if measures were underperforming.

The August 2011 plan update also established an application waitlist, which allowed PECO to manage customer expectations regarding incentive availability under the programs. Waitlists were established for the following programs:

- Smart Equipment Incentives – C&I
- Smart Construction Incentives
- Smart Equipment Incentives – Government and Non-Profit

Additionally, the Whole Home Performance Program and Residential New Construction Program in PECO's original EE&C plan did not report any savings during Phase I of Act 129.

Thirteen programs, listed in Table 2-22, reported savings in PECO's annual reports during Phase I. A list of the sectors to which each program was available follows the table.

[127] No additional iterations were required.

[128] This EE&C plan update was originally submitted in July 2011 and approved with modifications via Secretarial Letter through the expedited approval process explained in the Commission's June 9, 2011 Final Order at Docket No. M-2008-206988. The modified and accepted EE&C plan dated August 2011 was filed in response to the Secretarial Letter

[129] The August 2011 EE&C plan was approved via Secretarial Letter through the expedited approval process explained in the Commission's June 9, 2011 Final Order at Docket No. M-2008-206988.

Table 2-22: PECO Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Low Income Energy Efficiency Program	•	•	•	•
Smart Lighting Discounts Program	•	•	•	•
Smart Appliance Recycling Program	•	•	•	•
Smart Home Rebates Program	•	•	•	•
Smart Equipment Incentive – C&I	•	•	•	•
Smart Equipment Incentives – Government/Non-Profit	•	•	•	•
Conservation Voltage Reduction	•	•		
Smart Construction Incentives		•	•	•
Residential Smart AC Saver[1]				•
Commercial Smart AC Saver[1]				•
Permanent Load Reduction				•
Demand Response Aggregators[1]				•
Distributed Energy Resources[1]				•

[1] Demand savings only.

Residential Sector

- Smart Lighting Discounts Program
- Smart Home Rebates Program
- Smart Appliance Recycling Program
- Residential Smart AC Saver
- Conservation Voltage Reduction

Residential Low-Income Sector

- Low-Income Energy Efficiency Program
- Conservation Voltage Reduction

Commercial/Industrial Small Sector

- Smart Equipment Incentives – C&I
- Smart Construction Incentives
- Commercial Smart AC Saver
- Conservation Voltage Reduction
- Demand Response Aggregator Contracts
- Permanent Load Reduction
- Distributed Energy Resources

<u>Commercial/Industrial Large Sector</u>

- Smart Equipment Incentives – C&I
- Smart Construction Incentives
- Conservation Voltage Reduction
- Demand Response Aggregator Contracts
- Permanent Load Reduction
- Distributed Resources

<u>Government/Non-Profit Sector</u>

- Smart Equipment Incentives – Government/Non-profit
- Conservation Voltage Reduction
- Demand Response Aggregator Contracts
- Permanent Load Reduction
- Distributed Energy Resources

Details on the PECO programs listed above can be found in Appendix A, section A.2 of this report.

Some of these programs offered prescriptive measures that had approved savings protocols listed in the TRM. Table 2-23 and Table 2-24 show, respectively, the residential and non-residential 2012 TRM measures offered in PECO programs. These tables focus on prescriptive programs and do not include custom programs. The EE&C plan date given for each program in the tables is the compliance filing date of the first plan in which the TRM measure was included in the specific program.

Table 2-23: Residential TRM Measures Offered in PECO's Programs

TRM Measures (as of 2012 TRM)		PECO Residential Program Offerings
2.1	Electric HVAC	-Smart Home Rebates Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.2	Electric Clothes Dryer with Moisture Sensor	
2.3	Efficient Electric Water Heaters	-Smart Home Rebates Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.4	Electroluminescent Nightlight	-Smart Home Rebates Program (Sep 2010 Plan)[130]
2.5	Furnace Whistle	-Smart Home Rebates Program (Sep 2010 Plan)[131]
2.6	Heat Pump Water Heaters	-Smart Home Rebates Program (Dec 2009 Plan)
2.7	Home Audit Conservation Kits	
2.8	LED Nightlight	-Smart Home Rebates Program (Sep 2010 Plan)[132]
2.9	Low-Flow Faucet Aerators	-Smart Home Rebates Program (Sep 2010 Plan)[133] -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.10	Low-Flow Showerheads	-Smart Home Rebates Program (Sep 2010 Plan)[134] -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.11	Programmable Thermostat	-Smart Home Rebates Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.12	Room AC (RAC) Retirement	-Smart Appliance Recycling Program (Dec 2009 Plan)[135]

[130] Removed from program in August 2011 update.
[131] Removed from program in August 2011 update.
[132] Removed from program in August 2011 update.
[133] Removed from program in August 2011 update.
[134] Removed from program in August 2011 update.
[135] Removed from program in August 2011 update.

	TRM Measures (as of 2012 TRM)	PECO Residential Program Offerings
		-Low Income Energy Efficiency Program (Dec 2009 Plan)
2.13	Smart Strip Plug Outlets	-Smart Home Rebates Program (Sep 2010 Plan)[136]
2.14	Solar Water Heaters	
2.15	Electric Water Heater Pipe Insulation	-Low Income Energy Efficiency Program (Dec 2009 Plan)
2.16	Residential Whole House Fans	-Smart Home Rebates Program (Dec 2009 Plan)[137]
2.17	Ductless Mini-Split Heat Pumps	
2.18	Fuel Switching: Domestic Hot Water Electric to Gas	-Smart Home Rebates Program (Dec 2009 Plan)
2.19	Fuel Switching: Heat Pump Water Heater to Gas Water Heater	-Smart Home Rebates Program (Dec 2009 Plan)
2.20	Fuel Switching: Electric Heat to Gas Heat	-Smart Home Rebates Program (Dec 2009 Plan)
2.21	Ceiling/Attic and Wall Insulation	-Smart Home Rebates Program (Dec 2009 Plan)[138] -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.22	Refrigerator/Freezer Recycling and Replacement	-Smart Appliance Recycling Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.23	Refrigerator/Freezer Retirement (and Recycling)	-Smart Appliance Recycling Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.24	Residential New Construction	-Residential New Construction Program (Dec 2009 Plan)[139]
2.25	ENERGY STAR Appliances	-Smart Home Rebates Program (Dec 2009 Plan) -Low Income Energy Efficiency Program (Dec 2009 Plan)
2.26	ENERGY STAR Lighting	-Smart Lighting Discounts Program (Dec 2009 Plan) -Low-Income Energy Efficiency Program (Dec 2009 Plan) -Smart Home Rebates Program (Dec 2009 Plan)[140]

[136] Removed from program in August 2011 update.
[137] Removed from program in August 2011 update.
[138] Removed from program in August 2011 update.
[139] This program never reported any savings.

	TRM Measures (as of 2012 TRM)	PECO Residential Program Offerings
2.27	ENERGY STAR Windows	-Smart Home Rebates Program (Dec 2009 Plan)[141]
2.28	ENERGY STAR Audit	
2.29	Home Performance with ENERGY STAR	
2.30	ENERGY STAR Televisions (Versions 4.1 and 5.1)	-Smart Home Rebates Program (Sep 2010 Plan)[142]
2.31	ENERGY STAR Office Equipment	-Smart Home Rebates Program (Sep 2010 Plan)[143]
2.32	ENERGY STAR LEDs	-Smart Home Rebates Program (Dec 2009 Plan)
2.33	Residential Occupancy Sensors	
2.34	Holiday Lights	
2.35	Low-Income Lighting (FirstEnergy)	
2.36	Water Heater Tank Wrap	-Low Income Energy Efficiency Program (Dec 2009 Plan)
2.37	Pool Pump Load Shifting	
2.38	High-Efficiency Two-Speed Pool Pump	
2.39	Variable-Speed Pool Pumps (with Load Shifting Option)	

[140] Removed from program in August 2011 update.
[141] Removed from program in August 2011update.
[142] Removed from program in August 2011 update.
[143] Removed from program in August 2011 update.

Table 2-24: Non-Residential TRM Measures Offered in PECO's Programs

TRM Measures (as of 2012 TRM)		PECO Non-Residential Program Offerings
3.1	Baselines and Code Changes	
3.2	Lighting Equipment Improvements	-Smart Equipment Incentives - C&I (Dec 2009 Plan) -Smart Equipment Incentives - Government/Non-profit (Dec 2009 Plan)
3.3	Premium Efficiency Motors	-Smart Equipment Incentives - C&I (Dec 2009 Plan) -Smart Equipment Incentives - Government/Non-profit (Dec 2009 Plan)
3.4	Variable Frequency Drive (VFD) Improvements	-Smart Equipment Incentives - C&I (Dec 2009 Plan)
3.5	Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors	
3.6	HVAC Systems	-Smart Equipment Incentives - C&I (Dec 2009 Plan) -Smart Equipment Incentives - Government/Non-profit (Dec 2009 Plan)
3.7	Electric Chillers	
3.8	Anti-Sweat Heater Controls	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.9	High-Efficiency Refrigeration/Freezer Cases	
3.10	High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.11	High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.12	ENERGY STAR Office Equipment	

TRM Measures (as of 2012 TRM)		PECO Non-Residential Program Offerings
3.13	Smart Strip Plug Outlets	
3.14	Beverage Machine Controls	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.15	High-Efficiency Ice Machines	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.16	Wall and Ceiling Insulation	
3.17	Strip Curtains for Walk-In Freezers and Coolers	-Smart Equipment Incentives - C&I (Sep 2010 Plan)[144] -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)[145]
3.18	Geothermal Heat Pumps	-Smart Equipment Incentives - C&I (Dec 2009 Plan) -Smart Equipment Incentives - Government/Non-profit (Dec 2009 Plan)
3.19	Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons	
3.20	ENERGY STAR Electric Steam Cooker	
3.21	Refrigeration – Night Covers for Display Cases	-Smart Equipment Incentives - C&I (Sep 2010 Plan)[146] -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)[147]
3.22	Office Equipment – Network Power Management Enabling	

[144] Removed from program in August 2011 update.
[145] Removed from program in August 2011 update.
[146] Removed from program in August 2011 update.
[147] Removed from program in August 2011 update.

	TRM Measures (as of 2012 TRM)	PECO Non-Residential Program Offerings
3.23	Refrigeration – Auto Closers	-Smart Equipment Incentives - C&I (Sep 2010 Plan)[148] -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)[149]
3.24	Refrigeration – Door Gaskets for Walk-In Coolers and Freezers	
3.25	Refrigeration – Suction Pipes Insulation	
3.26	Refrigeration – Evaporator Fan Controllers	-Smart Equipment Incentives - C&I (Sep 2010 Plan) -Smart Equipment Incentives - Government/Non-profit (Sep 2010 Plan)
3.27	ENERGY STAR Clothes Washer	
3.28	Electric Resistance Water Heaters	
3.29	Heat Pump Water Heaters	
3.30	LED Channel Signage	
3.31	Low-Flow Pre-Rinse Sprayers	
3.32	Small C&I HVAC Refrigerant Charge Correction	
3.33	Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case	
3.34	ENERGY STAR Room Air Conditioner	-Smart Equipment Incentives - C&I (Dec 2009 Plan)

[148] Removed from program in August 2011 update.
[149] Removed from program in August 2011 update.

2.5.3 PPL

On July 1, 2009, PPL filed its initial EE&C plan with the Commission. This plan was partially approved and partially rejected, and PPL filed a revised EE&C plan in December 2009. This plan was approved in February 2010 and became PPL's first approved EE&C plan for Phase I of Act 129.

As Phase I implementation continued, PPL submitted further revisions to its EE&C plan. Table 2-25 shows the initial submission date, compliance date, and approval date of PPL's initial EE&C plan and the subsequent plan updates that affected its programs and the measures offered by its programs. Table 1-1 in Section 1.1.4 lists all of the EDCs' EE&C plan-related filings, including minor changes not affecting program structure, and the respective Commission Orders for each filing.

Table 2-25: PPL EE&C Plan Submission and Approval Dates

Initial Submittal	Compliance Filing	Approved by Commission
July 2009	December 2009	February 2010
September 2010	February 2011	May 2011
February 2012	May 2012	May 2012

Note: All EE&C plans are referenced by their compliance filing date except where noted.

Of the programs in PPL's initial EE&C plan, the Residential ENERGY STAR Homes and Time of Use Rates programs were discontinued in the May 2012 plan update and never reported any savings during Phase I of Act 129.

Twelve programs, listed in Table 2-26, reported savings in PPL's annual reports during Phase I. A list of the sectors to which each program was available follows the table. PPL's program structure was unique in that some programs served multiple sectors.

Table 2-26: PPL Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Appliance Recycling	•	•	•	•
Residential Lighting [1]	•	•	•	•
Custom Incentive	•	•	•	•
Energy Efficiency Behavior and Education		•	•	•
Efficient Equipment Incentive	•	•	•	•
E-Power Wise		•	•	•
WRAP	•	•	•	•
Renewable Energy	•	•	•	•
HVAC Tune-Up Program		•	•	•
Home Energy Assessment and Weatherization Program		•	•	•
Load Curtailment[2]				•
Direct Load Control[2]				•

[1] Called the Compact Fluorescent Lighting Campaign in PY1 and PY2.

[2] Reported demand savings only.

Residential Sector

- Appliance Recycling Program
- Residential Lighting Campaign
- Energy Efficiency Behavior and Education Program
- Efficient Equipment Incentive Program
- Renewable Energy Program
- Direct Load Control Program
- Home Energy Assessment and Weatherization Program
- Custom Incentive Program

Residential Low-Income Sector

All residential programs plus the following income-qualified programs:

- E-Power Wise
- Low-Income WRAP

Commercial/Industrial Small Sector

- Custom Incentive Program
- Efficient Equipment Incentive Program
- HVAC Tune-up Program
- Residential Lighting Program
- Direct Load Control Program
- Appliance Recycling Program
- Renewable Energy Program
- Load Curtailment

Commercial/Industrial Large Sector

- Custom Incentive Program
- Efficient Equipment Incentive Program
- HVAC Tune-up Program
- Appliance Recycling Program
- Load Curtailment Program

Government/Non-Profit Sector

- Custom Incentive Program
- Direct Load Control Program
- Efficient Equipment Incentive Program
- HVAC Tune-up Program
- Renewable Energy Program
- Appliance Recycling
- Load Curtailment Program
- Residential Lighting Program

Details on the PPL programs listed above can be found in Appendix A, section A.3 of this report.

Some of these programs offered prescriptive measures that had approved savings protocols listed in the TRM. Table 2-27 and Table 2-28 show, respectively, the residential and non-residential 2012 TRM measures offered by PPL programs. These tables focus on prescriptive programs and do not include custom programs. The EE&C plan date given for each program in the tables is the compliance filing date of the first plan in which the TRM measure was included in the specific program. Some measures were not offered in all program years. If PPL did not offer a rebate for a TRM measure through its prescriptive rebate programs, customers could request a rebate through the Custom Incentive Program.

Table 2-27: Residential TRM Measures Offered in PPL's Programs

TRM Measures (as of 2012 TRM)		PPL Residential Program Offerings
2.1	Electric HVAC	-Efficient Equipment Program (Dec 2009 Plan) -Energy Assessment & Weatherization Program (Dec 2009 Plan) -Renewable Energy Program (Dec 2009 Plan)[150] -Low-income WRAP (Dec 2009 Plan)
2.2	Electric Clothes Dryer with Moisture Sensor	
2.3	Efficient Electric Water Heaters	
2.4	Electroluminescent Nightlight	-E-Power Wise (Dec 2009 Plan)
2.5	Furnace Whistle	-Low-income WRAP (Dec 2009 Plan)
2.6	Heat Pump Water Heaters	-Efficient Equipment Program (Dec 2009 Plan)
2.7	Home Audit Conservation Kits	-E-Power Wise (Dec 2009 Plan) -Energy Assessment & Weatherization Program (Dec 2009 Plan)
2.8	LED Nightlight	
2.9	Low-Flow Faucet Aerators	-Energy Assessment & Weatherization Program (Dec 2009 Plan) -E-Power Wise Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.10	Low-Flow Showerheads	-E-Power Wise Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.11	Programmable Thermostat	-Efficient Equipment Program (Dec 2009 Plan)[151]
2.12	Room AC (RAC) Retirement	-Appliance Recycling Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)

[150] Program fully subscribed and therefore measure not offered as of June 2012 plan.
[151] Measure discontinued in June 2012 plan.

	TRM Measures (as of 2012 TRM)	PPL Residential Program Offerings
2.13	Smart Strip Plug Outlets	-Energy Assessment & Weatherization Program (Dec 2009 Plan)
2.14	Solar Water Heaters	-Efficient Equipment Incentive Program (May 2012 Plan)[152]
2.15	Electric Water Heater Pipe Insulation	-Energy Assessment & Weatherization Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.16	Residential Whole House Fans	
2.17	Ductless Mini-Split Heat Pumps	-Efficient Equipment Incentive Program (May 2012 Plan)
2.18	Fuel Switching: Domestic Hot Water Electric to Gas	
2.19	Fuel Switching: Heat Pump Water Heater to Gas Water Heater	
2.20	Fuel Switching: Electric Heat to Gas Heat	-Efficient Equipment Program (Dec 2009 Plan)
2.21	Ceiling/Attic and Wall Insulation	-Energy Assessment & Weatherization Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.22	Refrigerator/Freezer Recycling and Replacement	-Appliance Recycling Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.23	Refrigerator/Freezer Retirement (and Recycling)	-Appliance Recycling Program (Dec 2009 Plan)
2.24	Residential New Construction	-ENERGY STAR New Homes Program (Dec 2009 Plan)[153]
2.25	ENERGY STAR Appliances	-Efficient Equipment Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)

[152] Added as a pilot program in the June 2012 plan.
[153] New Homes Program was never implemented, but residential new construction measures were available through other programs.

TRM Measures (as of 2012 TRM)		PPL Residential Program Offerings
2.26	ENERGY STAR Lighting	-Efficient Equipment Program (Dec 2009 Plan) -Energy Assessment & Weatherization Program (Dec 2009 Plan) -Residential Lighting Program[154] (Dec 2009 Plan) -E-Power Wise Program (Dec 2009 Plan) -Low-income WRAP (Dec 2009 Plan)
2.27	ENERGY STAR Windows	
2.28	ENERGY STAR Audit	-Energy Assessment & Weatherization Program (Dec 2009 Plan)
2.29	Home Performance with ENERGY STAR	
2.30	ENERGY STAR Televisions (Versions 4.1 and 5.1)	
2.31	ENERGY STAR Office Equipment	-Efficient Equipment Program (Dec 2009 Plan)
2.32	ENERGY STAR LEDs	-Residential Lighting Program (May 2012)
2.33	Residential Occupancy Sensors	
2.34	Holiday Lights	
2.35	Low-Income Lighting (FirstEnergy)	
2.36	Water Heater Tank Wrap	-Low-income WRAP (Dec 2009 Plan)
2.37	Pool Pump Load Shifting	
2.38	High-Efficiency Two-Speed Pool Pump	
2.39	Variable-Speed Pool Pumps (with Load Shifting Option)	

[154] Called the Compact Fluorescent Lighting Campaign in PY1 and PY2.

Table 2-28: Non-Residential TRM Measures Offered in PPL's Programs

	TRM Measures (as of 2012 TRM)	PPL Non-Residential Program Offerings
3.1	Baselines and Code Changes	
3.2	Lighting Equipment Improvements	-Efficient Equipment Incentive Program (Dec 2009 Plan) -Compact Fluorescent Lighting Campaign (Dec 2009 Plan)[155] -Custom Incentive Program (Dec 2009 Plan)[156]
3.3	Premium Efficiency Motors	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.4	Variable Frequency Drive (VFD) Improvements	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.5	Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.6	HVAC Systems	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.7	Electric Chillers	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.8	Anti-Sweat Heater Controls	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.9	High-Efficiency Refrigeration/Freezer Cases	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.10	High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.11	High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.12	ENERGY STAR Office Equipment	-Efficient Equipment Incentive Program (Dec 2009 Plan)[157]

[155] This program changed its name to the Residential Lighting Program in the June 2012 EE&C plan. C&I customers are eligible to purchase discounted lighting in the Residential Lighting Program.
[156] LED lighting.
[157] Removed from program offerings in June 2012 plan.

TRM Measures (as of 2012 TRM)		PPL Non-Residential Program Offerings
3.13	Smart Strip Plug Outlets	
3.14	Beverage Machine Controls	
3.15	High-Efficiency Ice Machines	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.16	Wall and Ceiling Insulation	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.17	Strip Curtains for Walk-In Freezers and Coolers	-Efficient Equipment Incentive Program (Dec 2009 Plan)[158]
3.18	Geothermal Heat Pumps	-Renewable Energy Program (Dec 2009 Plan)
3.19	Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons	-Efficient Equipment Incentive Program (May 2012 Plan)
3.20	ENERGY STAR Electric Steam Cooker	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.21	Refrigeration – Night Covers for Display Cases	-Efficient Equipment Incentive Program (Dec 2009 Plan)[159]
3.22	Office Equipment – Network Power Management Enabling	
3.23	Refrigeration – Auto Closers	
3.24	Refrigeration – Door Gaskets for Walk-In Coolers and Freezers	
3.25	Refrigeration – Suction Pipes Insulation	
3.26	Refrigeration – Evaporator Fan Controllers	
3.27	ENERGY STAR Clothes Washer	-Efficient Equipment Incentive Program (Dec 2009 Plan)
3.28	Electric Resistance Water Heaters	

[158] Moved from Efficient Equipment Program to Custom Incentive Program in February 2011 plan.
[159] Moved from Efficient Equipment Program to Custom Incentive Program in February 2011 plan.

TRM Measures (as of 2012 TRM)		PPL Non-Residential Program Offerings
3.29	Heat Pump Water Heaters	-Efficient Equipment Incentive Program (May 2012 Plan)
3.30	LED Channel Signage	
3.31	Low-Flow Pre-Rinse Sprayers	
3.32	Small C&I HVAC Refrigerant Charge Correction	-HVAC Tune-Up Program (Dec 2009 Plan)
3.33	Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case	
3.34	ENERGY STAR Room Air Conditioner	-Efficient Equipment Incentive Program (May 2012 Plan)

2.5.4 FirstEnergy Legacy Companies

On July 1, 2009, Met-Ed, Penelec, and Penn Power (FirstEnergy Legacy Companies) jointly filed a petition for approval of their EE&C plans. Each company planned on implementing the same set of programs during Phase I of Act 129 and therefore asked for joint approval. After two revisions and iterations with the Commission, the companies submitted an EE&C plan in early February 2010 that was approved later in the same month, becoming the FirstEnergy Legacy Companies' first approved EE&C plan.

As Phase I implementation continued, the FirstEnergy Legacy Companies submitted further revisions to their EE&C plans. Table 2-29 shows the initial submission date, compliance filing date, and approval date of the first approved EE&C plan and the subsequent plan updates that affected its programs and the measures offered by its programs. Minor EE&C plan changes that affected program budgets are not included in the table as they did not affect the program structures or offered measures. Table 1-1 in Section 1.1 lists all of the EDCs' EE&C plan-related filings, including minor changes not affecting program structure, and the respective Commission Orders for each filing.

Table 2-29: FirstEnergy Legacy Company EE&C Plan Submission and Approval Dates

Initial Submittal	Compliance Filing	Approved by Commission
July 2009	February 2010	February 2010
September 2010	February 2011	March 2011 and January 2012[160]

Note: All EE&C plans are referenced by their compliance filing date except where noted.

In their February 2011 EE&C plan update, the FirstEnergy Legacy companies made the following modifications:

- Consolidated the Home Energy Audit Program and Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program.
- Added the Behavioral Modification and Education Program.
- Consolidated the Industrial Motors and Variable Speed Drives Program with the C&I Equipment Program.
- Consolidated the Energy Audit and Technical Assessment Program with the C&I Equipment Program.

These changes are further described below for each program.

Twenty programs, listed in Table 2-30, Table 2-31, and Table 2-32, reported savings in the FirstEnergy Legacy Companies' annual reports during Phase I. A list of the sectors to which each program was available follows the tables.

[160] Minor EE&C plan changes, as defined in the Commission's June 9, 2011 Final Order at Docket No. M-2008-206988, were approved in March 2011 via Secretarial Letter, and non-minor changes were approved by the Commission in January 2012.

Met-Ed

Table 2-30: Met-Ed Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	•
C&I Small Sector Energy Audit and Technical Assessment		•		
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs		•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•	•	•
Government/Non-Profit		•	•	•
Government/Remaining Non-Profit	•	•	•	•

Penelec

Table 2-31: Penelec Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	•
C&I Small Sector Energy Audit and Technical		•		

Assessment				
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs	•	•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•	•	•
Government/Non-Profit	•	•	•	•
Government/Remaining Non-Profit	•	•	•	•

<u>Penn Power</u>

Table 2-32: Penn Power Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Demand Reduction				•
Home Energy Audits	•	•		
Home Energy Audits and Outreach			•	•
Appliance Turn-In	•	•	•	•
EE HVAC		•	•	•
EE Products	•	•	•	•
New Construction		•	•	•
Behavioral Modification and Education				•
Whole Building		•		
Multiple Family		•		•
WARM Programs	•	•	•	
C&I Small Sector Energy Audit and Technical Assessment		•		
C&I Small Sector Equipment			•	•
C&I Large Sector Performance Contracting and Equipment	•	•		
C& Large Sector Industrial Motors and VSDs		•		
C&I Large Sector Equipment			•	•
PJM Demand Response				•
Government/Non-Profit Street lighting		•		
Government/Non-Profit		•		
Government/Remaining Non-Profit		•	•	•

<u>Residential Sector</u>

- Demand Reduction
- Home Energy Audits
- Appliance Turn-In

- EE HVAC
- EE Products
- New Construction
- Whole Building Comprehensive
- Multiple Family
- Home Energy Audits and Outreach
- Behavioral Modification and Education

Residential Low-Income Sector

- WARM Programs
- Home Energy Audits
- Appliance Turn-In
- EE Products

Commercial/Industrial Small Sector

- Energy Audit and Technical Assessment Program
- Small Sector Equipment
- Multifamily Building Program

Commercial/Industrial Large Sector

- Large Sector Performance Contracting and Equipment
- Industrial Motors and VSD
- Large Sector Equipment
- PJM Demand Response

Government/Non-Profit Sector

- Government/Non-Profit Street lighting
- Government/Non-Profit
- Government/Remaining Non-Profit
- Multifamily Building Program

Details on the FirstEnergy Legacy programs listed above can be found in Appendix A, section A.4 of this report.

Some of these programs offered prescriptive measures that had approved savings protocols listed in the TRM. Table 2-33 and Table 2-34 show, respectively, the residential and non-residential 2012 TRM measures offered by the FirstEnergy Legacy companies. These tables focus on prescriptive programs and do not include custom programs. The EE&C plan date given for each program in the tables is the compliance filing date of the first plan in which the TRM measure was included in the specific program.

Table 2-33: Residential TRM Measures Offered in FirstEnergy Legacy Companies' Programs

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Residential Program Offerings
2.1	Electric HVAC	-Residential Energy Efficient HVAC Equipment Program (Feb 2010 Plan) -Residential Whole Building Comprehensive Program (Feb 2010 Plan)[161] -WARM Programs (Feb 2010 Plan)
2.2	Electric Clothes Dryer with Moisture Sensor	
2.3	Efficient Electric Water Heaters	-Residential Energy Efficient Products Program (Feb 2010 Plan) -WARM Programs (Feb 2010 Plan)
2.4	Electroluminescent Nightlight	
2.5	Furnace Whistle	-WARM Programs (Feb 2010 Plan)
2.6	Heat Pump Water Heaters	-Residential Energy Efficient Products Program (Feb 2010 Plan)
2.7	Home Audit Conservation Kits	-WARM Programs (Feb 2010 Plan)
2.8	LED Nightlight	-Home Energy Audits Program (Feb 2010 Plan)[162] -Home Energy Audits and Outreach Program (Feb 2011 Plan) -Low Income Sector Programs (Feb 2010 Plan)

[161] This program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[162] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Residential Program Offerings
2.9	Low-Flow Faucet Aerators	-Home Energy Audits Program (Feb 2010 Plan)[163] -Residential Multifamily Building Program (Feb 2010 Plan) -Residential Whole Building Comprehensive Program (Feb 2010 Plan)[164] -Home Energy Audits and Outreach Program (Feb 2011 Plan) -WARM Programs (Feb 2010 Plan)
2.10	Low-Flow Showerheads	-Residential Whole Building Comprehensive Program (Feb 2010 Plan)[165] -Home Energy Audits and Outreach Program (Feb 2011 Plan) -WARM Programs (Feb 2010 Plan)
2.11	Programmable Thermostat	-Home Energy Audits Program (Feb 2010 Plan)[166] -Residential Energy Efficient Products Program (Feb 2010 Plan)
2.12	Room AC (RAC) Retirement	-Appliance Turn-In Program (Feb 2010 Plan)
2.13	Smart Strip Plug Outlets	-Residential Energy Efficient Products Program (Feb 2010 Plan) -WARM Programs (Feb 2010 Plan)
2.14	Solar Water Heaters	-Residential Energy Efficient Products Program (Feb 2010 Plan)

[163] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[164] This program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[165] This program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[166] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Residential Program Offerings
2.15	Electric Water Heater Pipe Insulation	-Residential Whole Building Comprehensive Program (Feb 2010 Plan)[167] -Home Energy Audits and Outreach Program (Feb 2011 Plan) -WARM Programs (Feb 2010 Plan)
2.16	Residential Whole House Fans	
2.17	Ductless Mini-Split Heat Pumps	-Residential Energy Efficient HVAC Equipment Program (Feb 2010 Plan)
2.18	Fuel Switching: Domestic Hot Water Electric to Gas	
2.19	Fuel Switching: Heat Pump Water Heater to Gas Water Heater	
2.20	Fuel Switching: Electric Heat to Gas Heat	
2.21	Ceiling/Attic and Wall Insulation	-Residential Whole Building Comprehensive Program (Feb 2010 Plan)[168] -Home Energy Audits and Outreach Program (Feb 2011 Plan) -WARM Programs (Feb 2010 Plan)
2.22	Refrigerator/Freezer Recycling and Replacement	-Appliance Turn-In Program (Feb 2010 Plan) -WARM Programs (Feb 2010 Plan)
2.23	Refrigerator/Freezer Retirement (and Recycling)	-Appliance Turn-In Program (Feb 2010 Plan)
2.24	Residential New Construction	-Residential New Construction Program (Feb 2010 Plan)
2.25	ENERGY STAR Appliances	-Residential Energy Efficient Products Program (Feb 2010 Plan)

[167] This program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[168] This program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Residential Program Offerings
2.26	ENERGY STAR Lighting	-Home Energy Audits Program (Feb 2010 Plan)[169] -Residential Multifamily Building Program (Feb 2010 Plan) -Residential Energy Efficient Products Program (Feb 2010 Plan) -Low Income Sector Programs (Feb 2010 Plan) -Home Energy Audits and Outreach Program (Feb 2011 Plan)
2.27	ENERGY STAR Windows	-Residential Whole Building Comprehensive Program (Feb 2010 Plan)[170] -Home Energy Audits and Outreach Program (Feb 2011 Plan)
2.28	ENERGY STAR Audit	-Home Energy Audits Program (Feb 2010 Plan)[171] -Residential Whole Building Comprehensive Program (Feb 2010 Plan)[172] -Home Energy Audits and Outreach Program (Feb 2011 Plan)

[169] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[170] This program was consolidated with the Home Energy Audits Program in the February 2011 EE&C Plan update to create the Home Energy Audits and Outreach Program.
[171] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[172] This program was consolidated with the Home Energy Audits Program in the February 2011 EE&C Plan update to create the Home Energy Audits and Outreach Program.

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Residential Program Offerings
2.29	Home Performance with ENERGY STAR	-Home Energy Audits Program (Feb 2010 Plan)[173] -Residential Whole Building Comprehensive Program (Feb 2010 Plan)[174] -Home Energy Audits and Outreach Program (Feb 2011 Plan)
2.30	ENERGY STAR Televisions (Versions 4.1 and 5.1)	
2.31	ENERGY STAR Office Equipment	
2.32	ENERGY STAR LEDs	
2.33	Residential Occupancy Sensors	
2.34	Holiday Lights	-Residential Energy Efficient Products Program (Feb 2010 Plan)
2.35	Low-Income Lighting (FirstEnergy)	-WARM Programs (Feb 2010 Plan)
2.36	Water Heater Tank Wrap	-WARM Programs (Feb 2010 Plan)
2.37	Pool Pump Load Shifting	
2.38	High-Efficiency Two-Speed Pool Pump	
2.39	Variable-Speed Pool Pumps (with Load Shifting Option)	-Residential Energy Efficient Products Program (Feb 2011 Plan)

[173] This program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program in the February 2011 EE&C plan update.
[174] This program was consolidated with the Home Energy Audits Program in the February 2011 EE&C Plan update to create the Home Energy Audits and Outreach Program.

Table 2-34: Non-Residential TRM Measures Offered in FirstEnergy Legacy Companies' Programs

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Non-Residential Program Offerings
3.1	Baselines and Code Changes	
3.2	Lighting Equipment Improvements	-C/I Equipment Program (Feb 2010 Plan) -Multifamily Building Program (Feb 2010 Plan) -Government and Institutional Programs (Feb 2010 Plan)
3.3	Premium Efficiency Motors	-Industrial Motors and Variable Speed Drives Program (Feb 2010 Plan)[175] -C/I Equipment Program (Feb 2011 Plan)
3.4	Variable Frequency Drive (VFD) Improvements	-Industrial Motors and Variable Speed Drives Program (Feb 2010 Plan)[176] -C/I Equipment Program (Feb 2011 Plan)
3.5	Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors	-Industrial Motors and Variable Speed Drives Program (Feb 2010 Plan)[177] -C/I Equipment Program (Feb 2011 Plan)
3.6	HVAC Systems	-C/I Equipment Program (Feb 2010 Plan)
3.7	Electric Chillers	-C/I Equipment Program (Feb 2010 Plan) -Governmental and Institutional Programs (Feb 2010 Plan)
3.8	Anti-Sweat Heater Controls	-C/I Equipment Program (Feb 2011 Plan)
3.9	High-Efficiency Refrigeration/Freezer Cases	-C/I Equipment Program (Feb 2010 Plan)
3.10	High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases	-C/I Equipment Program (Feb 2010 Plan)
3.11	High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases	-C/I Equipment Program (Feb 2010 Plan)
3.12	ENERGY STAR Office Equipment	-C/I Equipment Program (Feb 2010 Plan)

[175] This program was absorbed by the C&I Equipment Program in the February 2011 EE&C plan update.
[176] This program was absorbed by the C&I Equipment Program in the February 2011 EE&C plan update.
[177] This program was absorbed by the C&I Equipment Program in the February 2011 EE&C Plan update.

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Non-Residential Program Offerings
3.13	Smart Strip Plug Outlets	-C/I Equipment Program (Feb 2010 Plan)
3.14	Beverage Machine Controls	-C/I Equipment Program (Feb 2010 Plan)
3.15	High-Efficiency Ice Machines	-C/I Equipment Program (Feb 2010 Plan)
3.16	Wall and Ceiling Insulation	
3.17	Strip Curtains for Walk-In Freezers and Coolers	-C/I Equipment Program (Feb 2010 Plan)
3.18	Geothermal Heat Pumps	-C/I Equipment Program (Feb 2010 Plan)
3.19	Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons	
3.20	ENERGY STAR Electric Steam Cooker	-C/I Equipment Program (Feb 2010 Plan)
3.21	Refrigeration – Night Covers for Display Cases	-C/I Equipment Program (Feb 2010 Plan)
3.22	Office Equipment – Network Power Management Enabling	-C/I Equipment Program (Feb 2010 Plan)
3.23	Refrigeration – Auto Closers	
3.24	Refrigeration – Door Gaskets for Walk-in Coolers and Freezers	
3.25	Refrigeration – Suction Pipes Insulation	
3.26	Refrigeration – Evaporator Fan Controllers	
3.27	ENERGY STAR Clothes Washer	-C/I Equipment Program (Feb 2010 Plan)
3.28	Electric Resistance Water Heaters	-C/I Equipment Program (Feb 2010 Plan)
3.29	Heat Pump Water Heaters	-C/I Equipment Program (Feb 2010 Plan)
3.30	LED Channel Signage	

TRM Measures (as of 2012 TRM)		FirstEnergy Legacy Non-Residential Program Offerings
3.31	Low-Flow Pre-Rinse Sprayers	-C/I Equipment Program (Feb 2010 Plan)
3.32	Small C&I HVAC Refrigerant Charge Correction	-C/I Equipment Program (Feb 2010 Plan)
3.33	Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case	
3.34	ENERGY STAR Room Air Conditioner	

2.5.5 West Penn Power

On June 30, 2009, West Penn Power filed its initial EE&C plan with the Commission. This plan was partially approved and partially rejected, and West Penn Power filed a revised EE&C plan in December 2009. After two revisions and iterations with the Commission, West Penn Power submitted an EE&C plan in late April 2010 that was approved in June 2010, becoming West Penn Power's first approved EE&C plan.

As Phase I implementation continued, West Penn Power submitted further revision to its EE&C plan. These revisions were proposed in September 2010 and approved, subject to joint stipulations, in January 2011. In February 2011, however, West Penn Power was incorporated into the FirstEnergy family of companies. West Penn Power submitted further EE&C plan changes to make its program offerings more consistent with those of the other FirstEnergy companies in Pennsylvania; this required significant changes to the programs in its previous EE&C plan. The new EE&C plan was submitted in August 2011 and approved in May 2012. Explanations of mid-phase program modifications are discussed in individual program description sections in Appendix A, section A.5 .

Table 2-35 summarizes the initial submission, compliance filing, and approval dates of West Penn Power's EE&C plans. Minor EE&C plan changes that affected program budgets are not included in the table as they did not affect the program structures or offered measures. Table 1-1 in Section 1.1.4 lists all of the EDCs' EE&C plan-related filings, including minor changes not affecting program structure, and the respective Commission Orders for each filing.

Table 2-35: West Penn Power EE&C Plan Submission and Approval Dates

Initial Submittal	Compliance Filing	Approved by Commission
June 2009	April 2010	June 2010
September 2010	September 2010[178]	January 2011
August 2011	August 2011[179]	May 2012

Note: All EE&C plans are referenced by their compliance filing date except where noted.

The following programs proposed in West Penn Power's April 2010 EE&C plan never reported any savings during Phase I, either because they were never fully implemented or were removed from the program portfolio before claiming savings:

- Residential Efficiency Rewards Rebate
- Pay Ahead (Smart) Service Rate
- Hourly Pricing Option Rate
- Programmable Controllable Thermostat Program

[178] No additional iterations were required.
[179] Approval of the August 2011 plan included issues resolved in the Joint Petition for Settlement of All Issues filed January 6, 2012 between West Penn Power Company, the Office of Consumer Advocate, the Office of Small Business Advocate, Pennsylvania Communities Organizing for Change and West Penn Power Industrial Interveners.

- Residential Low Income Room Air Conditioner Replacement Program
- Distributed Generation Program
- Time of Use with Critical Peak Pricing Rate

In the September 2010 EE&C plan update, the following programs were removed from West Penn Power's EE&C program portfolio:

- Residential Efficiency Rewards Rebate
- Pay Ahead Smart Service Rate
- Hourly Pricing Option Rate
- Programmable Controllable Thermostat Demand Response Program
- Residential Low Income Room Air Conditioner Replacement Program

Twenty-four programs, listed in Table 2-36, reported savings in West Penn Power's annual reports during Phase I. A list of the sectors to which each program was available follows the table.

Table 2-36: West Penn Power Programs Reporting Savings by Program Year

Program Name	PY1	PY2	PY3	PY4
Compact Fluorescent Lighting Rewards Program	•	•		
Residential Energy Star and High Efficiency Appliance Program	•	•		
Residential Home Performance Program	•	•	•	•
Residential HVAC Efficiency Program	•			
Residential Low-Income Home Performance Check-Up Audit & Appliance Replacement Program	•	•		
Government/Non-Profit Lighting Efficiency Program	•	•		
Commercial Lighting Efficiency Program	•			
Residential Whole Home Appliance Efficiency Program		•		
Residential Low Income Joint Utility Usage Management Program		•	•	•
Commercial HVAC Efficiency Program		•		
Commercial Products Efficiency Program		•		
Custom Technology Applications Program		•		
Custom Applications Program		•		
Commercial and Industrial Drives Program		•		
Residential Appliance Turn-In Program			•	•
Residential Energy Efficient Products Program			•	•

Program Name	PY1	PY2	PY3	PY4
Residential Energy Efficient HVAC Equipment Program			•	•
Limited Income Energy Efficiency Program			•	•
Commercial & Industrial Equipment Program – Small			•	•
Commercial & Industrial Equipment Program – Large			•	•
Government and Institutional Program			•	•
Conservation Voltage Reduction				•
Critical Peak Rebate[1]				•
Customer Resources Demand Response[1]				•
Customer Load Response Program[1] [2]				

[1] Reported demand savings only.

[2] Impacts reported as part of Customer Resources Demand Response Program.

Residential Sector

- Compact Fluorescent Lighting Rewards Program
- Critical Peak Rebate Program
- Residential Energy Star and High Efficiency Appliance Program
- Residential Home Performance Program
- Residential HVAC Efficiency Program
- Residential Whole Home Appliance Efficiency Program
- Residential Appliance Turn-In Program
- Conservation Voltage Reduction Program
- Residential Energy Efficient Products Program
- Residential Energy Efficient HVAC Program

Residential Low-Income Sector

- Residential Low Income Home Performance Check-Up Audit & Appliance Replacement Program
- Residential Low Income Joint Utility Usage Management Program
- Conservation Voltage Reduction Program
- Limited Income Energy Efficiency Program

Commercial/Industrial Small Sector

- Commercial HVAC Efficiency Program
- Commercial Lighting Efficiency Program
- Custom Technology Applications Program
- Commercial Products Efficiency Program

- Conservation voltage Reduction Program
- C/I Equipment Program - Small

Commercial/Industrial Large Sector

- Custom Applications Program
- Customer Resources Demand Response Program
- Customer Load Response Program
- Commercial and Industrial Drives Program
- C/I Equipment Program – Large
- Conservation Voltage Reduction Program

Government/Non-Profit Sector

- Governmental/Non-Profit Lighting Efficiency Program
- Government and Institutional Program
- Conservation Voltage Reduction Program

Details on the West Penn Power programs listed above can be found in Appendix A, section A.5 of this report.

Some of these programs offered prescriptive measures that had approved savings protocols listed in the TRM. Table 2-37 and Table 2-38 show, respectively, the residential and non-residential 2012 TRM measures offered by West Penn. These tables focus on prescriptive programs and do not include custom programs. The EE&C plan date associated with each program in the tables is the compliance filing date of the first plan in which the TRM measure was included in the specific program.

Table 2-37: Residential TRM Measures Offered in West Penn Power's Programs

TRM Measures (as of 2012 TRM)		West Penn Power Residential Program Offerings
2.1	Electric HVAC	-Residential HVAC Efficiency Program (April 2010 Plan)[180] -Residential Whole Home Appliance Efficiency Program (Sep 2010 Plan)[181] -Residential Energy Efficient HVAC Equipment Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Plan) -Residential Joint Utility Usage Management Program (April 2010 Plan)
2.2	Electric Clothes Dryer with Moisture Sensor	
2.3	Efficient Electric Water Heaters	-Residential Whole Home Appliance Efficiency Program (Sep 2010 Plan)[182] -Residential Energy Efficient Products Program (Aug 2011 Plan) -Residential Joint Utility Usage Management Program (April 2010 Plan)
2.4	Electroluminescent Nightlight	
2.5	Furnace Whistle	-Residential Joint Utility Usage Management Program (April 2010 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Plan)
2.6	Heat Pump Water Heaters	-Residential Energy Efficient Products Program (Aug 2011 Plan)

[180] The name of this program changed to the Residential Whole Home Appliance Efficiency Program in the September 2010 EE&C Plan changes, as well as the measure offerings.
[181] This program was discontinued in the August 2011 EE&C plan.
[182] This program was discontinued in the August 2011 EE&C plan.

TRM Measures (as of 2012 TRM)		West Penn Power Residential Program Offerings
2.7	Home Audit Conservation Kits	-Residential Joint Utility Usage Management Program (April 2010 Plan) -Residential Home Performance Program (Aug 2011 Plan)
2.8	LED Nightlight	-Residential Joint Utility Usage Management Program (April 2010 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Plan)
2.9	Low-Flow Faucet Aerators	-Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[183] -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Plan)
2.10	Low-Flow Showerheads	-Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[184] -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Plan) - Residential Joint Utility Usage Management Program (April 2010 Plan)
2.11	Programmable Thermostat	-Residential ENERGY STAR and High Efficiency Appliance Program (April 2010 Plan)[185]

[183] This program was discontinued in the August 2011 EE&C plan.
[184] This program was discontinued in the August 2011 EE&C plan.
[185] This program was discontinued in the August 2011 EE&C plan.

TRM Measures (as of 2012 TRM)		West Penn Power Residential Program Offerings
2.12	Room AC (RAC) Retirement	-Residential ENERGY STAR and High Efficiency Appliance Program (April 2010 Plan)[186] -Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[187] -Residential Joint Utility Usage Management Program – Low Income Weatherization (April 2010 Plan) -Residential Appliance Turn-In Program (Aug 2011 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan)
2.13	Smart Strip Plug Outlets	-Residential Energy Efficient Products Program (Aug 2011 Plan) -Residential Home Performance Program (Aug 2011 Program) -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Joint Utility Usage Management Program (April 2010 Plan)
2.14	Solar Water Heaters	
2.15	Electric Water Heater Pipe Insulation	-Residential Joint Utility Usage Management Program (April 2010 Plan)
2.16	Residential Whole House Fans	
2.17	Ductless Mini-Split Heat Pumps	-Residential HVAC Efficiency Program (April 2010 Plan)[188]
2.18	Fuel Switching: Domestic Hot Water Electric to Gas	
2.19	Fuel Switching: Heat Pump Water Heater to Gas Water Heater	

[186] This program was discontinued in the August 2011 EE&C plan.
[187] This program was discontinued in the August 2011 EE&C plan.
[188] The name of this program changed to the Residential Whole Home Appliance Efficiency Program in the September 2010 EE&C plan changes, as well as the measure offerings.

	TRM Measures (as of 2012 TRM)	West Penn Power Residential Program Offerings
2.20	Fuel Switching: Electric Heat to Gas Heat	
2.21	Ceiling/Attic and Wall Insulation	-Residential Home Performance Program (Aug 2011 Plan) -Residential Joint Utility Usage Management Program (April 2010 Plan)
2.22	Refrigerator/Freezer Recycling and Replacement	-Residential ENERGY STAR and High Efficiency Appliance Program (April 2010 Plan)[189] -Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[190] -Residential Joint Utility Usage Management Program – Low Income Weatherization (April 2010 Plan) -Residential Appliance Turn-In Program (Aug 2011 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan)
2.23	Refrigerator/Freezer Retirement (and Recycling)	-Residential ENERGY STAR and High Efficiency Appliance Program (April 2010 Plan)[191] -Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[192] -Residential Joint Utility Usage Management Program – Low Income Weatherization (April 2010 Plan) -Residential Appliance Turn-In Program (Aug 2011 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan)
2.24	Residential New Construction	

[189] This program was discontinued in the August 2011 EE&C plan.
[190] This program was discontinued in the August 2011 EE&C plan.
[191] This program was discontinued in the August 2011 EE&C plan.
[192] This program was discontinued in the August 2011 EE&C plan.

TRM Measures (as of 2012 TRM)		West Penn Power Residential Program Offerings
2.25	ENERGY STAR Appliances	-Residential ENERGY STAR and High Efficiency Appliance Program (April 2010 Plan)[193] -Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[194] -Residential Joint Utility Usage Management Program – Low Income Weatherization (April 2010 Plan) -Residential Energy Efficiency Products Program (Aug 2011 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan)
2.26	ENERGY STAR Lighting	-Compact Fluorescent Lighting Rewards Program (April 2010 Plan)[195] -Residential Home Performance Program (April 2010 Plan) -Residential Low income Home Performance Check Up Audit & Appliance Replacement Program (April 2010 Plan)[196] -Residential Energy Efficiency Products Program (Aug 2011 Plan) -Limited Income Energy Efficiency Program (Aug 2011 Plan) -Residential Joint Utility Usage Management Program (April 2010 Plan)
2.27	ENERGY STAR Windows	-Residential Home Performance Program (Aug 2011 Plan)

[193] This program was discontinued in the August 2011 EE&C plan.
[194] This program was discontinued in the August 2011 EE&C plan.
[195] This program was discontinued in the August 2011 EE&C plan.
[196] This program was discontinued in the August 2011 EE&C plan.

TRM Measures (as of 2012 TRM)		West Penn Power Residential Program Offerings
2.28	ENERGY STAR Audit	-Residential Home Performance Program (April 2010 Plan)
2.29	Home Performance with ENERGY STAR	-Residential Home Performance Program (April 2010 Plan)
2.30	ENERGY STAR Televisions (Versions 4.1 and 5.1)	-Residential Energy Efficient Products Program (Aug 2011 Plan)
2.31	ENERGY STAR Office Equipment	
2.32	ENERGY STAR LEDs	
2.33	Residential Occupancy Sensors	
2.34	Holiday Lights	-Residential Energy Efficient Products Program (Aug 2011 Plan)
2.35	Low-Income Lighting (FirstEnergy)	-Residential Joint Utility Usage Management Program (April 2010 Plan)
2.36	Water Heater Tank Wrap	-Residential Joint Utility Usage Management Program (April 2010 Plan)
2.37	Pool Pump Load Shifting	
2.38	High-Efficiency Two-Speed Pool Pump	
2.39	Variable-Speed Pool Pumps (with Load Shifting Option)	

Table 2-38: Non-Residential TRM Measures Offered in West Penn Power's Programs

TRM Measures (as of 2012 TRM)		West Penn Power Non-Residential Program Offerings
3.1	Baselines and Code Changes	
3.2	Lighting Equipment Improvements	-Commercial Lighting Efficiency Program (April 2010 Plan)[197] -Government/School/Non-Profit Lighting Efficiency Program (April 2010 Plan)[198] -Commercial Products Efficiency Program (Sep 2010 Plan)[199] -C/I Equipment Program – Small (Aug 2011 Plan) -Government and Institutional Program (Aug 2011 Plan)
3.3	Premium Efficiency Motors	-Commercial and Industrial Drives Program (April 2010 Plan)[200]
3.4	Variable Frequency Drive (VFD) Improvements	-Commercial and Industrial Drives Program (April 2010 Plan)[201] -C/I Equipment Program – Small (Aug 2011 Plan) -C/I Equipment Program – Large (Aug 2011 Plan)
3.5	Variable Frequency Drive (VFD) Improvement for Industrial Air Compressors	-Commercial and Industrial Drives Program (April 2010 Plan)[202] -C/I Equipment Program – Small (Aug 2011 Plan) -C/I Equipment Program – Large (Aug 2011 Plan)
3.6	HVAC Systems	-Commercial HVAC Efficiency Program (April 2010 Plan)[203] -C/I Equipment Program – Small (Aug 2011 Plan)

[197] This program's name was changed to the Commercial Products Efficiency Program in the September 2010 EE&C plan changes.
[198] This program was discontinued in the August 2011 EE&C plan.
[199] This program was discontinued in the August 2011 EE&C plan.
[200] This program was removed from West Penn Powers EE&C plan in its September 2010 plan changes. As of the September 2010 plan, these measures were offered through the custom C&I programs.
[201] This program was removed from West Penn Powers EE&C plan in its September 2010 plan changes. As of the September 2010 plan, these measures were offered through the custom C&I programs.
[202] This program was removed from West Penn Powers EE&C plan in its September 2010 plan changes. As of the September 2010 plan, these measures were offered through the custom C&I programs.
[203] These measure offerings were discontinued in the September 2010 EE&C plan changes.

TRM Measures (as of 2012 TRM)		West Penn Power Non-Residential Program Offerings
3.7	Electric Chillers	-C/I Equipment Program – Small (Aug 2011 Plan) -C/I Equipment Program – Large (Aug 2011 Plan)
3.8	Anti-Sweat Heater Controls	-C/I Equipment Program – Small (Aug 2011 Plan)
3.9	High-Efficiency Refrigeration/Freezer Cases	-C/I Equipment Program – Small (Aug 2011 Plan)
3.10	High-Efficiency Evaporator Fan Motors for Reach-In Refrigerated Cases	-C/I Equipment Program – Small (Aug 2011 Plan)
3.11	High-Efficiency Evaporator Fan Motors for Walk-In Refrigerated Cases	-C/I Equipment Program – Small (Aug 2011 Plan)
3.12	ENERGY STAR Office Equipment	-C/I Equipment Program – Small (Aug 2011 Plan)
3.13	Smart Strip Plug Outlets	-Commercial Products Efficiency Program (Sep 2010 Plan)[204] -C/I Equipment Program – Small (Aug 2011 Plan)
3.14	Beverage Machine Controls	-C/I Equipment Program – Small (Aug 2011 Plan)
3.15	High-Efficiency Ice Machines	-C/I Equipment Program – Small (Aug 2011 Plan)
3.16	Wall and Ceiling Insulation	
3.17	Strip Curtains for Walk-In Freezers and Coolers	-C/I Equipment Program – Small (Aug 2011 Plan)
3.18	Geothermal Heat Pumps	-C/I Equipment Program – Small (Aug 2011 Plan)
3.19	Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons	
3.20	ENERGY STAR Electric Steam Cooker	-C/I Equipment Program – Small (Aug 2011 Plan)
3.21	Refrigeration – Night Covers for Display Cases	-C/I Equipment Program – Small (Aug 2011 Plan)
3.22	Office Equipment – Network Power Management Enabling	-C/I Equipment Program – Small (Aug 2011 Plan)
3.23	Refrigeration – Auto Closers	-C/I Equipment Program – Small (Aug 2011 Plan)

[204] This program was discontinued in the August 2011 EE&C plan.

	TRM Measures (as of 2012 TRM)	West Penn Power Non-Residential Program Offerings
3.24	Refrigeration – Door Gaskets for Walk-in Coolers and Freezers	-C/I Equipment Program – Small (Aug 2011 Plan)
3.25	Refrigeration – Suction Pipes Insulation	-C/I Equipment Program – Small (Aug 2011 Plan)
3.26	Refrigeration – Evaporator Fan Controllers	-C/I Equipment Program – Small (Aug 2011 Plan)
3.27	ENERGY STAR Clothes Washer	
3.28	Electric Resistance Water Heaters	-C/I Equipment Program – Small (Aug 2011 Plan)
3.29	Heat Pump Water Heaters	
3.30	LED Channel Signage	-C/I Equipment Program – Small (Aug 2011 Plan)
3.31	Low-Flow Pre-Rinse Sprayers	-C/I Equipment Program – Small (Aug 2011 Plan)
3.32	Small C&I HVAC Refrigerant Charge Correction	
3.33	Refrigeration – Special Doors with Low or No Anti-Sweat Heat for Low Temp Case	
3.34	ENERGY STAR Room Air Conditioner	

3 Demand Reductions

This section discusses the Act 129 demand reduction targets for Phase I, and the demand reductions achieved by the EDCs. This section also discusses the SWE Demand Response Study.

3.1 Restated Act 129 Targets – Phase I

Act 129 required that EDCs with at least 100,000 customers adopt a plan, approved by the Commission, to reduce peak demand by a minimum of 4.5% of the EDC's annual system peak demand in the 100 hours of highest demand by May 31, 2013, (achieved between June 1, 2012 and September 30, 2012), measured against the EDC's peak demand during the period June 1, 2007 – May 31, 2008.[205] Table 3-1 shows the peak demand reduction targets for each EDC.

Table 3-1: Act 129 Phase I Demand Reduction Targets by EDC

EDC	4.5% Demand Reduction (MW)
Duquesne	113
PECO	355
PPL	297
Met-Ed	119
Penelec	108
Penn Power	44
West Penn	157
Total	**1,193**

The demand reduction targets were established by order of the Commission using "[t]he EDCs' … historical system demand associated with retail sales customers… for the period of June 1, 2007 through September 30, 2007." [206]

The Commission considered two options for calculating the demand savings. The first was the "savings approach," which "measures the actual reduction in peak demand from what the peak demand would have been absent the EDC's demand reduction program." The second was the "demonstrated capability" option, which would "require each EDC to show that they have the demonstrated capability to reduce a specific amount of peak demand when a predetermined demand trigger point of peak demand is met."[207]

The Commission selected the savings approach for meeting the Phase I demand reduction targets. This option ensures that savings benefits are provided to consumers for load reductions during the top 100

[205] 66 Pa. C.S. § 2806.1(d).
[206] *Energy Consumption and Peak Demand Reduction Targets*, Docket No. M-2008-2069887, [206] Order entered March 30, 2009, p. 5.
[207] Phase I Commission Order, p. 20.

hours of 2012. Additionally, this option does not penalize the EDCs for economic growth in their service territories.[208]

The Commission also provided guidance for determining the 100 hours of highest demand that are to be used for calculating demand savings. The Phase I Implementation Order directed each EDC to use the 100 highest peak hours that occur during the months of June, July, August, and September, which would provide the most benefit and cost effectiveness. Therefore, for planning purposes, each EDC filing included "[t]he average of hourly peak loads for the 100 hours of highest load for June 1, 2007, through May 31, 2008, and the average of hourly peak loads for the 100 hours of highest load for the period of June 1, 2007, through September 30, 2007."[209]

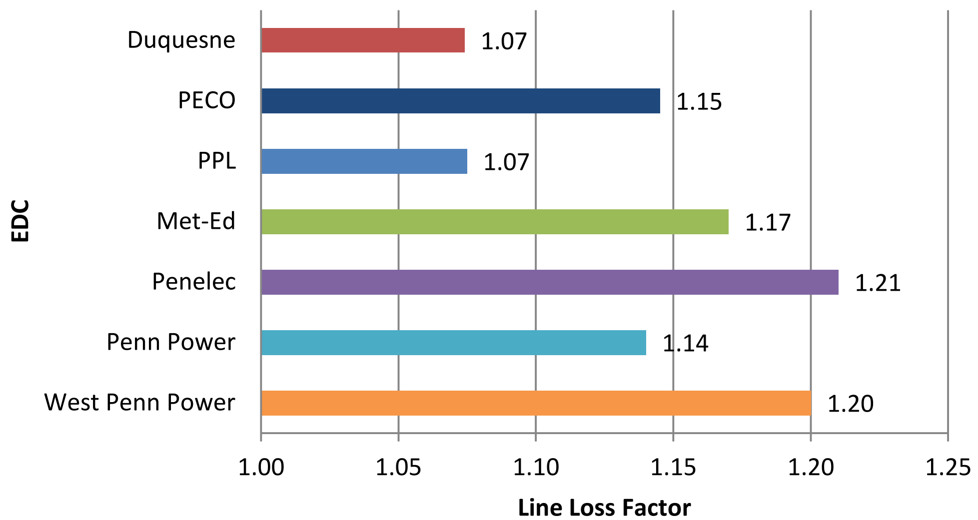
Additionally, according to the Act, demand forecasts are based on system demand, and therefore demand savings should be reported at the system level when comparing them with established targets. However, demand savings reported from both energy efficiency measures and demand response measures outlined in each EDC's EE&C plan are typically presented at the customer meter level. In order to convert the meter-level demand savings to the system-level savings, each EDC must determine the system losses associated with the transmission and distribution of electricity during the top 100 hours. These losses are used to calculate a line loss factor (LLF) that is applied to the reported demand values from each EDC in order to report system-level demand savings. The following equation outlines the formula used by the EDCs to convert meter-level savings to system-level savings:

$$System = Meter \times LLF$$

[208] ibid.
[209] ibid., p. 9.

The LLFs show a wide range of variation among the EDCs.[210] Figure A-1 shows the peak demand LLFs used by each EDC in its respective Program Year 4 annual reports.[211]

Figure A-1: Line Loss Factors by EDC



Finally, demand savings occur in both EE&C energy efficiency programs as well as in demand response (DR) programs (load curtailment, peak pricing, etc.). In the Phase I Implementation Order, the Commission allowed for both sources of demand savings to be combined for the purposes of reporting toward the demand reduction targets.[212] Section 3.3.9 provides a detailed review of the demand savings achieved through the EE&C energy efficiency programs.

[210] The SWE performed a review of two EDCs' peak line-loss factor assumptions. The SWE reviewed the underlying data and methodologies used to estimate the line-loss factors and determined that the estimates were reasonable.
[211] The LLFs for PPL and PECO illustrated here are averages of the line losses they use across their programs. All other EDCs use one LLF for all programs.
[212] Phase I Implementation Order, pp. 20-21.

3.2 Compliance Summary by EDC

This section summarizes the EDCs' compliance with the Phase I demand reduction targets under Act 129. The demand reductions for all EDCs were measured during the summer of 2012, between June 1, 2012 and September 30, 2012.

Table 3-2 summarizes each EDC's compliance based on TRM Verified Savings. Table 3-3 summarizes each EDC's compliance based the EDC Proposed Savings for demand reduction. The basis for each EDC's EDC Proposed Savings is described in this section. Duquesne is the only EDC that did not propose an alternative, EDC Proposed Savings for demand reduction.

Table 3-2: Top 100 Hours TRM Verified Savings - Demand Reduction Compliance Summary

EDC	Phase I - 4.5% Demand Reduction Target (MW)	Top 100 Hours CPITD TRM Verified Gross Demand Reductions (MW)	Percentage of Phase I Target
Duquesne	113	138.56	123%
PECO	355	399.2[1]	112%
PPL	297	340.90	115%
Met-Ed	119	125.02	105%
Penelec	108	113.95	106%
Penn Power	44	46.21	105%
West Penn Power	157	186.08	119%

[1] This number excludes 20.9 MW reported by PECO because the SWE does not believe it should count toward PECO's demand reduction compliance target. See description below.

Table 3-3: Top 100 Hours EDC Proposed Savings - Demand Reduction Compliance Summary

EDC	Phase I 4.5% Demand Reduction Target (MW)	Top 100 Hours CPITD EDC Proposed Verified Gross Demand Reductions (MW)	Percentage of Phase I Target
Duquesne	113	N/A	N/A
PECO	355	461.1	130%
PPL	297	356.56	120%
Met-Ed	119	137.11	115%
Penelec	108	125.63	116%
Penn Power	44	51.07	116%
West Penn Power	157	205.43	131%

PECO reported a CPITD TRM Verified Savings of 399.2[213] MW and a CPITD EDC Proposed Savings of 461.1 MW over the top 100 hours of 2012. Both of these savings estimates included 113.4 MW of demand savings from the Demand Response Aggregators (DRA) program and 16.4 MW of demand savings from the Distributed Energy Resources (DER) program. These demand response (DR) programs were designed specifically to reduce load during summer 2012 performance period. The DRA program incentivized customers to reduce consumption during peak hours, and the DER program incentivized customers to use on-site generation during peak hours to reduce the amount of load drawn from the grid.

The SWE believes that 20.9 MW of the 129.8 MW of peak demand reduction reported for the PECO DRA and DER programs should not count toward PECO's 4.5% peak demand reduction target of 355 MW because of two departures from the PJM measurement and verification (M&V) protocols[214] called for by the 2012 PA TRM. A technical discussion of these departures can be found in Appendix F. The SWE understands that the PECO DR programs are structured somewhat differently from the PJM DR markets and that PJM business rules may not always be a perfect solution. However, the 2012 TRM was clear that PJM business rules were to be followed in assessing the Act 129 impacts.

The SWE also notes that PECO benefitted from a strict application of PJM business rules in the residential sector by using PJM deemed savings estimates for its residential direct load control program which overstated the demand impacts of the program.[215] The SWE believes it is inappropriate for PECO to depart from the M&V protocols called for in the TRM for its commercial and industrial (C&I) programs, but not for residential programs where a departure would have produced a more accurate, but lower, estimate of peak demand impacts. The SWE recommends that the Commission consider a TRM verified gross demand savings of 399.2 MW when assessing PECO's compliance with the 4.5% peak demand reduction goal.

PECO also proposed alternative values for the coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting its Smart Lighting Discounts and Low-Income Energy Efficiency Programs. [216] PECO proposed a CF of 11.7% (5% in the TRM) and an IEF of 1.19 (unaccounted for in the TRM and therefore equal to 1.00).

PPL proposed to depart from the PJM M&V protocols[217] called for in the 2012 TRM when evaluating impacts from its load curtailment (C&I demand response) program and reported two sets of impacts in its PY4 final annual report. Following a strict interpretation of PJM M&V and settlement protocols, PPL

[213] This number excludes 20.9 MW reported by PECO because the SWE does not believe it should count toward PECO's demand reduction compliance target.
[214] 2012 PA TRM, p. 302..
[215] The assumed weather conditions for PJM deemed savings estimates were hotter than the observed weather conditions during any of PECO's event calls for the Smart AC Saver program. Cooler conditions translate to reduced demand for air conditioning and lower average demand impacts per home.
[216] See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.
[217] PPL claims it followed PJM M&V protocols completely but proposes to deviate from some of PJM's settlement protocols because they conflict with Act 129 requirements and PPL's contract with its CSP.

reported 118.20 MW of gross verified peak demand reduction from the load curtailment program. Using an alternative method whereby impacts from intervals when customers increased consumption relative to their baseline load are zeroed out, PPL reported 133.86 MW of gross verified peak demand reduction. A technical discussion of this alternative methodology and the SWE audit of the program are presented in Appendix F. The SWE believes that 118.20 MW is the more accurate estimate of program performance over the top 100 hours and recommends that the Commission use this figure, and the associated portfolio total of 340.90 MW, when assessing PPL's compliance with its 4.5% peak demand reduction target of 297 MW.

The FirstEnergy Legacy Companies and West Penn Power used the PJM M&V protocols called for in the 2012 PA TRM when evaluating demand reductions from their load curtailment (C&I demand response) programs as well as residential load control and price response programs. The FirstEnergy Legacy Companies reported EDC Proposed Savings for demand reductions from energy efficiency programs using an alternative CF and IEF for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small C&I[218] programs. For Met-Ed and Penn Power, the product of these two factors, CF x IEF, was capped at 15%, whereas for Penelec it was capped at 14.3%.[219] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%.

West Penn Power also reported EDC Proposed Savings for demand reductions from energy efficiency programs using an alternative CF and IEF for residential CFLs, affecting the Residential Energy Efficient Products, Home Performance, and Small C&I[220] programs. The product of these two factors, CF x IEF, was capped at 15%.[221]

[218] Some kits distributed to small C&I customers included CFLs that ended up in residential households.
[219] See Met-Ed, Penn Power, and Penelec final annual reports to the Pennsylvania PUC for explanations of these alternate factors.
[220] Some kits distributed to small C&I customers included CFLs that ended up in residential households.
[221] See West Penn Power final annual report to the Pennsylvania PUC for explanation of these alternate factors.

Another requirement of Act 129 was for the EDCs to achieve at least 10% of their energy and demand reductions from units of federal, state, and local governments, including municipalities, school districts, institutions of higher education, and non-profit entities (the GNI sector). Table 3-4 shows the CPITD TRM verified GNI sector demand reductions achieved by each EDC during Phase I.

Table 3-4: CPITD GNI TRM Verified Savings - Demand Reductions

EDC	Phase I 10% GNI Sector Demand Reduction Target (MW)	CPITD GNI Sector Top 100 Hours TRM Verified Gross Demand Reductions (MW)	Percentage of Phase I Target
Duquesne	11.3	15.20	135%
PECO	35.5	46.6	131%
PPL	29.7	31.23	105%
Met-Ed	11.9	22.73	191%
Penelec	10.8	20.60	191%
Penn Power	4.4	4.21	96%
West Penn Power	15.7	38.55	246%

All EDCs' CPITD TRM Verified Savings, other than for Penn Power, exceeded the demand reduction targets for the GNI sector. However, the EM&V conducted for the GNI program for Penn Power is based upon a review of actual performance for a random sample of completed projects based upon a 90% level of confidence and 6% margin of error (with a two-tailed test). The TRM Gross Verified Demand Savings achieved by Penn Power for the GNI sector for Phase I was 4.21 MW plus or minus 0.25 MW at a 90% confidence and 6% precision level. Because the GNI demand reduction target of 4.4 MW for Penn Power is within the 90% confidence interval for the estimated savings, the SWE has determined that Penn Power has met the GNI sector demand reduction savings target, as the measured 4.21 MW estimate is not significantly different from the 4.4 MW target from a statistical point of view.

Furthermore, the Act requires that each EE&C plan "include specific energy efficiency measures for households at or below 150% of the federal poverty income guidelines. The number of measures shall be proportionate to those households' share of the total energy usage in the service territory."[222] In orders approving the EE&C plans, the Commission directed the formation of a Low-Income Working Group (LIWG) to identify the standardized data used to determine the low-income households' share of total energy usage in each EDC's service territory. At its April 22, 2010 Public Meeting, the Commission adopted a Secretarial Letter at Docket No. M-2009-2146801 that released the March 19, 2010 report of the LIWG, and adopted the recommendations contained therein. The report stated that "…all EDCs have

[222] 66 Pa.C.S. §2806.1(b)(i)(G).

sufficient specific measures for low-income households to satisfy the 'proportionate number' criteria in the statute. This is the sole methodology for determining compliance with Act 129 through 2013."[223]

3.3 Results for Phase I

This section presents demand reduction results for Phase I of Act 129. CPITD figures are presented by program and EDC as well as by sector. Included are both TRM Verified Savings and EDC Proposed Savings for demand reductions, where reported, for the top 100 hours of highest demand and total demand reduction. The top 100 hours of highest demand are defined as the 100 hours during the period June 1, 2012 -- September 30, 2012 where the peak demand placed on an individual EDC was greater than the remaining hours of the period. The total demand is defined as all demand registered during Phase 1.

3.3.1 Statewide Summary

Table 3-5 and 3-6 summarize the Phase I top 100 hours and total demand reduction results reported by each EDC.

Table 3-5: Phase I Top 100 Hours Demand Reduction

	Statewide[224]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Reported Gross[225] Demand Reductions (MW)	**1,405.12**	135.49	423.3	314.87	146.63	136.96	49.08	198.79
CPITD TRM Verified Gross Demand Reductions (MW)	**1,349.92**	138.56	399.2[226]	340.90	125.02	113.95	46.21	186.08
CPITD EDC Proposed Verified Gross Demand Reductions (MW)	**N/A**	N/A	461.1	356.56	137.11	125.63	51.07	205.43

[223] Report of the Low-Income Working Group, Docket No. M-2009-2146801, March 19, 2010, p. 7.
[224] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[225] Gross savings represent change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.
[226] This number excludes 20.9 MW reported by PECO because the SWE does not believe it should count towards PECO's compliance target. This also includes an adjustment of .1 MW after the PY4 annual report was issued in response to a recalculation of the realization rate for GNI.

Table 3-6: Phase I Total Demand Reduction

	Statewide[227]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Reported Gross[228] Demand Reductions (MW)	**1,608.64**	156.77	447.5	376.27	163.43	153.73	55.30	255.64
CPITD TRM Verified Gross Demand Reductions (MW)	**1,540.61**	158.92	418.1[229]	409.98	136.92	128.22	51.30	237.17
CPITD EDC Proposed Verified Gross Demand Reductions (MW)	**N/A**	N/A	482.3	425.64	154.49	145.06	58.22	260.86

In Phase I, PECO, PPL, the FirstEnergy Legacy Companies (Met-Ed, Penelec, Penn Power), and West Penn Power reported EDC Proposed Savings using alternative evaluation results relative to those supported by protocols specified in the TRM to estimate demand reductions, as seen in the CPITD EDC Reported Verified Gross Demand Reductions rows of the two tables above.

PECO proposed alternative values for the coincidence factor (CF) and interactive effects factor (IEF) for residential CFLs, affecting its Smart Lighting Discounts and Low-Income Energy Efficiency Programs.[230] PECO proposed a CF of 11.7% (5% in the TRM) and an IEF of 1.19 (unaccounted for in the TRM and therefore equal to 1.00).

PPL proposed an alternative methodology to estimate the demand reduction from its Load Curtailment Program.[231] This methodology differed from the methodology determined by the SWE Team and resulted in a 15.66 MW increase in demand reductions for the Phase I.

The FirstEnergy Legacy Companies proposed alternative CFs and IEFs for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small C&I programs.[232] For Met-Ed and Penn Power, the product of CF x IEF was capped at 15%, whereas for

227 Statewide values are for illustration purposes only. There are no statewide targets under Act 129.

228 Gross savings represent change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

229 This number excludes 20.9 MW reported by PECO because the SWE does not believe it should count towards PECO's compliance target. This also includes an adjustment of .1 MW after the PY4 annual report was issued in response to a recalculation of the realization rate for GNI.

230 See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.

231 See PPL Final Annual Report to the Pennsylvania Public Utility Commission, November 15, 2013, Section 11.2.4, p. 137.

232 Some kits distributed to Small C&I customers included CFLs which ended up in residential households.

Penelec, the product of these two factors was 14.3%.[233]The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%.

West Penn Power proposed alternative CFs and IEFs for residential CFLs, affecting the Residential Energy Efficient Products, Home Performance, and Small C&I programs.[234] The product of CF x IEF was capped at 15%.[235]

summarize **the** total TRM verified Savings and EDC Proposed Savings for demand reductions by sector. As noted above, Duquesne did not propose alternative values for demand reductions and therefore does not have EDC Proposed Savings for demand reductions.

Table 3-7 and Table **3-8** summarize the TRM Verified Savings and EDC Proposed Savings for demand reductions by sector for the top 100 hours.

Table 3-9 and Table **3-10** summarize the total TRM verified Savings and EDC Proposed Savings for demand reductions by sector. As noted above, Duquesne did not propose alternative values for demand reductions and therefore does not have EDC Proposed Savings for demand reductions.

Table 3-7: Top 100 Hours TRM Verified Demand Reductions by Sector

TRM Verified Savings	Statewide[236]	Duquesne	PECO[237]	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Residential Verified Gross[238] Demand Reductions (MW)	**327.09**	8.10	170.8	66.30	28.98	21.97	6.88	24.06
CPITD Low-Income Verified Gross Demand Reductions (MW)	**20.43**	1.53	11.6	2.47	0.95	1.00	0.26	2.62
CPITD Commercial and Industrial Verified Gross Demand Reductions (MW)	**823.28**	113.75	170.2	240.9	72.35	70.37	34.86	120.85
CPITD Government, Non-Profit, and Institutional (GNI) Verified Gross Demand Reductions (MW)	**179.09**	15.17	46.6	31.23	22.73	20.60	4.21	38.55
CPITD Total Verified Gross Demand Reductions (MW)	**1349.92**	138.56	399.2	340.90	125.02	113.95	46.21	186.08

[233] See Met-Ed, Penn Power, and Penelec final annual reports to the Pennsylvania Public Utility Commission for explanations of these alternate factors.
[234] Some kits distributed to Small C&I customers included CFLs which ended up in residential households.
[235] See West Penn Power Final Annual Report to Pennsylvania Public Utility Commission for explanation of these alternate factors.
[236] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[237] PECO Conservation Voltage Reduction Program demand savings are divided between sectors based on reported gross savings from Table 9-1 in the PECO PY4 annual report.
[238] CPITD verified = sum of verified savings from PY1 through PY4. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.

Table 3-8: Top 100 Hours EDC Proposed Verified Savings- Demand Reductions by Sector

EDC Proposed Savings	Statewide[239]	Duquesne	PECO[240]	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Residential Verified Gross[241] Demand Reductions (MW)	**NA**	N/A	208.1	66.30	40.70	33.59	11.50	42.49
CPITD Low-Income Verified Gross Demand Reductions (MW)	**NA**	N/A	15.1	2.47	.95	1.00	.26	2.62
CPITD Commercial and Industrial Verified Gross Demand Reductions (MW)	**NA**	N/A	184.9	256.56	86.15	81.35	34.97	121.77
CPITD Government, Non-Profit, and Institutional (GNI) Verified Gross Demand Reductions (MW)	**NA**	N/A	52.8	31.23	9.31	9.70	4.45	38.55
CPITD Total Verified Gross Demand Reductions (MW)	**NA**	N/A	461.1	356.56	137.11	125.63	51.19	205.43

Table 3-9: Total TRM Verified Savings- Demand Reductions by Sector

TRM Verified Savings	Statewide[242]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Residential Verified Gross[243] Demand Reductions (MW)	**363.89**	11.15	175.4	76.18	35.25	27.54	9.05	29.32
CPITD Low-Income Verified Gross Demand Reductions (MW)	**22.48**	2.25	12.5	2.95	1.15	1.18	0.26	2.64
CPITD Commercial and Industrial Verified Gross Demand Reductions (MW)	**947.98**	128.98	177.2	289.26	74.72	76.25	37.21	163.64
CPITD Government, Non-Profit, and Institutional (GNI) Verified Gross Demand Reductions (MW)	**206.52**	16.54	53.0	41.59	25.79	23.25	4.78	41.57
CPITD Total Verified Gross Demand Reductions (MW)	**1540.61**	158.92	418.1	409.98	136.92	128.22	51.30	237.17

[239] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[240] PECO Conservation Voltage Reduction Program demand savings are divided between sectors based on reported gross savings from Table 9-1 in the PECO PY4 annual report.
[241] CPITD verified = sum of verified savings from PY1 through PY4. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.
[242] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[243] CPITD verified = sum of verified savings from PY1 through PY4. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.

Table 3-10: Total EDC Proposed Verified Demand Reductions by Sector

EDC Proposed Savings	Statewide[244]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Residential Verified Gross[245] Demand Reductions (MW)	**NA**	N/A	213.8	76.18	52.45	44.31	15.83	52.08
CPITD Low-Income Verified Gross Demand Reductions (MW)	**NA**	N/A	17.5	2.95	1.15	1.18	.26	2.64
CPITD Commercial and Industrial Verified Gross Demand Reductions (MW)	**NA**	N/A	191.9	304.92	75.10	76.32	37.35	164.57
CPITD Government, Non-Profit, and Institutional (GNI) Verified Gross Demand Reductions (MW)	**NA**	N/A	59.2	41.59	25.79	23.25	4.78	41.57
CPITD Total Verified Gross Demand Reductions (MW)	**NA**	N/A	482.3	425.64	154.49	145.06	58.22	260.86

[244] Statewide values are for illustration purposes only. There are no statewide targets under Act 129.
[245] CPITD verified = sum of verified savings from PY1 through PY4. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.

Figure A-1, Figure A-2, Figure A-3, and Figure A-4 Figure A-4 provide graphical summaries of the above-stated demand reductions.

Figure A-1: Top 100 Hours TRM Verified Savings Demand Reductions by Sector and EDC

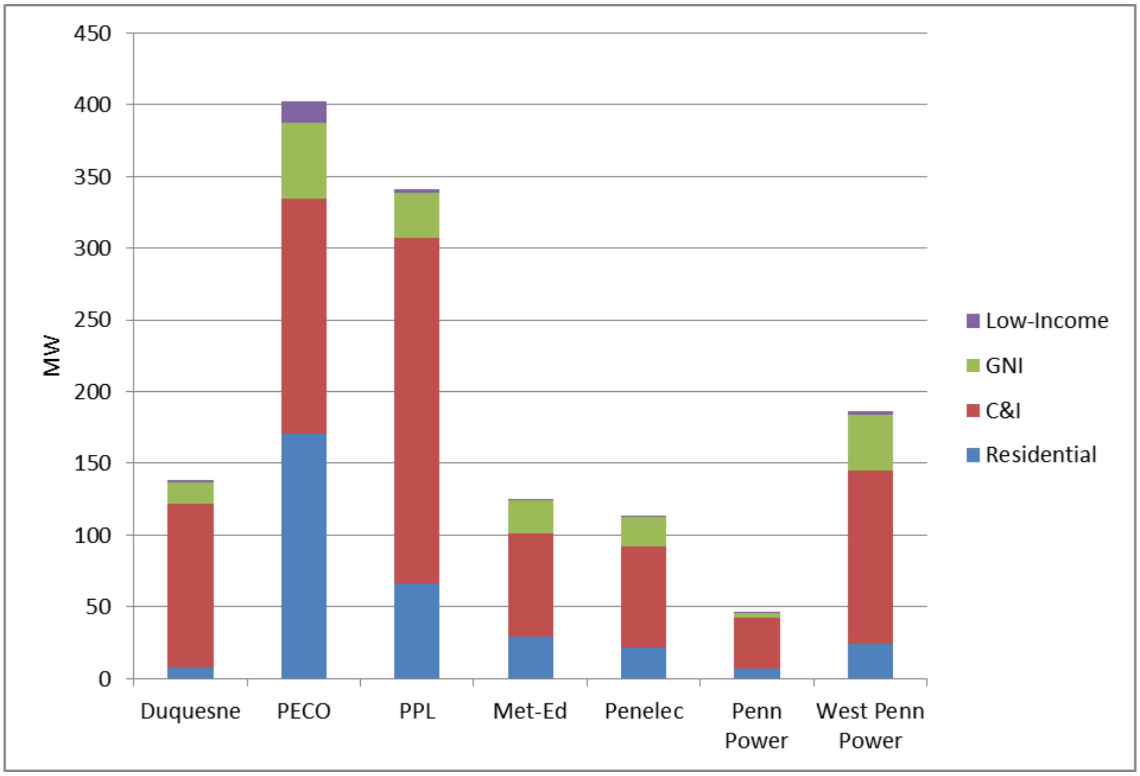


Figure A-2: Top 100 Hours EDC Proposed Verified Savings Demand Reductions by Sector and EDC

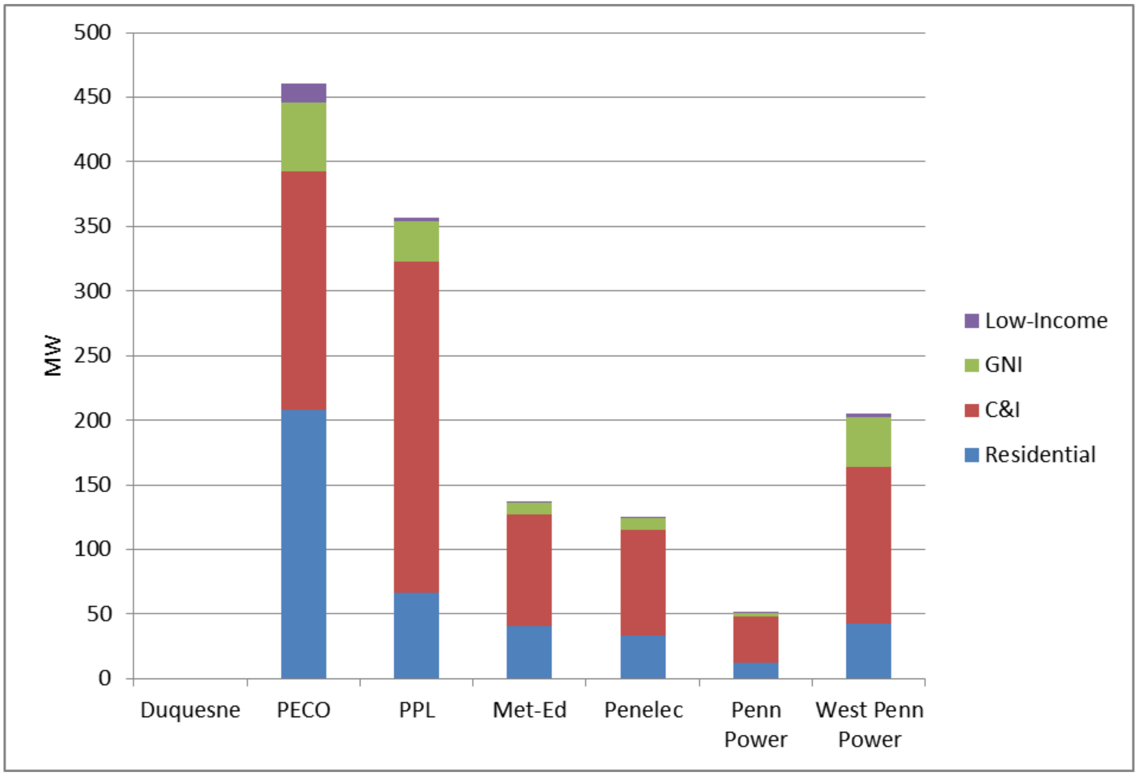


Figure A-3: Total TRM Verified Savings Demand Reductions by Sector and EDC

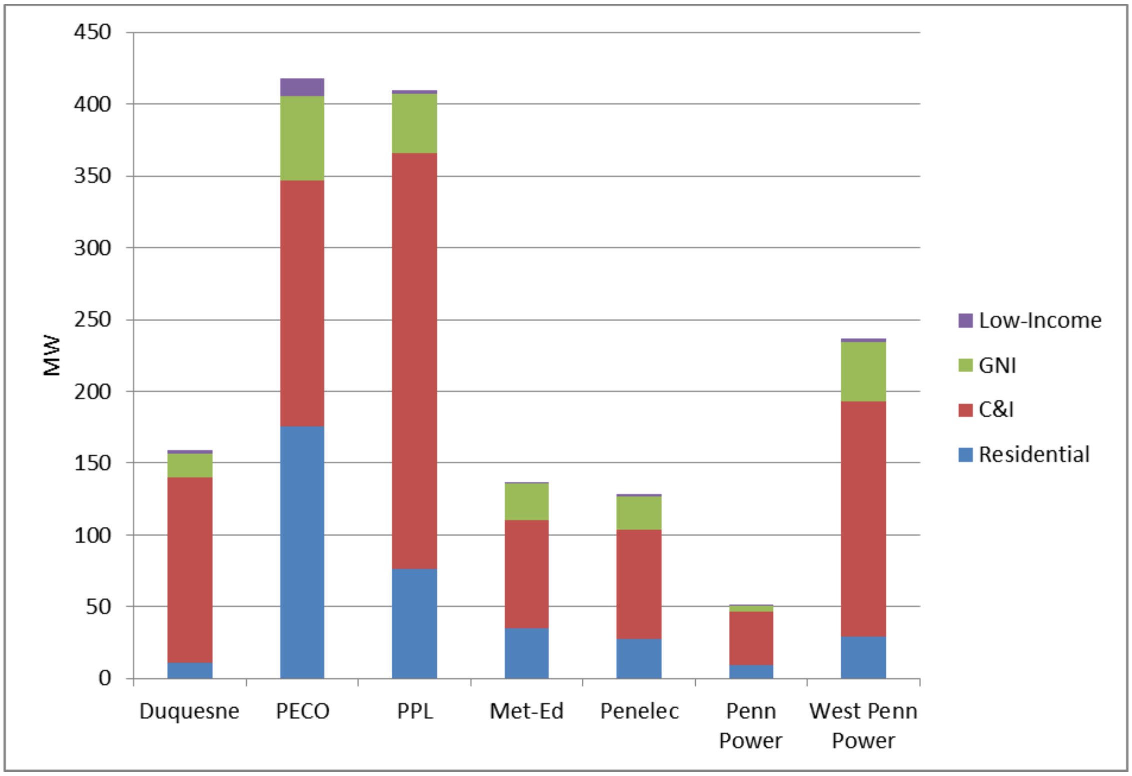
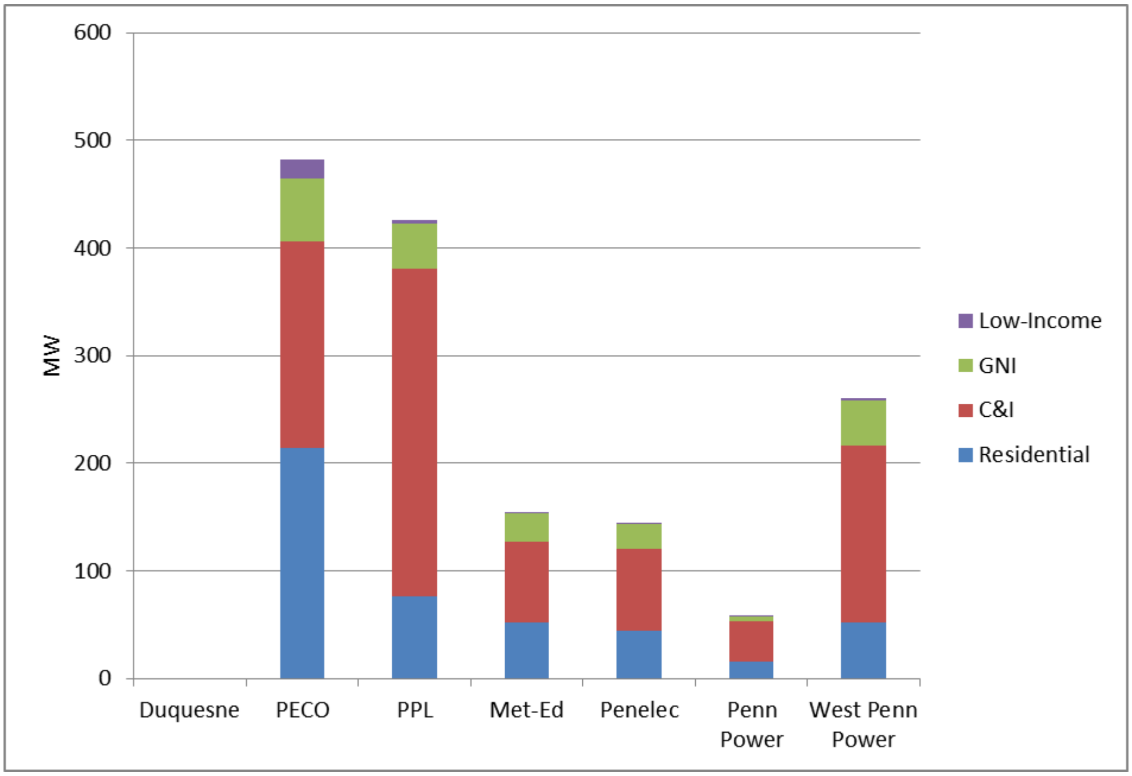


Figure A-4: Total EDC Proposed Verified Savings Demand Reductions by Sector and EDC



Top 100 Hours Phase I Demand Reduction[246]

- Statewide CPITD TRM Verified Savings for demand reductions are **1,349.92** MW.

Top 100 Hours Low-Income Sector

- The CPITD TRM Verifies Savings for demand reductions achieved by low-income sector programs are **20.43** MW, this is 1.5% of total portfolio verified savings.

Top 100 Hours Government/Educational/Non-Profit (GNI) Sector

- The CPITD TRM Verified Savings for demand reductions achieved by GNI sector programs are **179.09** MW, this is 13.3% of total portfolio verified savings.

[246] Demand reductions include both the demand savings from the installation of energy efficiency measures and the demand reduction associated with demand response programs.

Total Phase I Demand Reduction[247]

- The statewide CPITD TRM Verified Savings for demand reductions are **1,608.64** MW.

Total Low-Income Sector

- The statewide CPITD TRM Verified Savings for demand reductions in the low-income sector programs are **22.48** MW, this is 1.5% of total portfolio savings.

Total Government/Non-Profit/Institutional (GNI) Sector

- The statewide CPITD TRM Verifies Savings for demand reductions in the GNI sector are 206.52 MW, this is 13.4% of total portfolio verified savings.

[247] Demand reductions include both the demand savings from the installation of energy efficiency measures and the demand reduction associated with demand response programs.

3.3.2 Duquesne

Table 3-11 and Table 3-12 present Duquesne's TRM Verified Savings for each EE&C program in Phase I of Act 129. Figure A-5 presents the TRM Verified Savings for demand reductions for each program year during Phase I.

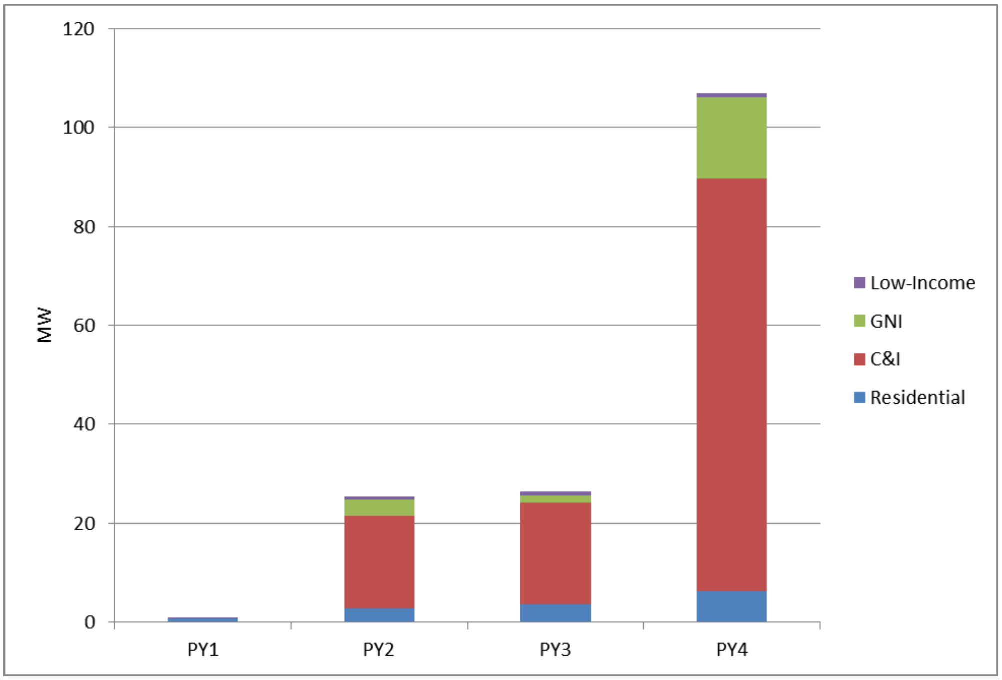
Table 3-11: Duquesne Phase I Top 100 Hours CPITD TRM Verified Savings - Demand Reductions by Program

Program: Top 100 Hours Demand Reductions	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings
Energy Efficiency Programs	DR/EE	
Residential: EE Program (REEP): Rebate Program	0.0/0.918	0.7%
Residential: EE Program (Upstream Lighting)	0.0/4.403	3%
Residential: School Energy Pledge	0.0/0.821	0.6%
Residential: Appliance Recycling	0.0/1.489	1%
Residential: Low Income EE	0.0/0.406	0.3%
Residential: Low Income EE (Upstream Lighting)	0.0/1.128	0.8%
Commercial Sector Umbrella EE	0.540/.998	1%
Commercial Sector Umbrella EE (Upstream Lighting)	0.0/18.533	13%
Healthcare EE	1.631/2.089	3%
Industrial Sector Umbrella EE	3.845/0.751	3%
Chemical Products EE	0.795/2.051	2%
Mixed Industrial EE	7.370/2.686	7%
Office Building – Large – EE	4.286/7.660	9%
Office Building – Small EE	0.073/1.947	2%
Primary Metals EE	44.175/3.805	35%
Public Agency / Non-Profit	7.519/7.656	11%
Retail Stores – Small EE	0.0/4.200	3%
Retail Stores – Large EE	1.129/2.586	3%
Demand Response Programs		
Residential Demand Response	0.465/0.0	0.3%
Large Curtailable Demand Response	2.602/0.0	2%
Subtotal DR Programs	74.43	53.7%
Subtotal EE Programs	64.13	46.3%
TOTAL	**138.56**	

Table 3-12: Duquesne Phase I Total CPITD TRM Verified Savings - Demand Reductions by Program

Program: Total Demand Reductions	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings
Energy Efficiency Programs	DR/EE	
Residential: EE Program (REEP): Rebate Program	0.0/1.378	0.9%
Residential: EE Program (Upstream Lighting)	0.0/6.351	4%
Residential: School Energy Pledge	0.0/0.835	0.5%
Residential: Appliance Recycling	0.0/2.116	1%
Residential: Low Income EE	0.0/0.622	0.4%
Residential: Low Income EE (Upstream Lighting)	0.0/1.628	1%
Commercial Sector Umbrella EE	0.540/1.196	1%
Commercial Sector Umbrella EE (Upstream Lighting)	0.0/25.582	16%
Healthcare EE	1.631/3.279	3%
Industrial Sector Umbrella EE	3.845/0.762	3%
Chemical Products EE	0.795/2.451	2%
Mixed Industrial EE	7.370/3.960	7%
Office Building – Large – EE	4.286/10.808	10%
Office Building – Small EE	0.073/2.394	2%
Primary Metals EE	44.175/4.448	31%
Public Agency / Non-Profit	7.519/9.026	10%
Retail Stores – Small EE	0.0/4.804	3%
Retail Stores – Large EE	1.129/2.846	3%
Demand Response Programs		
Residential Demand Response	0.465/0.0	0.3%
Large Curtailable Demand Response	2.602/0.0	2%
Subtotal DR Programs	74.43	46.8%
Subtotal EE Programs	84.49	53.2%
TOTAL	**158.91**	

Figure A-5: Duquesne Phase I TRM Verified Savings - Total Demand Reductions by Program Year



3.3.3 PECO

Table 3-13 and Table 3-14 present PECO's TRM Verified Savings and EDC Proposed Savings for demand reductions for each EE&C program in Phase I of Act 129. Figure A-6 presents the TRM Verified Savings for demand reductions in each program year of Phase I.

PECO proposed alternative values for the CF and IEF for residential CFLs, affecting its Smart Lighting Discounts and Low-Income Energy Efficiency Programs.[248] PECO proposed a CF of 11.7% (5% in the TRM) and IEF of 1.19 (unaccounted for in the TRM and therefore equal to 1.00).

Table 3-13: PECO Phase I Top 100 Hours CPITD Verified Savings and EDC Proposed Savings- Demand Reductions by Program

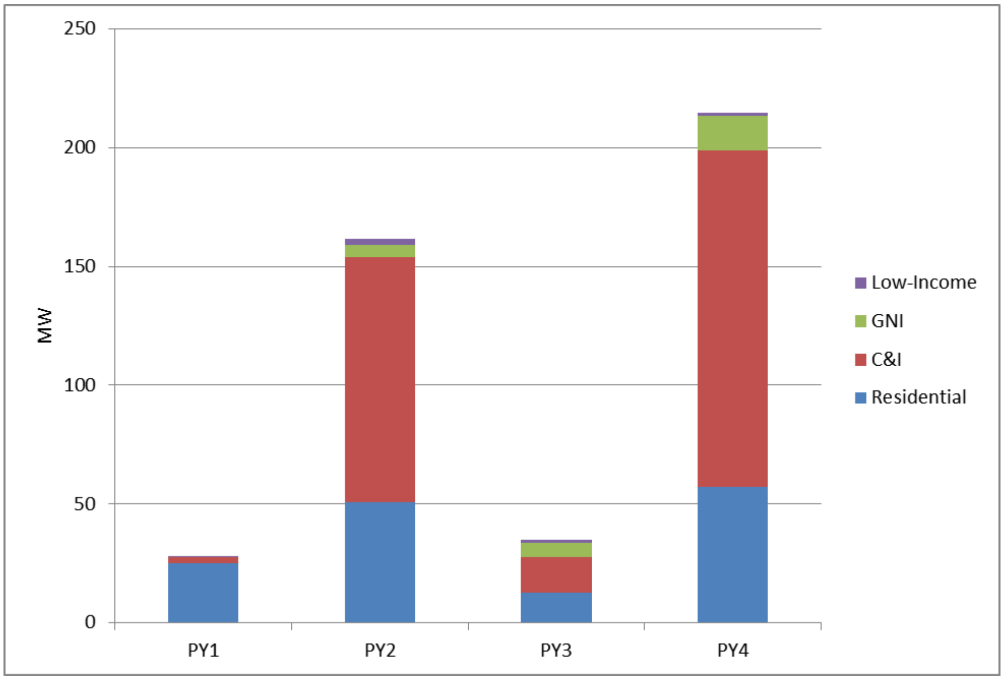
Program: Top 100 Hours Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Smart Lighting Discounts Program	62.0	16%	99.3	22%
Smart Appliance Recycling Program	9.1	2%	9.1	2%
Smart Home Rebates Program	18.9	5%	18.9	4%
Low-Income Energy Efficiency Program	4.4	1%	8.0	2%
Smart Equipment Incentives-C&I	34.4	9%	34.4	8%
Smart Construction Incentives	2.7	0.7%	2.7	0.6%
Smart Equipment Incentives - GNI	16.3	4%	16.3	4%
Conservation Voltage Reduction	89.3	22%	89.3	19%
Permanent Load Reduction	0.2	0.05%	0.2	0.04%
Subtotal Energy Efficiency Programs-	**237.3**	**60%**	**278.2**	**60.3%**
Demand Response Programs				
Residential Smart A/C Saver	51.3	13%	51.3	11%
Commercial Smart A/C Saver	1.6	0.4%	1.6	0.3%
Demand Response Aggregators	94.8	24%	113.4	25%
Distributed Energy Resources	14.1	4%	16.4	4%
Subtotal Demand Response Programs-	**161.8**	**40%**	**182.7**	**39.6%**
TOTAL	**399.2**		**461.1**	

[248] See PECO Final Annual Report for the Pennsylvania Public Utility Commission, November 15, 2013, p. 1.

Table 3-14: PECO Phase I Total CPITD Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Smart Lighting Discounts Program	63.4	15%	101.8	21%
Smart Appliance Recycling Program	9.6	2%	9.6	2%
Smart Home Rebates Program	21.6	5%	21.6	5%
Low-Income Energy Efficiency Program	5.4	1%	10.4	2%
Smart Equipment Incentives-C&I	40.4	10%	40.4	8%
Smart Construction Incentives	3.7	0.9%	3.7	0.8%
Smart Equipment Incentives - GNI	22.7	5%	22.7	5%
Conservation Voltage Reduction	89.3	21%	89.3	19%
Permanent Load Reduction	0.2	0.05%	0.2	0.04%
Subtotal Energy Efficiency Programs-	**256.3**	**61%**	**299.7**	**62.1%**
Demand Response Programs				
Residential Smart A/C Saver	51.3	12%	51.3	11%
Commercial Smart A/C Saver	1.6	0.4%	1.6	0.3%
Demand Response Aggregators	94.8	23%	113.4	24%
Distributed Energy Resources	14.1	4%	16.4	3.4%
Subtotal Demand Response Programs-	**161.8**	**39%**	**182.7**	**37.9%**
TOTAL	**418.1**		**482.3**	

Figure A-6: PECO Total TRM Verified Savings - Demand Reduction by Program Year



3.3.4 PPL

Table 3-15 and Table 3-16 present PPL's TRM Verified Savings and EDC Proposed Savings for demand reductions for each EE&C program in Phase I of Act 129. Figure A-7: presents the TRM Verified Savings for demand reductions for each program year of Phase I.

PPL reported EDC Proposed Savings using an alternative methodology to estimate the demand reduction from its Load Curtailment Program.[249] This methodology differed from the methodology determined by the SWE Team and resulted in a 15.66 MW increase in demand reductions for Phase I.

Table 3-15: PPL Top 100 Hours CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

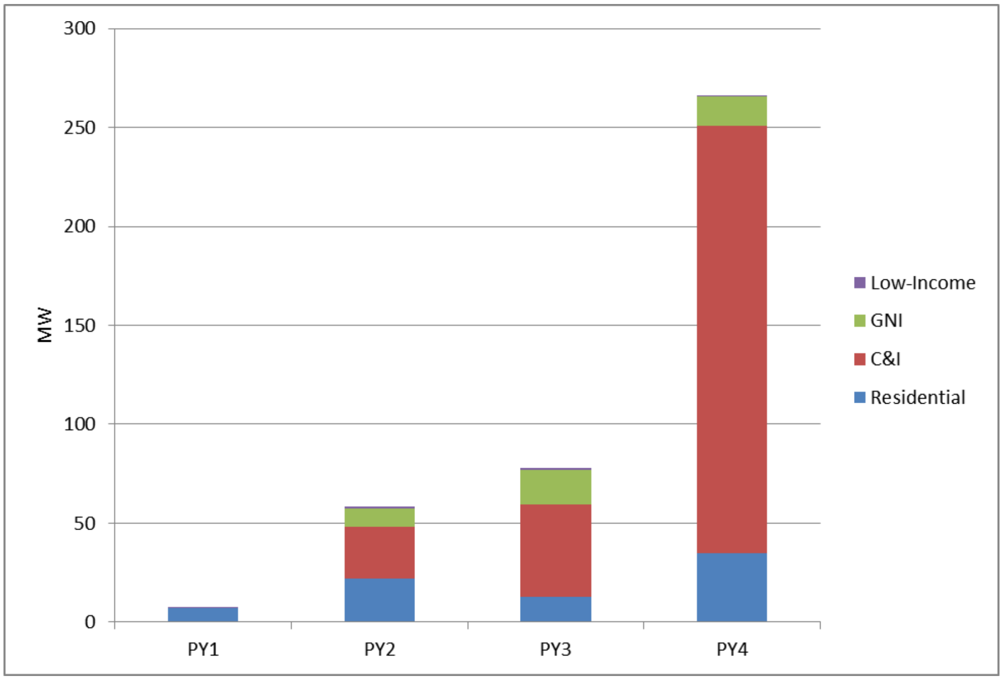
Program: Top 100 Hours Demand Reductions	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Gross MW Savings	% of Portfolio CPITD EDC Proposed Gross MW Savings
Energy Efficiency Programs				
Appliance Recycling	11.39	3%	11.39	3%
Custom Incentive	15.28	4 %	15.28	4%
Efficient Equipment Incentive	107.88	31%	107.88	30%
Energy Efficiency Behavior & Education	7.00	2%	7.00	2%
E-Power Wise	0.47	0.14%	0.47	0.13%
Home Energy Assessment & Weatherization	0.41	0.12%	0.41	0.11%
HVAC Tune-Up	1.13	0.3%	1.13	0.3%
Renewable Energy	3.97	1%	3.97	1%
Residential Lighting	54.96	16 %	54.96	15 %
WRAP	2.01	0.6%	2.01	0.6%
Subtotal Energy Efficiency Programs	**204.5**	**60%**	**204.5**	**57 %**
Demand Response Programs				
Load Curtailment	118.20	34%	133.86	37%
Direct Load Control	18.23	5%	18.23	5%
Subtotal Demand Response Programs	**136.43**	**40%**	**152.09**	**42%**
TOTAL	**340.90**		**356.56**	

[249] See PPL Final Annual Report to the Pennsylvania Public Utility Commission, November 15, 2013, Section 11.2.4, p. 137.

Table 3-16: PPL Total CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Gross MW Savings	% of Portfolio CPITD EDC Proposed Gross MW Savings
Energy Efficiency Programs				
Appliance Recycling	16.30	4%	16.30	4%
Custom Incentive	22.48	6%	22.48	5%
Efficient Equipment Incentive	150.97	37 %	150.97	35%
Energy Efficiency Behavior & Education	7.00	2%	7.00	2%
E-Power Wise	0.55	0.1%	0.55	0.1%
Home Energy Assessment & Weatherization	0.54	0.1%	0.54	0.1%
HVAC Tune-Up	1.20	0.3%	1.20	0.3%
Renewable Energy	4.02	1.0%	4.02	0.9%
Residential Lighting	68.11	17%	68.11	17%
WRAP	2.40	0.6%	2.40	0.6%
Subtotal Energy Efficiency Programs	**273.57**	**67%**	**273.57**	**65%**
Demand Response Programs				
Load Curtailment	118.20	29%	133.86	31%
Direct Load Control	18.23	4%	18.23	4%
Subtotal Demand Response Programs	**136.43**	**33%**	**152.09**	**36%**
TOTAL	**409.98**		**425.64**	

Figure A-7: PPL Total TRM Verified Savings - Demand Reduction by Program Year[250]



3.3.5 Met-Ed

Table 3-17 and Table 3-18 present Met-Ed's TRM Verified Savings and EDC Proposes Savings for each EE&C program in Phase I of Act 129. Figure A-8 presents the TRM Verified Savings for demand for each program year of Phase I.

Met-Ed reported EDC Proposed Savings using an alternative CF and IEF for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small C&I programs.[251] The product of CF x IEF was capped at 15%.[252] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRIM and therefore equal to 1.00) was 5%.

[250] From PY1-PY4 annual reports, scaled from reported PYTD values when no verified values were available by sector.
[251] Some kits distributed to Small C&I customers included CFLs which ended up in residential households.
[252] See Met-Ed Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

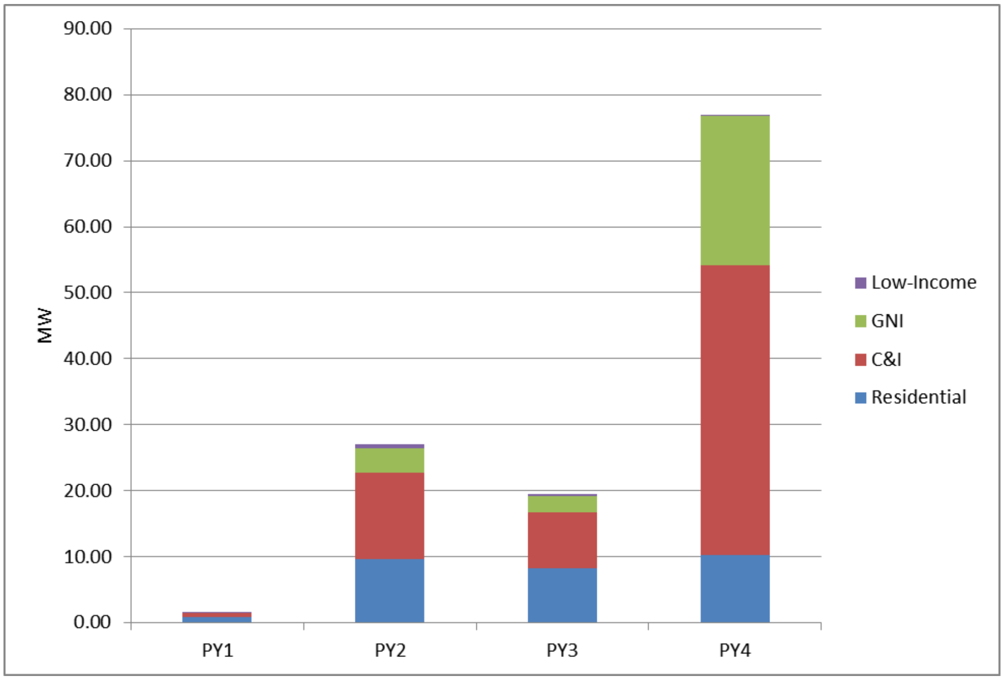
Table 3-17: Met-Ed Top 100 Hours CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Top 100 Hours Demand Reductions	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	2.72	2%	5.86	4%
Appliance Turn-In	6.35	5%	6.35	5%
EE HVAC	4.93	4%	4.93	4%
EE Products	5.36	4%	13.57	10%
New Construction	0.70	1%	0.70	1%
Behavioral Modification and Education	0.05	0%	0.05	0%
Multiple Family	0.18	0%	0.55	0%
WARM Programs	0.95	1%	0.95	1%
C&I Small Sector Equipment	17.41	14%	17.78	13%
C&I Large Sector Performance Contracting and Equipment	17.17	14%	17.17	13%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.28	0%	0.28	0%
Government/Remaining Non-Profit	9.03	7%	9.03	7%
Subtotal Energy Efficiency Programs	**65.13**	**52%**	**77.22**	**56%**
Demand Response Programs				
PJM Demand Response	51.20	41%	51.20	37%
Direct Load Control	8.69	7%	8.69	6%
Subtotal Demand Response Programs	**59.89**	**48%**	**59.89**	**44%**
TOTAL	**125.02**		**137.11**	

Table 3-18: Met-Ed Total CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	4.64	3%	9.52	6%
Appliance Turn-In	7.31	5%	7.31	5%
EE HVAC	5.85	4%	5.85	4%
EE Products	7.57	6%	19.52	13%
New Construction	0.97	1%	0.97	1%
Behavioral Modification and Education	0.05	0%	0.05	0%
Multiple Family	0.18	0%	0.55	0%
WARM Programs	1.15	1%	1.15	1%
C&I Small Sector Equipment	18.69	14%	19.07	12%
C&I Large Sector Performance Contracting and Equipment	18.25	13%	18.25	12%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.35	0%	0.35	0%
Government/Remaining Non-Profit	12.02	9%	12.02	8%
Subtotal Energy Efficiency Programs	**77.03**	**56%**	**94.61**	**61%**
Demand Response Programs				
PJM Demand Response	51.20	37%	51.20	33%
Direct Load Control	8.69	6%	8.69	6%
Subtotal Demand Response Programs	**59.89**	**44%**	**59.89**	**39%**
TOTAL	**136.92**		**154.50**	

Figure A-8: Met-Ed TRM Verified Total Demand Reduction by Program Year



3.3.6 Penelec

Table 3-19 and

Table 3-20 present Penelec's TRM Verified Savings and EDC Proposed Savings each EE&C program in Phase I of Act 129. Figure A-9 presents the TRM Verified Savings for demand reductions for each program year of Phase I.

Penelec reported EDC Proposed Savings using an alternative CF and IE) for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small C&I programs.[253] The product of CF x IEF was 14.3%.[254] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 0.05.

[253] Some kits distributed to small C&I customers included CFLs which ended up in residential households.
[254] See Penelec Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

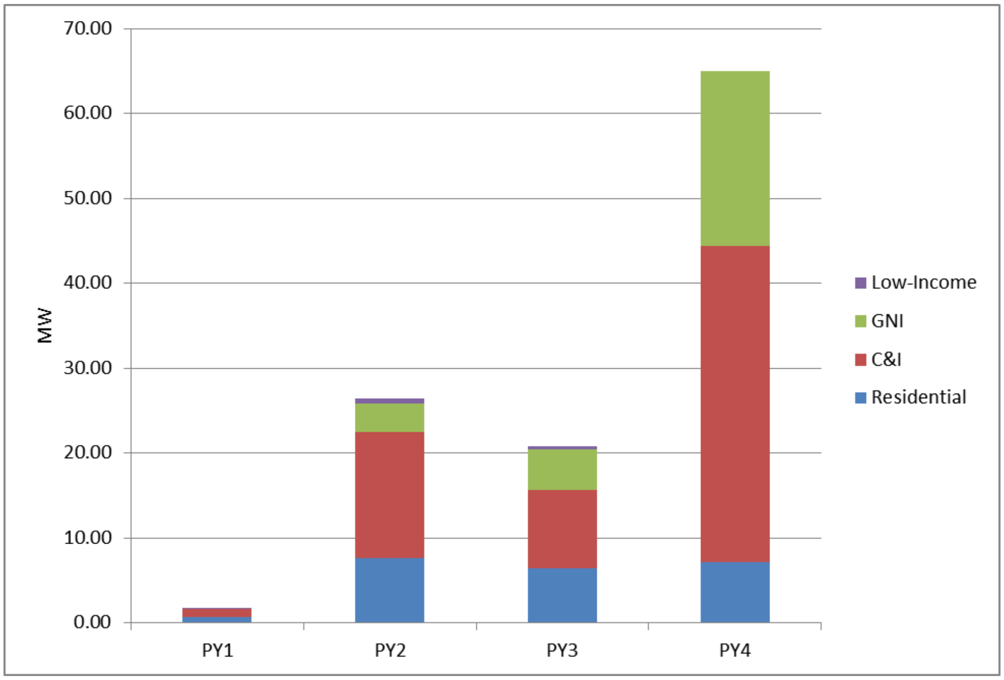
Table 3-19: Penelec Top 100 Hours CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Top 100 hours	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	2.47	2%	5.21	4%
Appliance Turn-In	5.40	5%	5.40	4%
EE HVAC	1.97	2%	1.97	2%
EE Products	5.53	5%	13.88	11%
New Construction	0.36	0%	0.36	0%
Behavioral Modification and Education	0.03	0%	0.03	0%
Multiple Family	0.29	0%	0.83	1%
WARM Programs	1.00	1%	1.00	1%
C&I Small Sector Equipment	16.90	15%	16.97	14%
C&I Large Sector Performance Contracting and Equipment	9.99	9%	9.99	8%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.36	0%	0.36	0%
Government/Remaining Non-Profit	9.33	8%	9.33	7%
Subtotal Energy Efficiency Programs	**53.63**	**47%**	**65.33**	**52%**
Demand Response Programs				
PJM Demand Response	54.39	48%	54.39	43%
Direct Load Control	5.92	5%	5.92	5%
Subtotal Demand Response Programs	**60.31**	**53%**	**60.31**	**48%**
TOTAL	**113.94**		**125.63**	

Table 3-20: Penelec Total TRM Verified Savings - Demand Reduction by Program Year

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	4.20	3%	8.52	6%
Appliance Turn-In	6.52	5%	6.52	4%
EE HVAC	2.54	2%	2.54	2%
EE Products	7.68	6%	19.59	14%
New Construction	0.37	0%	0.37	0%
Behavioral Modification and Education	0.03	0%	0.03	0%
Multiple Family	0.29	0%	0.83	1%
WARM Programs	1.18	1%	1.18	1%
C&I Small Sector Equipment	20.10	16%	20.16	14%
C&I Large Sector Performance Contracting and Equipment	12.67	10%	12.67	9%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.36	0%	0.36	0%
Government/Remaining Non-Profit	11.98	9%	11.98	8%
Subtotal Energy Efficiency Programs	**67.92**	**53%**	**84.76**	**58%**
Demand Response Programs				
PJM Demand Response	54.39	42%	54.39	37%
Direct Load Control	5.92	5%	5.92	4%
Subtotal Demand Response Programs	**60.31**	**47%**	**60.31**	**42%**
TOTAL	**128.60**		**145.06**	

Figure A-9: Penelec TRM Verified Total Demand Reduction by Program Year



3.3.7 Penn Power

Table 3-21 and Table 3-22 present Penn Power's TRM Verified Savings and EDC Proposed Savings for each EE&C program in Phase I of Act 129. Figure A-10 presents the TRM Verified Savings for each program year of Phase I.

Penn Power reported EDC Proposed Savings using an alternative CF and IEF for residential CFLs, affecting the Residential Energy Efficient Products, Home Energy Audits and Outreach, Multiple Family, and Small C&I programs.[255] The product CF x IEF was capped at 15%.[256] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%.

[255] Some kits distributed to small C&I customers included CFLs which ended up in residential households.
[256] See Penn Power Final Annual Report to the Pennsylvania Public Utility Commission for explanations of these alternate factors.

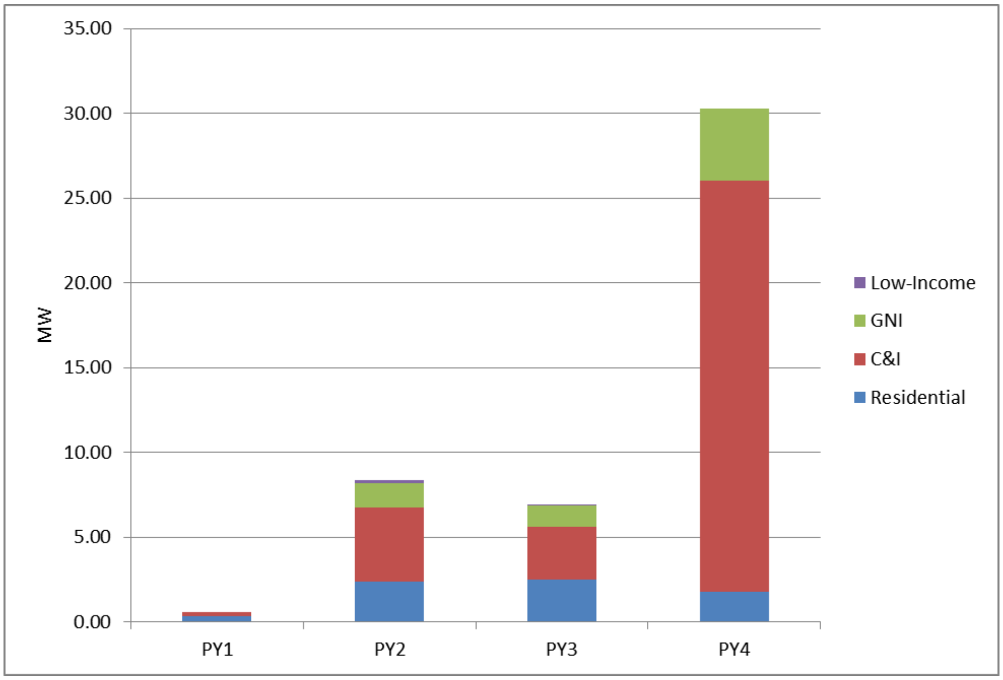
Table 3-21: Penn Power Top 100 Hours CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Top 100 Hours	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	0.69	1%	1.48	3%
Appliance Turn-In	1.30	3%	1.30	3%
EE HVAC	1.01	2%	1.01	2%
EE Products	2.24	5%	6.19	12%
New Construction	0.54	1%	0.54	1%
Behavioral Modification and Education	0.04	0%	0.04	0%
Multiple Family	0.05	0%	0.16	0%
WARM Programs	0.27	1%	0.27	1%
C&I Small Sector Equipment	6.59	14%	6.72	13%
C&I Large Sector Performance Contracting and Equipment	2.48	5%	2.48	5%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.01	0%	0.01	0%
Government/Remaining Non-Profit	2.82	6%	2.82	6%
Subtotal Energy Efficiency Programs	**18.04**	**39%**	**24.17**	**47%**
Demand Response Programs				
PJM Demand Response	27.00	58%	27.00	53%
Direct Load Control	1.16	3%	1.16	2%
Subtotal Demand Response Programs	**28.16**	**61%**	**28.16**	**55%**
TOTAL	**46.19**		**51.17**	

Table 3-22: Penn Power Total CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	1.36	3%	2.66	5%
Appliance Turn-In	1.59	3%	1.59	3%
EE HVAC	1.25	2%	1.25	2%
EE Products	3.01	6%	8.39	14%
New Construction	0.74	1%	0.74	1%
Behavioral Modification and Education	0.04	0%	0.04	0%
Multiple Family	0.05	0%	0.16	0%
WARM Programs	0.27	1%	0.27	0%
C&I Small Sector Equipment	7.69	15%	7.83	13%
C&I Large Sector Performance Contracting and Equipment	3.63	7%	3.73	6%
Government/Non-Profit Street lighting	0.00	0%	0.00	0%
Government/Non-Profit	0.01	0%	0.01	0%
Government/Remaining Non-Profit	3.39	7%	3.39	6%
Subtotal Energy Efficiency Programs	**23.03**	**45%**	**30.05**	**52%**
Demand Response Programs				
PJM Demand Response	27.00	2%	27.00	46%
Direct Load Control	1.16	53%	1.16	2%
Subtotal Demand Response Programs	**28.16**	**55%**	**28.16**	**48%**
TOTAL	**51.18**		**58.20**	

Figure A-10: Penn Power Total TRM Verified Savings - Demand Reductions by Program Year



3.3.8 West Penn Power

Table 3-23 and Table 3-24 present West Penn Power's TRM Verified Savings and EDC Proposed Savings for each EE&C program in Phase I of Act 129. Figure A-11 presents the TRM Verified Savings for demand reductions for each program year of Phase I.

West Penn Power reported EDC Proposed Savings using an alternative CF and IEF for residential CFLs, affecting the Residential Energy Efficient Products, Home Performance, and Small C&I programs.[257] The product of CF x IEF was capped at 15%.[258] The product of these two factors in the TRM (CF = 0.05, IEF unaccounted for in the TRM and therefore equal to 1.00) was 5%.

Table 3-23: West Penn Power Top 100 Hours CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

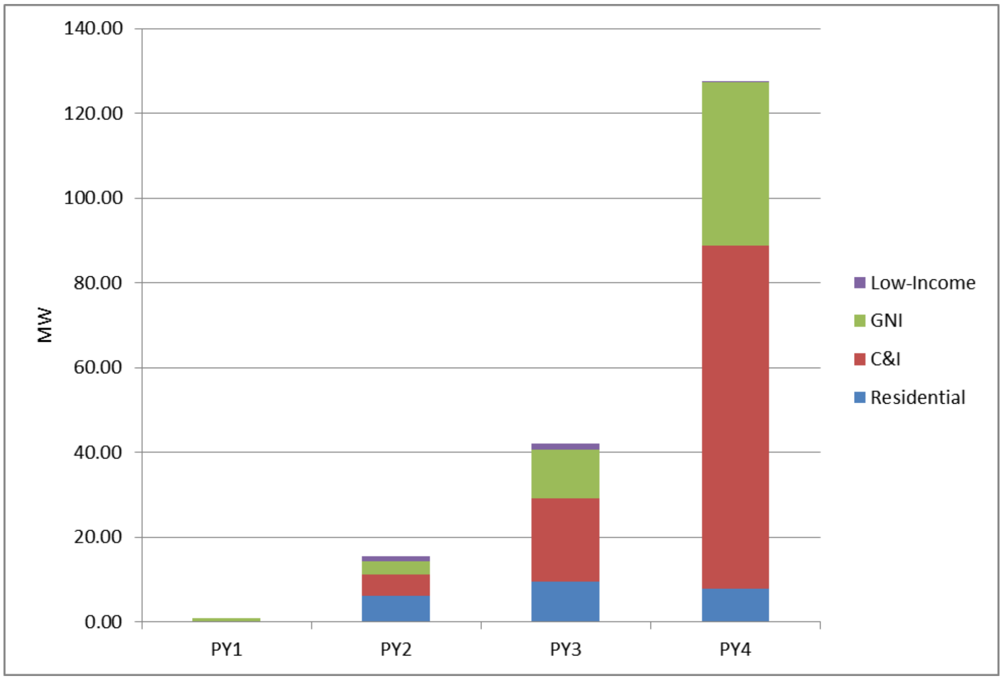
Program: Top 100 Hours	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	7.25	4%	12.91	6%
Appliance Turn-In	2.83	2%	2.83	1%
EE HVAC	6.82	4%	19.58	10%
EE Products	2.01	1%	2.01	1%
New Construction	1.91	1%	1.91	1%
Behavioral Modification and Education	0.71	0%	0.71	0%
Multiple Family	21.69	12%	22.62	11%
WARM Programs	8.10	4%	8.10	4%
C&I Small Sector Equipment	11.38	6%	11.38	6%
C&I Large Sector Performance Contracting and Equipment	24.61	13%	24.61	12%
Government/Non-Profit Street lighting	**87.31**	**47%**	**106.66**	**52%**
Government/Non-Profit				
Government/Remaining Non-Profit	93.60	50%	93.60	46%
Subtotal Energy Efficiency Programs	5.16	3%	5.16	3%
Demand Response Programs	**98.76**	**53%**	**98.76**	**48%**
PJM Demand Response	**186.07**		**205.43**	

[257] Some kits distributed to small C&I customers included CFLs which ended up in residential households.
[258] See Met-Ed Final Annual Report to the Pennsylvania Public Utility Commission for explanation of these alternate factors.

Table 3-24: West Penn Power Total CPITD TRM Verified Savings and EDC Proposed Savings - Demand Reductions by Program

Program: Total Demand Reduction	CPITD TRM Verified Gross MW Savings	% of Portfolio CPITD TRM Verified Gross MW Savings	CPITD EDC Proposed Verified Gross MW Savings	% of Portfolio CPITD EDC Proposed Verified Gross MW Savings
Energy Efficiency Programs				
Home Energy Audits and Outreach	9.56	4%	19.27	7%
Appliance Turn-In	4.49	2%	4.49	2%
EE HVAC	7.02	3%	20.07	8%
EE Products	3.08	1%	3.08	1%
New Construction	1.95	1%	1.95	1%
Behavioral Modification and Education	0.69	0%	0.69	0%
Multiple Family	50.60	21%	51.53	20%
WARM Programs	22.00	9%	22.00	8%
C&I Small Sector Equipment	11.38	0%	11.38	4%
C&I Large Sector Performance Contracting and Equipment	27.64	5%	27.64	11%
Government/Non-Profit Street lighting	**138.41**	**58%**	**162.10**	**62%**
Government/Non-Profit				
Government/Remaining Non-Profit	93.60	39%	93.60	36%
Subtotal Energy Efficiency Programs	5.16	2%	5.16	2%
Demand Response Programs	**98.76**	**42%**	**98.76**	**38%**
PJM Demand Response	**237.17**		**260.86**	

Figure A-11: West Penn Power Total TRM Verified Savings - Demand Reduction by Program Year



3.3.9 Demand Reduction from Energy Efficiency

Energy efficiency (EE) programs implemented by the EDCs were designed to meet the energy consumption reduction targets established by Act 129. Depending on the measures, however, they can also achieve demand savings, if they reduce energy consumption during times of peak demand.

For example, all of the EDCs have implemented commercial lighting programs that are designed to reduce energy consumption among commercial customers. As commercial lighting is in use during times typically associated with peak demand (i.e., midafternoon during the work week), these efficiency measures also reduce system load needed during these times and therefore are estimated to have peak demand reductions.

Table 3-25 shows the demand savings achieved by each EDC through both demand response and EE programs. These totals were obtained from each EDC's PY 4 annual report.

Table 3-25: Source of Top 100 Hours Demand Savings by EDC

EDC	Demand Response Program Savings (MW)	Energy Efficiency Program Savings (MW)	Total Demand Savings (MW)	% Demand from EE
Duquesne	74.43	64.13	138.56	46%
PECO	161.80	240.30	402.10	60%
PPL	136.43	204.50	340.93	60%
Met-Ed	59.89	65.13	125.02	52%
Penelec	60.31	53.63	113.94	47%
Penn Power	28.16	18.04	46.20	39%
West Penn Power	98.76	87.31	186.07	47%
Total	**619.78**	**733.04**	**1352.82**	**54%**

This table shows that 54% of the EDCs' overall demand savings resulted from EE programs implemented in their territories. These programs are providing dual benefits to consumers by enabling the EDCs to meet both energy and demand reduction targets.

In order to calculate the peak demand savings associated with each EE program measure, EDCs first consider the date of measure installation. Measures must be installed before the summer peak period to claim the full demand savings. Measures installed receive credit only for the top 100 hours that occur after installation. Measures installed after the top 100 hours cannot claim peak demand savings toward the 4.5% peak demand reduction goal, although the demand savings are included in the benefits calculation of the TRC test.

EDCs then use a measure-specific demand savings algorithm which typically includes a CF. The PA TRM defines a CF as "the fraction of the total technology demand that is coincident with the utility system summer peak, as defined by Act 129."[259] In other words, the CF represents the likelihood that a measure is operating and generating savings during this peak time period of the top 100 hours between June and September. These CFs were established in the TRM for each prescriptive measure offered by the EDCs and are multiplied by the demand savings achieved by each measure to determine the demand savings expected to occur during the top 100 hours. Table 3-26 outlines the CFs associated with a sample of measures established by the TRM.[260]

Table 3-26: Coincidence Factors for Sample of Measures

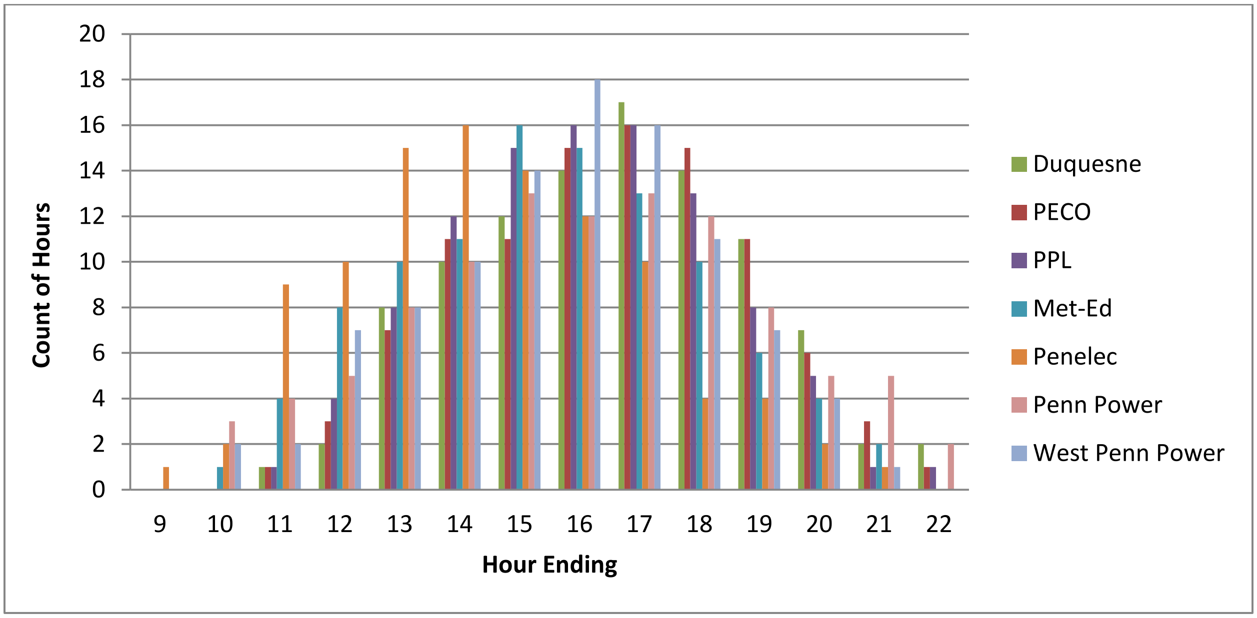
Measure	Coincidence Factor
Lighting - Office	0.84
Lighting - Retail	0.89
Lighting - Grocery	0.94
Exit Sign	1.00
Premium Motor - Single Motor	0.74
Electric Chiller	0.80
Smart Power Strip	0.50

The Lighting –Office CF of 0.84 indicates that this measure produces demand savings 84% of the time during peak demand periods.

[259] Pennsylvania Public Utilities Commission, *Technical Reference Manual*, June 2012.
[260] ibid.

There are potential issues with consistency in using the CFs established in the TRM across the EDCs. According to the TRM, "The time periods for energy savings and coincident peak demand savings were chosen to best fit the Act 129 requirement, which reflects the seasonal avoided cost patterns for electric energy and capacity that were used for the energy efficiency program cost effectiveness purposes."[261] However, the CFs in the TRM reflect various studies and summer peak load periods as the basis of the calculation and thus the CFs do not (nor can they) correlate exactly with the hours in which the top 100 peak load hours occurred in 2012 for each EDC. Figure A-1 presents the frequency of the top 100 hours by hour ending for each of the EDCs.

Figure A-1: Frequency of Top 100 Hours by Hour Ending for Each EDC



[261] Pennsylvania Public Utilities Commission, *Technical Reference Manual*, June 2012.

Table 3-27 shows the percentages of the top 100 hours occurring within the TRM defined peak period (12:00 p.m. -- 8:00 p.m. from June through September) for each EDC.

Table 3-27: Percentage of EDC's Top 100 Hours during 2012 TRM Peak by EDC

EDC	% of Top 100 Hours occurring during TRM Peak
Duquesne	93%
PECO	92%
PPL	93%
Met-Ed	85%
Penelec	77%
Penn Power	81%
West Penn Power	88%

The hourly load of different end uses varies with time of day. For example, residential lighting loads are higher during evening periods than daytime periods. Given the number of top 100 hours in the evening as shown in Table 3-27 and the significant contribution of residential lighting to savings, several EDC evaluators elected to develop EDC-specific estimates of residential lighting performance during the EDC's top 100 hours using lighting load shapes rather than simple coincidence factors.

Table 3-28 presents the first day each EDC experienced a top 100 hour as well as the last day one such hour occurred. All days were in 2012.

Table 3-28: EDC First and Last Top 100 Hour Date

EDC	First Hour Date	Last Hour Date
Duquesne	June 19	September 6
PECO	June 20	August 9
PPL	June 20	August 9
Met-Ed	June 20	September 7
Penelec	June 20	September 6
Penn Power	June 18	September 6
West Penn Power	June 19	September 6

It is apparent from the spread of hours across the EDCs for 2012 alone that it would be extremely challenging to produce CFs that fairly account for demand savings across all EDCs using the top 100 hours definition of peak period. Equally challenging is the task to create CFs that would remain defensible from one year to the next, based on the difficulty of predicting the top 100 hours beforehand.

However, starting in 2014, the EDCs are using the PJM definition of peak, which is 2:00 p.m. to 6:00 p.m. on non-holiday weekdays from June through August, as outlined in the 2014 TRM.[262] This standardization of the peak definition will enable the development of more consistent CFs across the EDCs and more reliable estimates of peak demand reductions from EE programs.

3.4 Summary of EDC Demand Response Programs

During Phase I of Act 129, as discussed previously, demand reductions were achieved through both EE measures and DR programs. EE measures provided a constant demand reduction during the period when a measure was in use. If this period fell within the top 100 hours of the 2012 summer, the demand reduction counted toward the EDCs' demand reduction targets. DR programs provided an instantaneous reduction in demand that lasted only for the duration of the demand response event. If the demand response event fell within the top 100 hours of the 2012 summer, the demand reduction counted toward the EDCs' demand reduction targets. Savings from DR programs were reported only during PY4.

Descriptions of each EDC's EE programs, which also contributed to achieving the Act 129 demand reduction targets, are in Section 2.3 of this report.

3.4.1 Duquesne

Duquesne reported savings from two DR programs in its PY4 annual report:

- Residential Demand Response Program
- Large Curtailable Demand Response Program

Both programs reported only demand and not energy impacts. Details on these two programs can be found in Appendix A, section A.1 of this report.

3.4.2 PECO

PECO reported savings from five DR programs in its PY4 annual report:

- Residential Smart AC Saver Program
- Commercial Smart AC Saver
- Permanent Load Reduction Program
- Demand Response Aggregators
- Distributed Energy Resources

The Permanent Load Reduction Program reported both energy and demand impacts, whereas the other DR programs reported only demand and not energy impacts. Details on these five programs can be found in Appendix A, section A.2 of this report.

[262] Pennsylvania Public Utilities Commission, *Technical Reference Manual*, June 2014.

3.4.3 PPL

PPL reported savings from two DR programs in its PY4 annual report:

- Direct Load Control Program
- Load Curtailment Program

Both programs reported only demand and not energy impacts. Details on these two programs can be found in Appendix A, section A.3 of this report.

3.4.4 FirstEnergy Legacy Companies

Met-Ed, Penelec, and Penn Power implemented the same programs during Phase I of Act 129 and are therefore discussed together in this section. All three companies reported savings from two DR programs in their PY4 annual report:

- Residential Demand Reduction Program
- Commercial and Industrial Sector Demand Response Program – CSP Mandatory and Voluntary Curtailment Program

Both programs reported energy and demand impacts. Details on these two programs can be found in Appendix A, section A.4 of this report.

3.4.5 West Penn Power

West Penn Power reported savings from two DR programs in its PY4 annual report but implemented three programs:

- Residential Critical Peak Rebate Rate
- Customer Load Response Program
- Customer Resources Demand Response Program

The impacts from the Customer Load Response Program were reported under the Customer Resources Demand Response Program. Both programs that reported savings reported only demand and not energy impacts. Details on these three programs can be found in Appendix A, section A.5 of this report.

3.5 SWE Demand Response Study

Act 129 requires the subject EDCs to reduce, by May 31, 2013, total annual weather-normalized energy consumption by at least 3% and peak demand by 4.5% over the 100 hours of highest demand. By enacting a demand reduction target greater than the required reduction for energy consumption, the Commission encouraged EDCs to implement peak shaving programs. The Commission approved, through the EE&C plan proceedings, the EDCs' implementation of Demand Response (DR) programs during the summer 2012 performance period to achieve the Act 129 peak demand reduction target.[263]

[263] In support thereof, the Commission approved protocols in the 2012 TRM Order for determining demand reductions from DR programs. Implementation of the Alternative Energy Portfolio Standards Act of 2004:

The Commission also directed the SWE to conduct a Demand Response Study to evaluate the effectiveness of Act 129 DR programs in Phase I and to inform decisions about whether peak load reduction targets can be justified in future phases of Act 129.[264]

Demand reduction goals can be achieved by DR programs or EE programs because most EE measures permanently reduce equipment power consumption during periods of peak demand over the life of the measure. A DR goal is achieved solely by reducing peak demand temporarily through dispatched peak shaving resources or pricing signals and does not include the permanent reduction in demand resulting from EE programs. Phase I of Act 129 did not have a specific DR goal.

In brief, "demand response" generally refers to an end-user, or retail utility customer, forgoing, shifting, or self-generating electricity:[265]

- In response to a per-event signal from the applicable ISO or EDC on a dispatchable (or callable) basis; or
- In response to high electricity prices on a non-dispatchable basis, with pricing incentives offered, typically through an EDC's retail service tariffs.

Standards for the Participation of Demand Side Management Resources – *Technical Reference Manual 2012 Update*, Docket No. M-00051865, December 16, 2011, pp.61-65.

[264] Pennsylvania Public Utility Commission, Energy Efficiency and Conservation Program Secretarial Letter, served March 4, 2011, at Docket No. M-2008-2069887. The study can be found on the Commission's website: http://www.puc.pa.gov/pcdocs/1256728.docx.

[265] National Action Plan for Energy Efficiency (2010). Coordination of Energy Efficiency and Demand Response. Prepared by Charles Goldman (Lawrence Berkeley National Laboratory), Michael Reid (E Source), Roger Levy, and Alison Silverstein; www.epa.gov/eeactionplan.

Table 3-29 summarizes the common types of dispatchable and non-dispatchable DR programs.

Table 3-29: Common Types of Demand Response Programs

Non-Dispatchable	Dispatchable
Time-of-Use Rates: Rates with fixed price Blocks that differ by time of day	**Direct Load Control**: Customers receive incentive payments for allowing the utility a degree of control over equipment, such as air-conditioners
Critical Peak Pricing: Rates that include a pre-specified, extra-high rate that is triggered by the utility and is in effect for a limited number of hours	**Demand Bidding/ Buyback**: Customers offer bids to curtail load when wholesale prices are high
Real Time Pricing: Rates that vary at some regular interval (usually hourly) in response to wholesale market prices	**Emergency:** Customers receive payments for load reductions when needed for reliability purposes
	Capacity Market Programs: Customers receive payments for providing load reductions as substitutes for system capacity
	Interruptible/ Curtailable: Customers receive a discounted rate for agreeing to reduce load reduction upon request
	Ancillary Services Market: Customers receive payments from an ISO/RTO for committing to curtail load when needed to support operation of the grid

Dispatchable demand response refers to load reductions that the end user agrees to make in response to direction from someone other than the end user itself. For example, direct load control (DLC)[266] programs and interruptible utility services fall into this category. The DR programs implemented by the Pennsylvania EDCs in 2012 were primarily dispatchable. Non-dispatchable DR programs are those in which the end user decides whether and when to reduce consumption in response to and based on a dynamic pricing structure that exposes the end user to higher electricity prices during peak demand periods.[267]

Two distinct financial transaction markets need to be considered when examining demand response: forward capacity markets (FCMs) and energy markets. Capacity is an annual commitment to provide energy when needed and assures that there will be sufficient resources when they are most needed. An FCM attempts to ensure that demand for electricity will be met in the future by providing pricing signals

[267] Federal Energy Regulatory Commission. *National Action Plan on Demand Response*, (June 2010), available at www.ferc.gov/legal/staff-reports/06-17-10-demand-response.pdf.

to encourage reliability investments such as generation, energy efficiency, and demand response. Capacity revenues are paid whether energy is produced by the committed resource or not. Energy is the generation of electrical power over a fixed period of time and is commonly valued on an hourly basis. Several deregulated markets in the United States, including the PJM Interconnection (PJM), use locational marginal pricing (LMP) to assign wholesale market prices for electricity in dollars per megawatt-hour ($/MWh).

The SWE Demand Response Study presented the findings and recommendations of the SWE based on a benefit-cost assessment of the Phase I DR programs, a review of DR goals and protocols in other jurisdictions, and a historical analysis of market conditions in the Commonwealth of Pennsylvania.[268] The SWE's findings and recommendations contained in the SWE Demand Response Study included the following:

- Act 129 DR programs were not cost-effective as offered in 2012. However, the SWE does not believe that this automatically means DR programs should not be included in future phases of Act 129.
- Act 129 demand reduction targets in Pennsylvania are more aggressive than the other states examined in the study.
- Most EE measures produce percent peak demand reductions that are comparable to the percent energy savings they achieve. Because the Act 129 peak demand reduction target was greater than the energy reduction target, each of the seven Pennsylvania EDCs elected to offer multiple dispatchable DR programs in 2012 in an effort to meet the mandated demand reduction goals. Approximately 2.5% of the 4.5% peak DR goal established by Act 129 was achieved through the coincident peak demand reduction produced by EE measures, effectively presenting a 2.0% DR goal to be achieved in a single summer.
- Aggressive reduction targets appear to have contributed to the poor benefit-cost ratios observed across the state in 2012. The penalty aspect of Act 129 limited the discretion that EDCs could afford to use and led to EDCs "overpaying" for DR resources to ensure that the 4.5% peak DR goal was met.
- Meeting Act 129's DR target for the 100 hours of highest demand required EDCs to predict when the highest 100 hours would occur over the course of the summer. These predictive difficulties are less common for DR programs in the other states and in the ISOs examined, where DR programs are used only when necessary based on reliability triggers or market pricing conditions. The SWE recommends that the top 100 hour definition be discontinued.

[268] This analysis was not meant to be a determination of EDC compliance with the summer of 2012 peak demand reduction mandates as prescribed at 66 Pa. C.S. § 2806.1(d)(1).

- The treatment of DR incentive payments varies among the states examined in this report. California, New York, and Pennsylvania treat DR incentive payments by EDCs to DR program participants as proxies for participant costs in the TRC calculations. Whereas Pennsylvania and New York include the entire incentive payment as the proxy for participant costs, California includes 75% of the incentive payment as a proxy because it assumes that a customer will only participate in a DR program if the benefit is greater than the costs to participate. Adoption of this protocol will increase the perceived cost-effectiveness of a program by 5% to 30% depending on the proportion of program costs attributable to customer incentives. This protocol is shown to have a greater impact on load curtailment programs, because customer incentives represent a dominant share of program costs.

- California and Illinois treat ISO payments to EDCs as a benefit in their respective TRC test calculations when the payments are direct revenue received for bidding retail demand response into the wholesale market. The SWE believes this is the most beneficial mechanism for the continuation of EDC DLC programs. Rather than calculating an avoided cost of capacity, an EDC that bids its DLC program into the PJM forward capacity auction can include direct revenue in its benefit-cost calculations. Bidding DLC into PJM can reduce the capacity needs of the region that must be secured through generation and can exert downward pressure on wholesale capacity prices.

- Residential customers are effectively unable to go to market in the PJM DR programs without aggregation by an EDC within a DLC program. The SWE believes there is value in EDCs acting in this role for the residential sector that does not exist for the C&I sector because those customers are able to participate in the PJM markets without EDC intervention.

- A historical analysis of LMPs[269] and capacity prices in Pennsylvania indicates that DR programs are less cost-effective for EDCs in the western part of the Commonwealth than those in the eastern part. In New York, the New York Public Service Commission (NYPSC) determined that DR programs are most practical and economical in the New York City Metropolitan Area and only established DR goals in the Con Edison service territory. The SWE recommends that the decision to include DR targets in future phases of Act 129 be made at the EDC level rather than on a statewide basis.

- Capacity prices play a significant role in the cost-effectiveness of DR programs and can vary from year to year. The decision whether or not to include DR targets in future phases of Act 129 should be dependent on the direction of capacity prices in the region. Based on the program expenditures and impacts observed during the 2012 performance period, the avoided cost of generation capacity will need to be in excess of $70 to $80 per kW-year to justify continuation of Act 129 DR programs. The SWE recommends that the Commission pay careful attention to the

[269] The LMP of electricity is the price of electricity that varies by time and location within PJM.

results of the PJM Base Residual Auctions for the 2016/2017 and 2017/2018 delivery years when considering DR goals for Phase III of Act 129.

- Avoided transmission and distribution (T&D) benefits are a major source of uncertainty in the benefit-cost analysis of demand response. Additional research is needed by the Pennsylvania EDCs to quantify these benefits. The benefit-cost analysis presented in the study considers low, medium, and high cases of $0, $25, and $50 per kW-year, respectively, for the monetization of T&D benefits. Without the inclusion of some T&D benefits, the SWE believes that Act 129 DR programs are unlikely to pass a TRC test.

- Additional research is needed to estimate the possible benefits from wholesale price suppression.[270] These benefits were not considered for Phase I Act 129 EE programs and were not quantified in the benefit-cost analysis presented in the May 2013 release of the SWE Demand Response Study. Estimates of price suppression benefits from peak-shaving will allow for a more accurate assessment and comparison of DR and EE potential and should be included in a DR potential study.

- The value of demand response is correlated with the cost of the generation resources it is competing against. The Energy Information Administration estimates the overnight construction cost of an advanced combustion turbine to be $666 per kW in its 2012 Annual Energy Outlook. The SWE recommends that the Commission consider the costs of generation capacity that can be avoided through demand response. Given the relatively low upfront cost of construction of a new combustion turbine, its lengthy measure life, and the cost and availability of fuel, DR programs will have to be operated very efficiently to provide a cost-effective alternative to generation.

- Act 129 commercial and industrial (C&I) load curtailment programs face significant challenges because of the thriving PJM DR markets available to these customers. A significant portion of the participants in Act 129 C&I programs are also enrolled as capacity resources in the PJM Emergency Load Response Program. Engaging these participants in Act 129 DR programs does not offer additional capacity into the system. When EDCs secure DR resources that are not committed in the PJM program, the capacity needs of the region are not adjusted accordingly, so the benefits to wholesale capacity prices are not realized. The SWE urges the Commission to be very cautious about establishing any goals for C&I DR programs. If goals are established, the SWE recommends carefully considering how Act 129 can offer incremental value to the competitive markets already in place.

[270] The dispatch of DR resources during high-priced hours for energy (i.e., hours with high LMP) can have a positive effect on zonal energy prices. This “suppression” of wholesale energy prices creates a benefit for both the load being curtailed (avoiding high energy prices) and for non-curtailment loads (paying a reduced LMP because of demand response).

- Although DLC programs did not prove to be cost-effective in 2012, there is indication that the programs could offer value in future phases of Act 129. Equipment purchase, customer recruiting, and installation costs result in high upfront costs for DLC programs. The SWE recommends that the Commission view the Phase I infrastructure costs of these programs as "sunk" and consider continuing the programs if future benefits are expected to outweigh the future costs. If DLC programs are continued, the SWE believes they should be bid into the PJM capacity market and that the revenue received should count as a benefit in the TRC test.

- Precisely estimating the number of hours during which demand response is likely to be cost-effective or needed for reliability is challenging because of the variation observed in Pennsylvania from year to year due to weather and economic conditions. Consequently, the SWE recommends that any future DR targets be crafted such that the compliance metric is the average load reduction observed over a subset of hours during which demand response is likely to provide a cost-effective alternative to generation rather than a fixed number of hours.

- The optimal number of MW to acquire and dispatch in each EDC service territory should be determined through a DR potential study. Estimates of wholesale price suppression benefits, T&D benefits, and the amount of load reduction that can be achieved with less aggressive EDC spending will be important components of this assessment.

The SWE produced an addendum to the SWE Demand Response Study that was released for stakeholder comment on November 14, 2013. This addendum included preliminary estimates of wholesale capacity price suppression benefits and a prospective TRC analysis of Act 129 demand response under an alternative structure to the top 100 hours performance definition. This addendum was accompanied by a Peak Demand Cost Effectiveness Determination Tentative Order from the Commission which proposed that the SWE conduct an in-depth wholesale price suppression analysis and DR potential study.

4 Act 129 Benefits and Costs

Act 129 directs the Commission to use a Total Resource Cost (TRC) test to analyze costs and benefits of the energy efficiency and conservation (EE&C) plans that the EDCs subject to Act 129's consumption reduction mandates were required to file. Act 129 defines a TRC test to be "a standard test that is met if, over the effective life of each plan not to exceed 15 years, the net present value of the avoided monetary cost of supplying electricity is greater than the net present value of the monetary cost of energy efficiency conservation measures."[271] The Commission entered its initial TRC Test Order for Act 129 on June 23, 2009,[272] adapting the California TRC model[273] for use in evaluating the costs and benefits of the EE&C plans. The Commission recognized that there would be ongoing issues in the application of the TRC test, and directed Commission staff to convene a stakeholder group to address the issues identified in the order and other issues as might arise in the TRC test process.[274] The 2009 TRC Test Order provided that the TRC test could be amended based on experience or input from stakeholders.

After the issuance of a tentative order and a comment period, the Commission entered a Final Order on August 2, 2011 revising the TRC test with respect to several areas, including demand response, net-to-gross (NTG) issues, fuel switching, TRC calculation, and TRC reporting.[275] On May 6, 2011, the 2011 TRC Test Tentative Order was issued to address these ongoing issues and other issues that were not discussed in the 2009 TRC Order that were brought up by stakeholders. After review of stakeholder comments, the 2011 TRC Test Order was adopted on July 28, 2011. The 2011 TRC Order addressed several important issues related to demand response (DR) programs, use of NTG ratios, fuel-switching, and general TRC calculations.

Regarding demand response, the Commission stated that "all DR payments from PJM will be…excluded from the TRC test on a going forward basis through May 31, 2013,"[276] and that "payments made by EDCs directly to DR program participants or to DR CSPs should be included as a cost in the calculation of the PA TRC test."[277] The Commission further concluded that the measure life of DR measures should be considered one year.[278]

[271] 66 Pa. C.S. § 2806.1(m).
[272] Implementation of Act 129 of 2008 – Total Resource Cost (TRC) Test, Docket No. M-2009-2108601, June 23, 2009 ("2009 TRC Test Order").
[273] *California Standard Practice Manual – Economic Analysis of Demand-Side Programs and Projects*, July 2002.
[274] 2009 TRC Test Order, p. 32.
[275] Implementation of Act 129 of 2008 – Total Resource Cost (TRC) Test 2011 Revisions, Docket No. M-2009-2108601, August 2, 2011 ("2011 TRC Test Order"), p. 7. The Commission provided that future updates to the 2011 TRC test may also be proposed.
[276] ibidIbid., p. 13.
[277] ibidIbid., p. 15.
[278] ibidIbid, p. 20.

Regarding the use of NTG ratios, the Commission stated that all EDCs must collect NTG data to apply when determining the cost-effectiveness of future modifications of existing programs. NTG data were not to be used, however, for compliance targets or for cost-effectiveness reporting of Phase I programs.[279]

Regarding fuel switching, the Commission determined that increased fuel costs based on fuel switching should be based on New York Mercantile Exchange (NYMEX) gas costs for the first 10 years and Energy Information Administration (EIA) gas cost projections thereafter. The Commission also determined that any costs of infrastructure upgrades and installations associated with fuel switching should be included as a cost in the TRC test, and that only ENERGY STAR equipment, where available, should be eligible for inclusion in EE&C fuel switching programs.[280]

Regarding general TRC calculations, the Commission approved the development of an incremental cost database by the SWE "to assist the EDCs with developing incremental costs for TRC ratio calculations and to standardize EDC assumptions."[281] The Commission also provided that "EDCs should use the database for either new measures added to the current phase of their EE&C plans, or for measures offered under any next phases of Act 129."[282] The Commission also allowed the EDCs to use "DEER data even where there is already previously filed incremental cost data," in order to give EDCs the capability to use the most appropriate data possible.[283]

4.1 TRC Test Results

Table 4-1 summarizes the Phase I TRM Verified and EDC Proposed TRC test results observed by each EDC.

Table 4-1: Phase I TRM Verified and EDC Proposed TRC Ratios by EDC

	TRM Verified			EDC Proposed[2]		
EDC	Avoided Cost (1000)	TRC Cost (1000)	TRC Ratio	Avoided Cost (1000)	TRC Cost (1000)	TRC Ratio
Duquesne	$345,847	$110,617	3.1	N/A[1]	N/A[1]	N/A[1]
PECO	$1,287,541	$448,186	2.9	$1,385,375	$448,186	3.1
PPL	$1,304,636	$597,221	2.2	$1,305,177	$597,221	2.2
Met-Ed	$374,502	$235,084	1.6	$375,429	$235,084	1.6
Penelec	$341,200	$140,894	2.4	$342,065	$140,894	2.4
Penn Power	$122,724	$40,668	3.0	$123,070	$40,668	3.0
West Penn Power	$415,939	$182,714	2.3	$416,616	$182,714	2.3
Statewide Total	$4,192,389	$1,755,384	2.4	$4,293,579	$1,755,384	2.4

[1] Duquesne did not propose alternative values.

279 ibid., p. 25.
280 ibid., pp. 28-30.
281 ibid., p. 33. The SWE developed and made available an incremental cost database in PY 4 of Phase I.
282 ibid., p. 32.
283 ibid., pp. 32-33. DEER is the California PUC's Database for Energy Efficient Resources.

[2] See Sections 2.2 and 3.2 for the differences between TRM Verified and EDC Proposed savings estimates.

Table 4-2 details the TRC test results for each EDC's EE&C portfolio of programs for all of Phase I broken down by program year. TRC requirements had been waived for PY1 reporting purposes and as such are not available. Detailed results of program-level TRC ratios for PY4 are discussed further in Appendix F.

Table 4-2: Phase I TRM Verified TRC Ratios by Program Year and EDC

	PY2 Avoided Cost (1000)	PY2 TRC Cost (1000)	PY2 TRC Ratio	PY3 Avoided Cost (1000)	PY3 TRC Cost (1000)	PY3 TRC Ratio	PY4 Avoided Cost (1000)	PY4 TRC Cost (1000)	PY4 TRC Ratio
Duquesne	$109,666	$29,905	**3.7**	$99,039	$29,328	**3.4**	$139,767	$48,529	**2.9**
PECO	$749,047	$150,293	**5.0**	$169,960	$76,601	**3.4**	$217,376	$158,030	**1.4**
PPL	$370,637	$214,671	**1.7**	$473,186	$212,496	**2.2**	$628,650	$239,405	**2.6**
Met-Ed	$151,115	$33,439	**4.5**	$79,698	$26,573	**3.0**	$140,832	$156,115	**0.9**
Penelec	$142,731	$46,058	**3.1**	$94,930	$31,406	**3.0**	$104,918	$51,348	**2.0**
Penn Power	$51,255	$13,750	**3.7**	$26,199	$7,155	**3.7**	$42,759	$16,494	**2.6**
West Penn Power	$42,821	$21,620	**2.0**	$128,810	$52,244	**2.5**	$244,237	$160,987	**1.5**

For the purposes of this table and the three figures that follow, cumulative TRC costs for DR programs have been put into PY4.

Graphical representations of these results are shown for EDC and program year and for program type in Figure A-1 and Figure A-2, respectively.

Figure A-1: Phase I Cost-Effectiveness by EDC and Year - All Programs

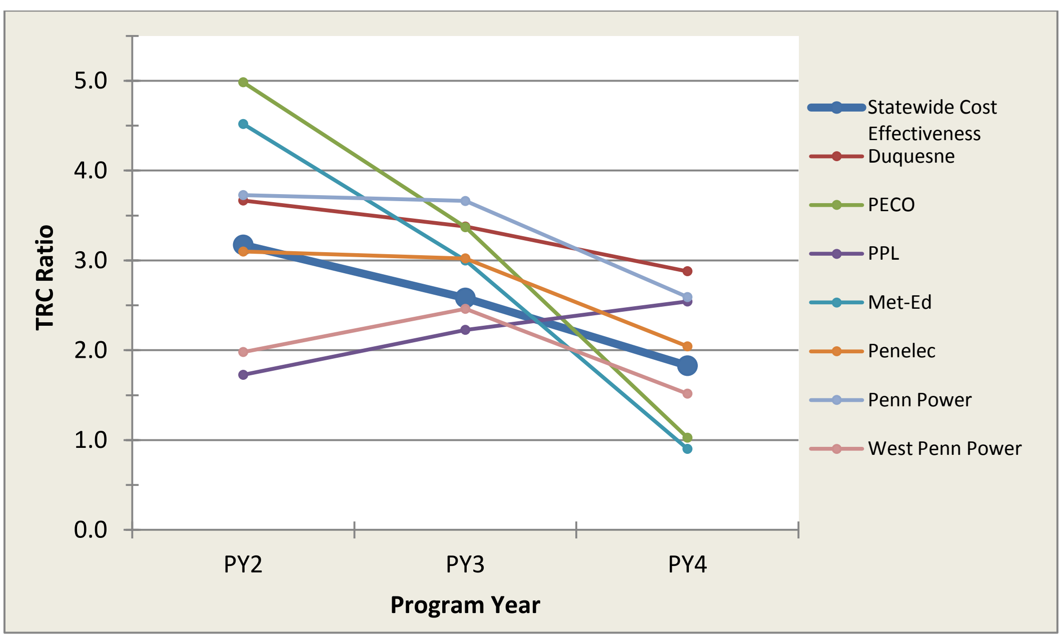
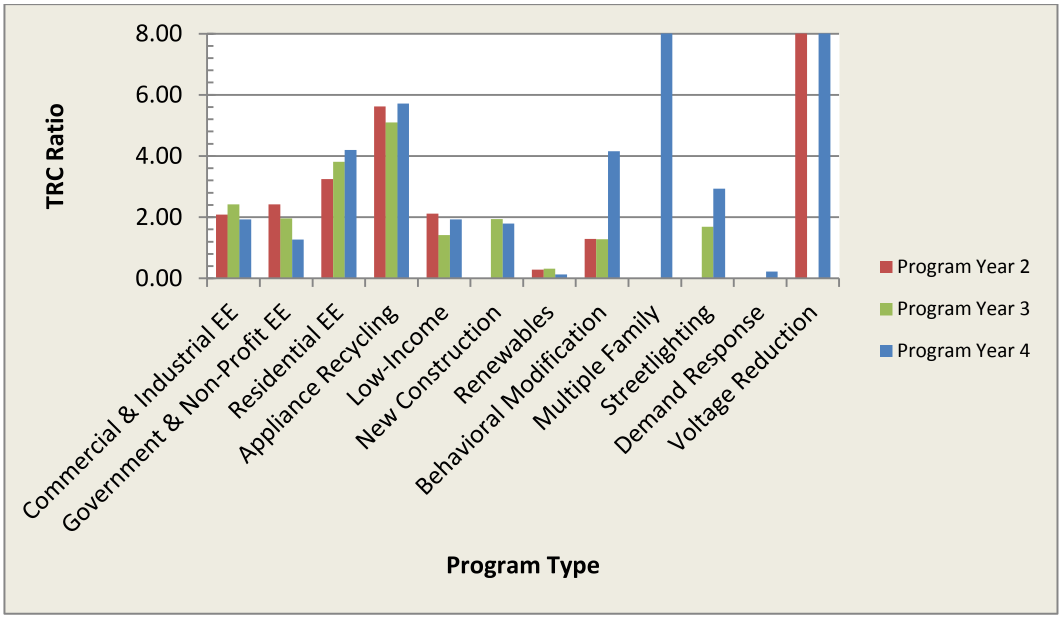
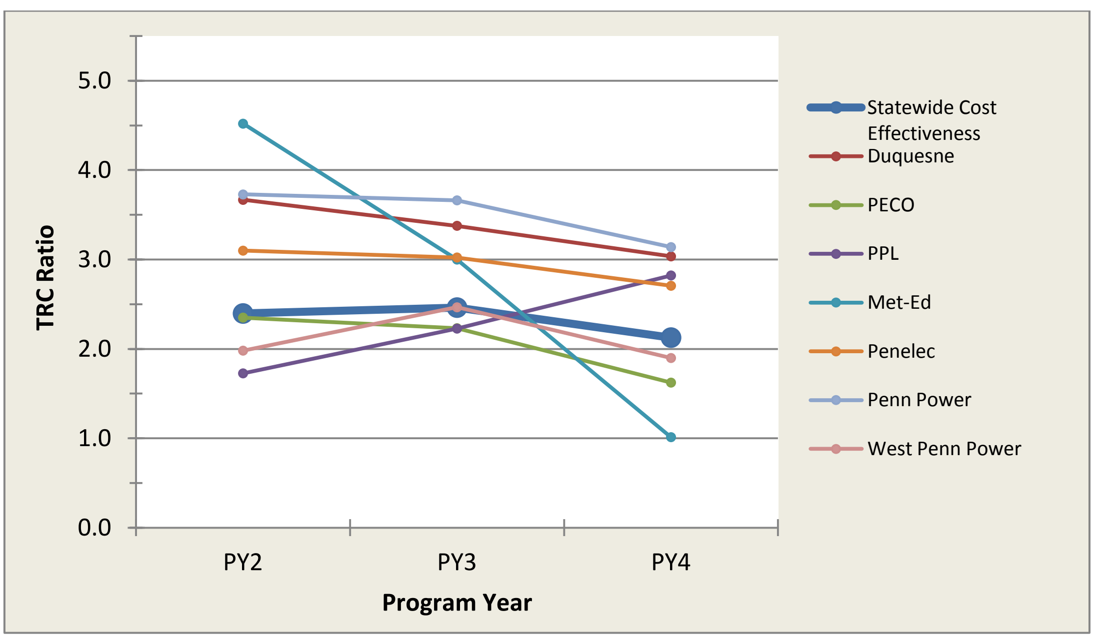


Figure A-2: Phase I Cost-Effectiveness by Program Type



As shown in Figure A-1, there is a general downward trend in TRC ratios from PY2 to PY4. Much of this is due to PECO's Conservation Voltage Reduction Program in PY2 (TRC Ratio: 262.41) and the statewide introduction of DR programs in PY4 (average TRC Ratio: 0.2). Removing these programs and focusing solely on the EE programs, the trend from PY2 through PY4 becomes flatter, as shown in Figure A-2.

Figure A-3: Phase I Cost-Effectiveness by EDC and Year, Energy Efficiency Programs Only



Notice in Figure A-3 that without the Conservation Voltage Reduction Program, PECO's TRC ratio in PY2 drops from 5.0 to 2.4, bringing the statewide average down from 3.2 to 2.4.

Other program types contributing to a high TRC ratio were appliance recycling programs, residential EE programs, and multiple family programs, with TRC ratios of approximately 5.5, 3.8, and 23.0 respectively. Most other program types saw TRC ratios between 1.0 and 2.0. Appliance recycling programs saw high TRC ratios in part because of the generous measure life applied to the equipment in the calculations. There were several contributing factors to the high ratios associated with residential EE programs. Many programs offered under this category saw substantial participation at extremely low TRC costs, such as West Penn Power's CFL Rewards Program and PECO's Smart Lighting Discounts. CFL incremental costs are minimal and therefore can produce much higher TRC ratios than other lighting measures. In addition to this, PPL reported a TRC ratio of 13.31 for its Residential Lighting Program in PY4. This number incorporates a cross-sector sales adjustment for figures that were later moved to and grossed-up in the Small C&I Program. Multiple family programs exhibit seemingly high TRC ratios as the avoided costs were not realized until the year after most of the TRC costs were accrued.

4.1.1 Line Loss Factor

Line loss factors (LLFs) must be applied to savings associated with TRC calculations to account for energy lost during transmission due to electrical resistance. Increasing the LLF will increase the benefits associated with a program, so it follows that larger LLFs will result in higher TRC ratios. Each EDC uses an LLF as specified in its original EE&C plans, or an updated factor approved by the SWE, as shown in Table 4-3.

Table 4-3: Phase I Line Loss Factors

EDC	Energy LLF	Demand LLF
Duquesne	6.90%	6.90%
PECO	7.10%	Varies by Sector[1]
PPL	Varies by Sector[2]	Varies by Sector[3]
Met-Ed	11.00%	16.60%
Penelec	11.00%	21.20%
Penn Power	11.00%	14.20%
West Penn Power	11.00%	20.00%
Average	9.67%	

[1] For demand calculations, PECO applied program-specific LLFs reflecting the rate class of participating customers. The LLF varied between 16.1%, 10.0%, and 10.5%.

[2] For energy calculations, PPL used 8.33% for residential, small C&I, and government/non-profit programs, but 4.12% for large C&I programs.

[3] For demand calculations, PPL used 4.12% for large C&I, but 8.33% for all other sectors.

4.1.2 Discount Rate

The nominal discount rate is another underlying assumption that has considerable effect on the final TRC ratio. In a TRC test, the discount rate reflects the utility cost associated with borrowing capital. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur throughout a measure's lifetime to the upfront costs of installation and implementation. Table 4-4 shows the Phase I discount rates for each EDC[284], along with the average across the seven EDCs.

Table 4-4: Phase I Discount Rates

EDC	PY2	PY3	PY4
Duquesne	6.90%	6.90%	6.90%
PECO	7.45%	7.60%	7.60%
PPL	8.00%	8.00%	8.00%
Met-Ed	7.92%	7.92%	7.92%
Penelec	7.92%	7.92%	7.92%
Penn Power	7.92%	7.92%	7.92%
West Penn Power	9.03%	9.03%	7.92%
Average	7.88%	7.90%	7.74%

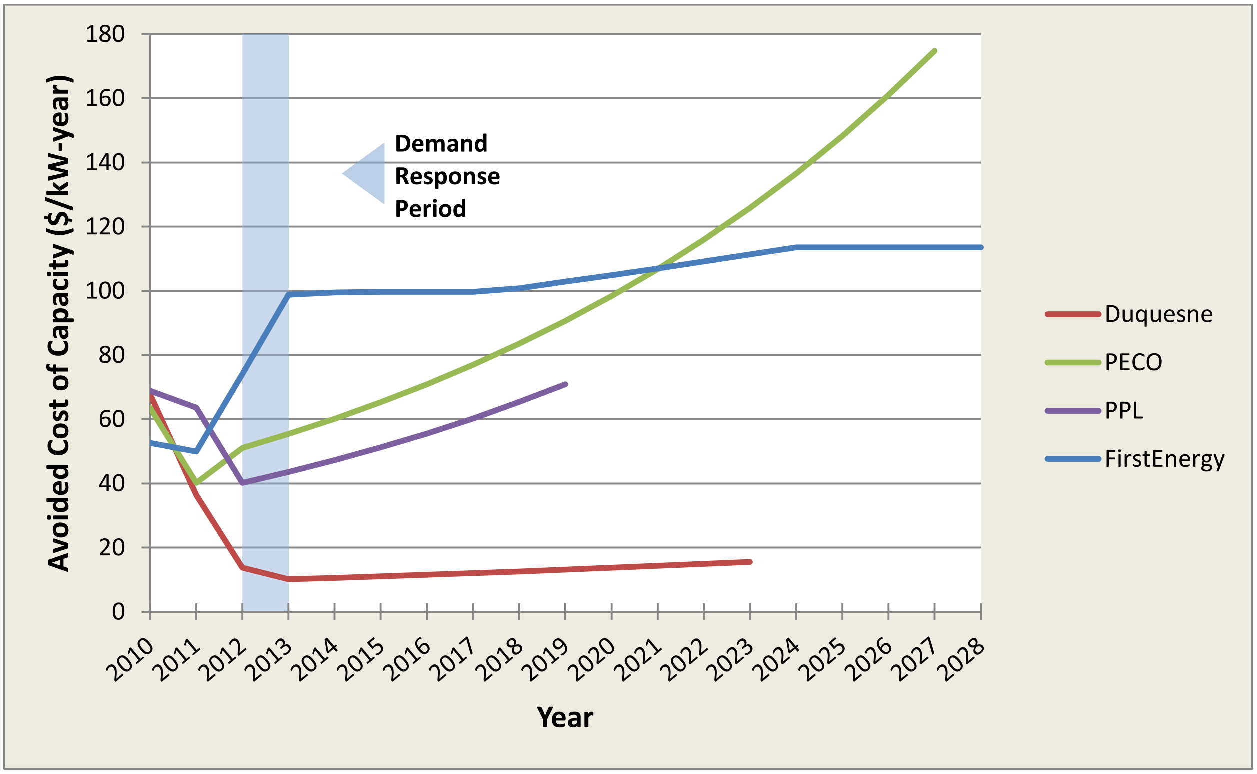
4.1.3 Avoided Costs

Avoided cost of capacity benefits, or the TRC test benefits associated with peak demand savings, is another area that varied considerably among EDCs.[285] The short-term values used were based on the annual PJM Base Residual Auction results. Avoided cost of capacity benefits were especially important in PY4 as this was the year DR programs were active. DR programs rely solely on peak demand reductions for benefits because no energy savings are reported. Figure A-1 shows the annual avoided cost of capacity used by each EDC. These avoided costs were approved in each EDC's EE&C plan.

[284] In accordance with the PUC's TRC orders and Implementation Order, the discount rate is the EDC's weighted average cost of capital. Values shown are per each EDC's approved EE&C Plan.

[285] Avoided costs were determined in accordance with the PUC's TRC Orders and Implementation Order. The discount rate is the EDC's weighted average cost of capital. Values shown are per each EDC's approved EE&C Plan. Differences in energy and capacity market prices will vary across EDCs (as published in NYMEX Futures and PJM Capacity markets).

Figure A-1: Annual Avoided Cost of Capacity by EDC[286]



Note that DR programs take into account only the avoided cost of capacity of the current year,[287] whereas EE programs consider the avoided costs over the life of the measure.

No value is assigned to the avoided cost of capacity for Duquesne's EE programs because the avoided cost of energy filed by Duquesne in its EE&C plan included the cost of capacity, so a separate calculation is not needed to account for capacity benefits.[288] (For more information on this, see Appendix F, section F.7.1). PPL's TRC model does not include separate estimates for the avoided cost of capacity beyond 2019 because the energy futures used to determine the avoided energy cost included the cost of capacity. There is significant variation between the annual values EDCs associate with not having to expand generation capacity. The variation in the avoided capacity costs leads to significant differences in the financial benefits attributed to measures that reduce peak demand.

See Section 6.3.5 for further information on avoided cost of capacity and its impact on cost-effectiveness in the upcoming program years.

[286] As determined in each EDC's approved 2009 EE&C plan
[287] See 2011 TRC Order, pp. 17-20.
[288] The avoided cost of capacity values shown in Figure A-1 were provided by Duquesne to the SWE upon request but are otherwise included in the avoided cost of energy forecast.

4.2 Summary of TRC Test Formulae and Terms

The TRC test takes into account the combined effects of the EDCs' EE&C plans on both participating and non-participating customers based on the costs incurred by both the EDC and any participating customers. The benefits in the TRC test include utility avoided supply costs and capacity costs for the periods when there was a reduction in consumption.[289] Additionally, participant benefits, such as incentives paid by a federal agency and avoided capital and operating costs of equipment not chosen in fuel substitution programs, are included in the benefits calculation.[290] The avoided supply costs are calculated using gross verified program savings and are limited to a maximum of 15 years.[291]

The TRC test costs include the costs of the various programs paid by an EDC or a default service provider and the participating customers, and reflect any net change in supply costs for the periods in which consumption is increased in the event of load shifting.[292] These costs are represented as incremental costs of services and equipment. For example, equipment, installation, operation and maintenance costs, cost of removal (less salvage value), and administrative costs, regardless of who paid for them, are included.[293] The TRC test excludes environmental and societal costs and benefits unless such costs and benefits were already embedded in the wholesale cost for generation of electricity.[294]

TRC test results are expressed as both an NPV and a benefit-cost ratio (B/C ratio). The NPV is the discounted value of the net benefits over a specified period of time (e.g., the expected useful life of the EE measure), and is a measure of the change in the total resource costs due to the program. An NPV above zero indicates that an EE&C plan's EE program is a less expensive resource than the supply option on which the marginal costs are based. The B/C ratio is the ratio of the discounted total benefits of the EE&C plan's EE program to the discounted total costs over the expected useful life of the EE measure(s) in the program. The B/C ratio gives an indication of the rate of return of a program. A B/C ratio above 1 indicates that the program is beneficial to the utility and its ratepayers on a TRC test basis.[295]

The TRC test formulae and definitions for calculating TRC test results are shown in the equations that follow and in Table 4-5.[296]

$$NPV_{TRC} = B_{TRC} - C_{TRC}$$

$$BCR_{TRC} = B_{TRC}/C_{TRC}$$

$$LC_{TRC} = LCRC/IMP$$

289 ibid., p. 5.
290 2009 TRC Test Order, pp. 21-22.
291 ibid, pp. 9-10.
292 2011 TRC Test Order, p. 6.
293 2009 TRC Test Order, pp. 3-4.
294 ibid, p. 5.
295 2011 TRC Test Order, p. 6.
296 2011 TRC Test Order, Appendix A.

The B_{TRC}, C_{TRC}, LCRC, and IMP terms are defined as follows. The first summation in the B_{TRC} equation should be used for conservation and load management programs. For fuel substitution programs, both the first and second summations should be used.

$$B_{TRC} = \sum_{t=1}^{N} \frac{UAC_t + TC_t}{(1+d)^{t-1}} + \sum_{t=1}^{N} \frac{UAC_{at} + PAC_{at}}{(1+d)^{t-1}}$$

$$C_{TRC} = \sum_{t=1}^{N} \frac{PRC_t + PCN_t + UIC_t}{(1+d)^{t-1}}$$

$$LCRC = \sum_{t=1}^{N} \frac{PRC_t + PCN_t - TC_t}{(1+d)^{t-1}}$$

$$IMP = \frac{\sum_{t=1}^{n} [(\sum_{i=1}^{n} \Delta EN_{it}) \; or \; (\Delta DN_{it} \; where \; I = peak \; period)\,]}{(1+d)^{t-1}}$$

The utility avoided cost terms (UAC_t, UIC_t, ,and UAC_{at}) are determined by costing period to reflect time-variant costs of supply:

$$UAC_t = \sum_{i=1}^{I} (\Delta EN_{it} \times MC{:}E_{it} \times K_{it}) + \sum_{i=1}^{I} (\Delta DN_{it} \times MC{:}D_{it} \times K_{it})$$

UAC_{at} = Use UAC_t formula but with marginal costs and costing periods appropriate for the alternate fuel utility

$$UIC_t = \sum_{i=1}^{I} (\Delta EN_{it} \times MC{:}E_{it} \times (K_{it} - 1)) + \sum_{i=1}^{I} (\Delta DN_{it} \times MC{:}D_{it} \times (K_{it} - 1))$$

Table 4-5: TRC Formulae Definitions of Terms

Term	Definition
ΔDN_{it}	Reduction in gross demand in costing period *i* in year *t*
ΔEN_{it}	Reduction in gross energy use in costing period *i* in year *t*
BCR_{TRC}	Benefit-cost ratio of total costs of the resource
B_{TRC}	Benefits of the program
C_{TRC}	Costs of the program
d	Interest rate (discount)
E	Discounted stream of system energy sales (kWh or therms) or demand sales (kW) for first-year customers.
E_t	System sales in kWh, kW, or therms for first-year customers
I	Number of periods of a participant's participation
IMP	Total discounted load impacts of the program
K_{it}	1 when ΔEG_{it} or ΔDG_{it} is positive (i.e., a reduction) in costing period *i* in year *t*, and 0 (zero) otherwise
LCRC	Total resource costs used for levelizing
LC_{TRC}	Levelized cost per unit of the total cost of the resource (cents/kWh for conservation programs; $/kWh for load management programs)
$MC:D_{it}$	Marginal cost of demand in costing period *i* in year *t*
$MC:E_{it}$	Marginal cost of energy in costing period *i* in year *t*
NPV_{TRC}	Net present value of total costs of the resource
PAC_{at}	Participant avoided costs in year *t* for the alternate fuel devices (i.e., costs of devices not chosen)
PCN_t	Net participant costs; in PA, the costs of the end-user customer (participating or non-participating)
PRC_t	Program administrator costs in year *t*; in PA, the EDC
TC_t	Tax credits year *t*
UAC_{at}	Utility avoided supply costs for the alternate fuel in year *t*
UAC_t	Utility avoided supply costs in year *t*
UIC_t	Utility increased supply costs in year *t*

4.3 Summary of Benefits

Under the TRC test, the potential benefits include avoided supply costs – specifically generation, transmission, and distribution (GT&D)costs. Additional potential benefits include incentives paid by federal agencies (e.g., federal tax credits, American Recovery and Reinvestment Act [ARRA] incentives) and avoided capital and operating costs of equipment not chosen in fuel substitution programs.

The 2009 TRC Test Order stated that the forecasted GT&D avoided costs should be calculated in three intervals of 5 years, each for the stipulated maximum assumed measure life of 15 years.[297] The methods for estimating these potential benefits are described below.

4.3.1 Generation Costs

For the first five years, generation costs are estimated using NYMEX PJM futures price by "prompt month," two months prior to the filing date. For the second five years, generation costs are estimated according to the NYMEX natural gas futures prices, converted to electric energy prices using the spark price spread methodology, using the prompt month equal to two months prior to the filing date. The final five years generation costs are estimated using EIA Annual Energy Outlook data.[298]

4.3.2 Transmission, Distribution, and Capacity Costs

T&D costs include transmission prices as set by FERC for each EDC zone, EDC distribution rates, generally accepted ancillary service rates to the extent known, escalation factors as determined by the U.S. Bureau of Labor and Statistics (BLS) Electric Power GTD sector industry index for Electric Power Generation,[299] and adjustments for T&D line losses to the extent that they are not already included.[300]

Capacity costs are estimated using the PJM Reliability Pricing Model[301] (RPM) and escalation rates determined by the U.S. BLS Electric Power GTD sector industry index for Electric Power Generation.[302]

4.3.3 Supply Cost Adjustments

Several adjustments were made to supply costs to improve the accuracy of avoided cost estimates.[303]

- End-Use Adjustments: In cases where it was appropriate and feasible, the end-use load shapes of a particular measure could be used to calculate the supply costs. If not appropriate or feasible, the class average consumption profile was used.

[297] 2009 TRC Test Order, p. 9.
[298] ibid, pp. 10-12.
[299] NAICS 221110
[300] 2009 TRC Test Order, p. 12-13.
[301] The PJM Reliability Pricing Model (RPM) is PJM's capacity market model that procures capacity resources for future demand in the PJM region. The RPM is a series of auctions for a delivery year in the future. The majority of capacity is procured in the first auction for a particular delivery year, known as the Base Residual Auction, which is conducted three years ahead of a given delivery year.
[302] This escalator is widely accepted in the industry and financial markets and is energy-industry-specific, readily ascertainable, and easy to use. Like its more familiar counterparts, the BLS Consumer Price Index (CPI) and Producer Price Index (PPI) will produce expected values of future market variables within reasonable limits.
[303] 2009 TRC Test Order, pp. 16-19.

- GT&D Costs: GT&D costs could be adjusted for losses, where not already adjusted.
- Locational, Temporal, and Zonal Differences: Zonal adjustments were to be made to GT&D and capacity costs according to the *PJM State of the Market* report, “Zonal real-time, simple average LMP (dollars per MWh).” Additionally, natural gas prices in years 6 through 10 were to be adjusted according to the basis differential between Henry Hub as the source and TETCOM-3 as the destination for utilities west of the Susquehanna and Transco Zone 5 as the destination for utilities east of the Susquehanna.
- Compliance with the Pennsylvania Alternative Energy Portfolio Standards Act of 2004 (AEPS Act) and Carbon Issues: The costs of compliance with the AEPS Act that were known and knowable were to be included in TRC cost accounting. However, carbon reduction expenses were not accounted for in Act 129 EE&C plans.
- Discount Factor: For first-year TRC calculations, the EDC specific post-tax weighted average cost of capital (WACC) was to be used as the discount rate.
- Customer Self-Generation Credits: In cases where customers were self-generating electricity, the full retail rate was to be assumed when calculating avoided energy and capacity cost for the TRC test.

4.4 Summary of Costs

Under the PA TRC test, potential costs included equipment costs, operation and maintenance costs, installation costs, customer dropout and equipment removal costs, administration costs, marketing costs, and evaluation, measurement, and verification (EM&V) costs. [304] Since the TRC test represents the benefits and costs to society, these costs are included regardless of who pays them.

When calculating equipment costs, the installation scenario affects the cost structure used to determine the expense. For replace-on-burnout scenarios, where the base equipment being replaced has reached the end of its useful life, the incremental cost for a new device or measure is the additional cost incurred to purchase an efficient device or measure over and above the cost of the standard (i.e., less efficient) efficiency device or measure. However, in retrofit or early replacement scenarios, where the equipment being replaced is still fully functional, the incremental cost of the new device or measure is the whole cost of the new efficient device or measure, including all installation costs. In cases where new equipment is being procured (i.e., not replacing older equipment), the equipment cost is calculated as the incremental cost of the high-efficiency equipment over the current market or code standard-efficiency equipment. [305]

In an effort to promote uniformity among the EDCs' reported incremental cost values, the SWE drafted a Pennsylvania-specific incremental equipment cost database. Although the database was created for EDC use in TRC calculations, its use was not mandatory, as it was created to provide another alternative to existing sources of cost data. Moreover, the database was constructed to mirror the TRM, in that each measure's installation scenario (replace-on-burnout or early replacement) followed the specific installation scenario used in the TRM.

To create the database, project files submitted from the EDCs were reviewed and their respective cost data consolidated into the database to align with the categories proposed in the Market Potential Study. Because the incremental costs submitted by the EDCs did not encompass all of the categories set forth in the Market Potential Study, other primary and secondary data sources were sought to supplement the gaps in cost data and add to the overall robustness of the data. Specifically, some less frequently used measures' available cost data were either limited or considered too volatile to set forth a single cost value and thus were not included in the database. Also, invoices reviewed from EDC project files typically did not include labor cost on a per-unit-installed basis, rather, the labor was typically shown as a single line item.

[304] Per the 2009 TRC Test Order, "incentive payments from an EDC to a customer will not . . .be included in the TRC test because such costs are a cost to the EDC and a benefit to the customer that cancel each other out." 2009 TRC Test Order, p. 9.
[305] ibid., pp. 30-31.

5 SWE Analysis of Phase I

This section discusses the SWE's analysis of Phase I, including discussions of Phase I process evaluation, best practices and lessons learned related to all SWE auditing activities, Phase I cost-effectiveness, and recommendations for program improvements in future phases and program years of Act 129.

5.1 Process Evaluation

The purpose of process evaluation is to determine if there are ways to alter the program to improve cost-effectiveness or the program's efficiency in acquiring resources. Process evaluations are a significant undertaking and must be designed and executed systematically in order to ensure unbiased and useful results.

The process evaluation consists of in-depth examinations of the design, administration, delivery and implementation, and market response to EE&C programs. As with all evaluations, a process evaluation should respond to the program goals rather than to an ideal. Process evaluations, while they primarily serve the EDC's program staff and management, also provide a vehicle for sharing program design and operational improvements with other professionals in the field. Below are examples of how decision-makers can use the results of process evaluations:

- Improve program performance with respect to internal administration and communications, promotional practices, program delivery, incentive levels, and data management.
- Improve customer satisfaction and identify market threats and opportunities.
- Provide information to regulators and other interested parties that programs are being implemented effectively and modified as necessary.
- Contribute to industry-wide knowledge and best practices so that other EDCs can improve their programs.

Through the first four program years, many lessons were learned in performing process evaluations, both about the programs and the process evaluations themselves. Included in this section are the lessons learned about the process evaluation process. The results of the process evaluations and suggestions for program improvement can be found in Appendix D. The following are six lessons learned in Phase I and suggestions for Phase II:

1. Follow-up is important, to ensure that suggestions get implemented. During Phase I the SWE team discovered that the EDCs were not reporting to the SWE the actions being taken by EDCs to respond to each recommendation made by their independent third-party evaluators. Upon making this discovery, the SWE team requested information from each EDC on whether recommendations had been implemented, still under consideration, or rejected. This review by the SWE team has helped ensure that evaluation recommendations get acted upon.
2. More structure is needed in process evaluation activities. During Phase I the SWE team recognized the importance of process evaluation to make programs more efficient and effective, but spent more time on creating an evaluation framework, auditing impact evaluation results, and updating the TRM on an annual basis. Now that the essential impact evaluation foundation

has been established for the ACT 129 programs, the SWE team can focus more of its time on guiding process evaluation activities to provide more timely and actionable results.

3. The SWE and Bureau of Technical Utility Services should be more involved in the review of survey methodology and survey questions. During the course of Phase I, the SWE team discovered that survey instruments for similar programs across EDCs were not consistent and survey instruments did not always provide the information needed for impact and process evaluations. For example, very few EDCs collected information on whether removed refrigerators and freezers were replaced, and some EDCs did not collect impact or process evaluation data on participants in their low income programs. Based on these and other instances, the SWE decided that it would review all draft survey instruments in order to improve consistency of data collection across EDCs and to ensure that survey instruments included sufficient questions to address researchable issues.
4. Feedback should be presented early in the process evaluation cycle, to aid in immediate improvement to programs. During Phase I, the SWE discovered that process evaluation results were most often reported five months after the end of a program year. As noted above, the SWE also discovered that process evaluation reports did not include any information on whether process evaluation recommendations have been accepted, rejected, or were still under consideration. The SWE started the process during Phase I of working with the EDCs to speed up the dissemination of information about process evaluation recommendations and EDC action with respect to those recommendations.
5. There should be a clear and consistent plan for how often process evaluation is performed and how often feedback is provided. During Phase I, the process evaluation plans submitted by many of the EDCs did not specify how often process evaluations would be undertaken. The SWE team is redoubling its efforts to make sure the schedule for process evaluations is understood better during Phase II.
6. There should be a clear and consistent format between the EDCs of reporting the methodology and results. During Phase I, the SWE team discovered several areas where the EDCs reported inconsistently, such as the following:
    a. Some EDCs reported NTG ratios for each program.
    b. Some EDCs did not report a breakout of small C&I and large C&I MWh savings in their Phase I annual reports.
    c. One EDC made a correction for four years of residential lighting program savings all in PY4. The other EDCs made such corrections in each year of Phase I.
    d. Many EDCs reported Phase I MW savings as proposed by EDC evaluators but one EDC did not.
    e. Some EDCs had very detailed descriptions of their process evaluation methodology and others did not.
    f. Some EDCs had very detailed process evaluation reports filed with the PUC and others would scramble to prepare a short memo if requested for results.

Additionally, through its collective experiences, the SWE came to see the following as best practices for process evaluation. These best practices are detailed in the Phase II Evaluation Framework, Section 3.7 as well. Process evaluations use program data, secondary data, document review, and different types of one-on-one or group interviews and surveys to gather information to describe and assess programs. The design for each process evaluation should begin with the program's original design intent and should provide evidence of program progress in achieving its goals and objectives from the perspective of the program's various target audiences.

Each process evaluation should have a detailed plan that describes the objectives, sampling plan, research activities, and specific issues to be addressed, along with a schedule of milestones and deliverables.[306]

Every program should have at least one process evaluation in every funding cycle or phase. This evaluation can be either an in-depth, comprehensive process evaluation or one of several types of focused process evaluations. Process evaluations should be timed to coincide with decision points for the program design and implementation process. The primary types of process evaluations are:

1) Standard Comprehensive Process Evaluation – This includes data collection activities with each of the program's target audiences, including participants, non-participants, end-users, and trade allies. These are complex projects that require resources and take time to implement. The New York State Process Evaluation Protocols[307] provide excellent guidance on the best practices for all process evaluations, and in-depth, comprehensive process evaluations will adhere to the majority of those protocols.

2) Market Characterization and Assessment Evaluation – Market characterization and market assessment activities are important to aid program staff in understanding how the market is structured and operating (characterization) and how it is responding to the program offerings and to activities external to the program (assessment). Such studies usually focus on specific technologies or product and service types. They are conducted in order to inform program design and redesign and may be integrated into a comprehensive process evaluation.

3) Topic-Specific Focused Evaluation – Not every process or market evaluation must be comprehensive. In cases where a comprehensive evaluation has been conducted recently, it may be appropriate to conduct an abbreviated evaluation that focuses on specific items (e.g., program features, or ideas program staff want to explore) to see if changes to the program are

[306] The SWE reserves the right to review the process evaluation plans.
[307] Johnson Consulting Group. New York State Process Evaluation Protocols. Prepared for the New York State Research and Development Authority, the New York State Evaluation Advisory Group, and the New York Public Service Commission. January 2012. Accessed 4/10/13. http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/Process_Evaluation_Protocols.pdf.

warranted. In these cases, data collection involves targeted questions to carefully selected audiences.

4) Early Feedback Evaluations – New programs, recently updated or modified programs, and pilot programs benefit from early program evaluation feedback. Such evaluations can help program designers and managers refine the program design before full-scale rollout, or compare the effectiveness of changes with previous program years. Early feedback evaluations should be short and focus on as few as three to six months of program operation in order to give program staff rapid and specific feedback.

5) Real-Time Evaluation – In many cases, process and market evaluation can help programs be more effective if the information on program progress and performance can be conducted and reported in real time. When evaluators work with program designers and managers during program development and embed the evaluation into the program, data can be collected throughout the implementation period that informs the program staff in real time regarding opportunities for improvement. Real-time evaluations typically last one to two years, with ongoing data collection, and include quarterly to biannual reporting that targets the type of information program staff need to gauge their program's progress and effectiveness.

Most programs do not need a process evaluation every year of their implementation cycle. For instance, some aspects of a program may be assessed most successfully during its second or third year. However, it may be beneficial to conduct a process evaluation of new programs during their first year, and to involve the program evaluation staff early in the design process. The value of process evaluation is in the *doing*. Process evaluations are considered a formative evaluation; by conducting the evaluation, the evaluator actually has an effect on the program. Thus it is important to consider the reason and timing for the process evaluation carefully, and to address them in the research plan.

5.2 Best Practices and Lessons Learned

This section summarizes the best practices implemented and lessons learned during Phase I in the area of process evaluation. It also summarizes improvements made to the Technical Reference Manual (TRM), the sampling design and protocols for auditing the EDCs' energy and demand savings, and the total resource cost (TRC) test. Additionally, the SWE identified areas for improvements with regard to the EDCs' development of net-to-gross ratios (NTGRs). These improvements were informed through the SWE's review of recognized best practices, and lessons learned based on experience gleaned during Phase I. The improvements have served to enhance the SWE's impact evaluation and cost-effectiveness evaluation of the EDCs' Phase I energy efficiency and conservation (EE&C) programs, and to facilitate the continual development of a strong foundation for the impact and cost-effectiveness evaluations to be undertaken during Phase II.

5.2.1 Impact Evaluation and Technical Reference Manual

Throughout Phase I of Act 129, the SWE performed an annual review and update of the TRM. More than 60 new measure protocols were added, and many existing protocols were refined and updated. The addition and refinement of protocols led to the standardization and increased transparency of savings protocols among the EDCs, allowing for an easier comparison and understanding of how savings were estimated. As Phase I progressed, the SWE focused its efforts on refining protocols and methodologies for measures comprising the largest amount of statewide savings. Such measures included residential and non-residential lighting, and non-residential heating, ventilation, and air conditioning (HVAC) and motors and drives.

As a result of lessons learned in Program Year 1 (PY1), the protocols for commercial and industrial (C&I) lighting underwent significant changes to improve the process and accuracy of reporting savings. After experience in PY1 using the 2009 TRM, it was determined that the TRM protocols were neither uniform nor coordinated and lacked significant details required for EDCs to estimate savings in a consistent and accurate way. The 2010 TRM incorporated a prescriptive lighting table for customers self-certifying baseline lighting systems, simplified Appendix C (Lighting Audit and Design Tool) to the TRM to make it more user-friendly, and provided opportunity for reference to spec sheets for fixture types not listed in the TRM.[308]

Additional improvements continued to be made in the 2011 TRM through experience, review, and resolution of issues. The SWE found inconsistency among the EDCs in the application of the Lighting Audit and Design Tool, resulting in inaccuracies in reported savings. Thus the 2011 TRM update included revisions to increase the accuracy of savings estimates and make the Lighting Audit and Design Tool easier to use. The update also included an increase in the number of standard lamp types and allowed for the use of custom fixture types, with documentation, adding flexibility and increased consistency among the EDCs in applying the TRM protocols.

In PY3, an issue arose regarding the hours of use (HOU) estimates for C&I lighting. There were several instances where project implementers or program evaluators interpreted the application of usage groups and deemed HOU in a different manner than did the SWE in verifying savings. There were also instances where the deemed HOU for a specific building type differed significantly from the actual HOU of the facility, but could not be adjusted under the approved TRM protocols. To resolve this issue, the SWE recommended an update for the 2012 TRM, removing the mandatory requirement to use usage groups and thus leaving it to the discretion of the program implementers and program evaluators. The 2012 update also allowed for reported HOU through customer interviews to be used in place of TRM deemed hours, allowing for increased accuracy in savings estimation. Furthermore, the 2012 TRM update required metering for projects with high savings impact (greater than 200 kW) or with high uncertainty. These revisions based on experience and lessons learned continued to increase the consistency in HOU estimating protocols and to improve the accuracy of Phase I energy savings estimates.

Other impact evaluation improvements were made during Phase I. For example, to estimate the savings for weather-dependent measures in the TRM, a reference city must be selected so key variables such as

[308] 2010 TRM final Order, pp. 8-10.

equivalent full load hours (EFLH) can be quantified. Prior to the 2012 TRM update, each EDC used its own methodology to select reference cities for its projects and installed measures, leading to inconsistencies among EDCs and differences in opinion between the EDCs and the SWE Team. To resolve this issue, the SWE developed Zip Code Mapping Tables, which mapped every zip code in Pennsylvania to a reference weather city in the TRM. This presented a consistent methodology agreed upon by both the SWE and EDCs, and through which EDCs could select the appropriate reference city.

During Phase I, the SWE issued several guidance memoranda to develop consistency in the impact evaluations and instill best practices into the impact evaluation process.[309] For example, early in Phase I it was observed that there was little consistency among the EDCs in the protocols used for quantifying coincidence factors (CF), not otherwise stipulated, for estimating peak demand reductions. To resolve this issue and create more transparency in estimating peak demand reductions, the SWE issued Guidance Memo-004 (GM-004), providing for a consistent methodology for estimating peak demand savings of custom measures, or measures without stipulated estimating protocols.

As Phase I progressed, it became apparent that refinements to the interim measure protocol (IMP) and custom measure protocol (CMP) processes were needed. In GM-008 and GM-011, the SWE set forth a four-step process for reviewing and implementing IMPs:

1. The EDCs submit interim TRM protocols to the SWE.
2. The protocols undergo iterative review process between the SWE and the program evaluation group (PEG), and once accepted by the SWE, achieve “interim approved TRM protocol” status and are posted to the SWE SharePoint site.
3. To facilitate timely review, an IMP tracking process is implemented, inclusive of time frames for SWE review and comment, and for EDC reply and comment.
4. The interim protocols are subsequently included as proposals in the next TRM update for comment by the public and all stakeholders, and are submitted to the Commission for review and approval.

The initial CMP process, as described in the 2009 TRM Order and the SWE Phase I Audit Plan, required Commission approval of a measurement and verification (M&V) plan for a custom measure before the project could be implemented. This process proved difficult to implement, and was not consistent with the best practices implemented in other jurisdictions. It also precluded many custom projects from being implemented for more than six months, in part because of the difficulty of reaching consensus on a generic savings estimation methodology adequate for all EDCs. To resolve these issues, the SWE issued GM-002, reflecting a consensus among the PEG participants for a revised CMP process. The new process did not require EDCs to submit CMPs for each measure and technology type, but gave the SWE the right to audit and review claimed and verified impacts of all custom measures after the impacts had been verified by the EDCs’ program evaluators. This process was in line with the CMP approval processes in

[309] Guidance memoranda issued during Phase I are listed in Appendix B and summarized in Appendix C. This section provides a brief summary of selected guidance memoranda.

other jurisdictions, which enabled the program evaluators to verify savings using their own methodologies, and allowed the EDCs to implement custom projects without delay.

The SWE commends the EDCs for contributing to impact evaluation improvements made during Phase I. For example, in PY3, the FirstEnergy program evaluator completed a thorough and rigorous evaluation of the lighting kits distributed to commercial customers. The survey sent to these customers identified that some bulbs distributed for C&I use ended up in residential homes. This was an important finding, as the HOU for residential bulbs is less than the HOU of bulbs installed in a commercial building. Therefore the gross verified savings for the program were affected. Additionally, the FirstEnergy program evaluator used light loggers to verify the HOU of the CFLs from the kits installed in the commercial buildings.

Finally, experience and lessons learned in Phase I also are influencing improvements in the TRM protocols for Phase II. The SWE found in Phase I the need to develop Pennsylvania-specific data for HOU, and is planning two metering studies during Phase II to develop such data. In addition, for the 2013 TRM update the SWE refined the home energy modeling protocols, based on the Pennsylvania-specific results developed in the Residential Baseline Study, to estimate the EFLH for weather-sensitive residential measures. The previous EFLH estimates were based on generic home models in the ENERGY STAR calculator.

5.2.2 Sampling Design and Protocols

In the initial issuance of the SWE Phase I Audit Plan, the SWE set forth sampling guidelines for program evaluation that it believed would be appropriate and applicable to Act 129 programs based on past experience and the sampling guidelines of other jurisdictions. Confidence intervals and precision levels were assigned by measure type under the expectation that EE&C programs would be structured around homogeneous population groups and could be stratified into measure groups. As program implementation began, the SWE observed that programs tended to be structured along sector lines and contained multiple measure types, meaning that the prescribed sampling guidelines to meet statistical parameters were insufficient.

As a result, the SWE issued GM-003, which presented sampling protocol revisions and set forth guidance intended to be flexible in order to accommodate the wide diversity of EDC portfolios, including guidelines for nested sampling that were being used by program evaluators. Confidence and precision targets of 90% ±10% were set for both the residential and non-residential portfolios of programs, and targets of 85% ±15% for each specific program. The SWE also modified through GM-003 the guidelines for the coefficient of variation (Cv) to inform sampling designs to achieve precision requirements.

Additionally, the SWE drafted two more guidance memos, GM-016 and GM-018, and a white paper[310] regarding sampling during Phase I. The white paper and GM-016 were drafted in response to EDC evaluator questions regarding whether a one-tailed sampling approach would be prudent in order to

[310] White Paper on Statistical Testing for Act 129 Program Evaluation. August 23, 2012.

reduce the size of the evaluation sample and reduce the expenditures on verification exercises. GM-016 clarified that a one-tailed sampling approach would not be appropriate based on the SWE's understanding of the methodology used for determining compliance for Act 129, and the white paper provided further support and technical discussion of the issue. GM-018 provided guidance on how verified energy and peak demand reductions should be calculated and reported at the conclusion of Phase I of Act 129 to establish a consistent methodology across all seven of Pennsylvania's subject EDCs.

Throughout Phase I, there were some instances where EDCs did not hit their precision targets of ±15% at the program level. This occurred when ex-post and ex-ante savings were less correlated than the sampling assumed. To ensure that EDC evaluators met their precision targets in future years, the SWE provided recommendations in its annual reports, including using a more conservative approach in sample design (a more conservative error estimate), increasing sample sizes, treating more projects within the program as custom, and using more robust methods for calculating ex-ante savings. These actions helped and will continue to help the EDC evaluators meet precision targets in current and future years of Act 129.

5.2.3 TRC Test Protocols

As Phase I progressed, it became apparent that there was substantial difficulty in comparing TRC test results among the EDCs and achieving statewide consistency in applying the TRC test. A significant reason for this was that each EDC initially could develop its own incremental cost database and choose between using adjusted California Database for Energy Efficient Resources (DEER) values or other values they considered appropriate. This resulted in different measure costs being used by the EDCs for similar measures, and limited transparency and the ability to compare TRC test results.

In order to increase transparency and promote standardization of cost data for the TRC tests, the SWE developed the Incremental Measure Cost Database. The database was developed using invoices provided by the EDCs for projects and measures implemented and purchased through their Act 129 programs (i.e., Pennsylvania-specific data). While use of the database was not mandatory, it presented a framework for standardizing incremental measure costs and introducing PA-specific cost information into TRC calculations, thus allowing for more transparent, consistent, and accurate TRC calculations among the EDCs. In PY4, some EDCs elected to use the SWE Incremental Measure Cost Database as the source for their cost information for some measures.

Another inconsistency among the EDCs was the manner in which they applied the 15 years of avoided energy and demand costs to program impacts. The SWE determined that these differences were a function of Act 129 program years (June 1 -- May 31) falling across two calendar years. For example, PY4 began in 2012 and concluded in 2013. The avoided cost forecasts that are multiplied by gross verified savings to calculate the financial benefits of programs appeared to be specified by calendar year (January 1 -- December 31). The TRC Order limits the effective useful life of any energy efficiency to 15 years for the purposes of the benefit-cost calculations but does not specifically address which 15 years of avoided costs should be used. Some EDCs chose to use the beginning year of the program year as the first year of the avoided cost stream, while others chose the ending year as the first year of the avoided cost stream. Additionally, one EDC used a fixed avoided cost stream, beginning in 2009 and ending 15 years later. Furthermore, some EDCs calculated avoided costs on a monthly basis and mapped them to align exactly with the program years. It was therefore difficult to compare TRCs across EDCs.

The SWE drafted GM-019 to summarize the issue and present recommendations to the EDCs. The SWE recommended that EDCs use the calendar year at the close of the program year when avoided costs are calculated by calendar year. The SWE also stated that at the EDCs' discretion, they could choose to calculate avoided costs on a monthly basis and determine annual values by mapping to align exactly with the program year, as this methodology would produce the most realistic estimate of cost-effectiveness. By recommending these guidelines, the SWE ensured consistency and accuracy among the EDCs and created a more transparent methodology, making it easier to compare cost-effectiveness across the state.

Another TRC-related issue arose during Phase I regarding low-income sector cost reporting. Per the 2010 Low-Income Working Group, the EDCs were required to estimate low-income participation in non-low-income programs in order to reflect fully how Act 129 EE&C programs affected the low-income sector. However, the EDCs were not required to explicitly report the costs associated with the low-income participation in non-low-income sector EE&C programs. In order to provide estimates of the costs of low-income participation in non-low-income programs, the SWE issued GM-017, which set forth a consistent methodology for reporting the portion of low-income costs associated with low-income sector participation in EE&C programs not expressly targeted to the low-income sector.

5.2.4 Net-to-Gross Issues

In the 2009 TRC Order, the Commission stated that there would be no NTGR adjustment for the first year of Act 129 programs but that a stakeholder process would be convened to examine the issues associated with developing NTGRs.[311] In the 2011 TRC Order, the Commission ordered that all EDCs "collect data necessary to determine the NTG ratio for their programs and to apply the ratio when determining the cost-effectiveness of future modifications of existing programs."[312] In response to this directive, the SWE prepared a comprehensive review of best practices for conducting net-to-gross (NTG) studies and developing NTGRs during Phase I. [313]

In reviewing the NTG studies prepared in Phase I, the SWE observed that some programs in the EDCs' portfolios exhibited high free-ridership,[314] which occurs when a participant receives an incentive for something that he or she would have done in the absence of receiving the incentive. Act 129 incentive

[312] 2011 TRC Order, p. 25.
[313] See Appendix B.5.2 . See also Section 6.4, which presents the results of the EDCs' NTG studies.
[314] Free-ridership is one component used to estimate NTGRs. A program can exhibit high free-ridership but still have a high overall NTGR depending on other factors used in NTGR estimation. See section 6.4 for definitions of high, medium, and low NTGRs and free-ridership.

programs exhibiting substantial free-ridership included C&I equipment rebate programs, appliance recycling programs, and upstream CFL programs. The SWE found these free-ridership results to be consistent with the free-ridership results of similar program types in other jurisdictions.

The SWE reviewed best practices and recommended ways to reduce free-ridership in EE&C programs implemented in future phases of Act 129. The SWE's recommendations included the following:[315]

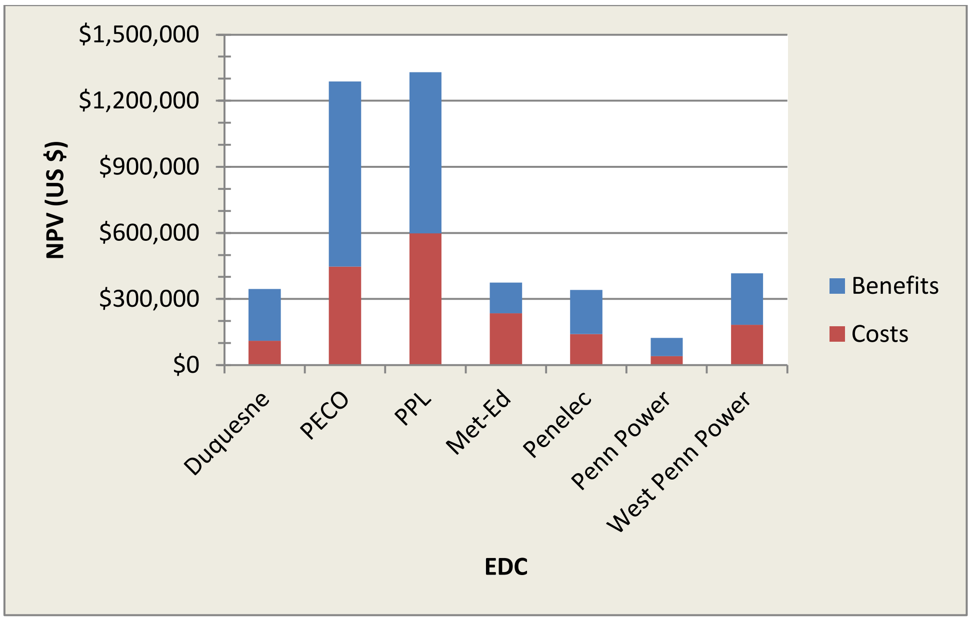
- All EDCs should consider actions to reduce free-ridership, such as implementing a 90-day rebate eligibility clause for purchase of EE equipment. There are many other ways to reduce free-ridership, and the SWE recommends that the EDCs look into which methods suit their individual programs.
- EDCs should assess the eligibility of their projects and limit or disqualify projects that have already commenced or that apply retroactively for program incentives.
- EDCs should optimize program incentive levels. For example, they could:
  - Provide a tiered measure incentive design.
  - Increase rebates for premium or ultra-high efficiency equipment.
  - Reduce the incentive amount for commonly installed measures or efficiency levels.
- EDCs should assess the stringency of measure efficiency. For example:
  - Ensure that program measures surpass current code requirements.
  - As CFLs become more commonplace, transition lighting rebates from CFLs to more efficient LEDs.
- EDCs should encourage trade ally participation. Pushing trade allies to engage in projects at an early stage can help influence a customer's decision to install a measure.

[315] These recommendations were made in the SWE PY3 Annual Report.

5.3 Phase I Cost-Effectiveness

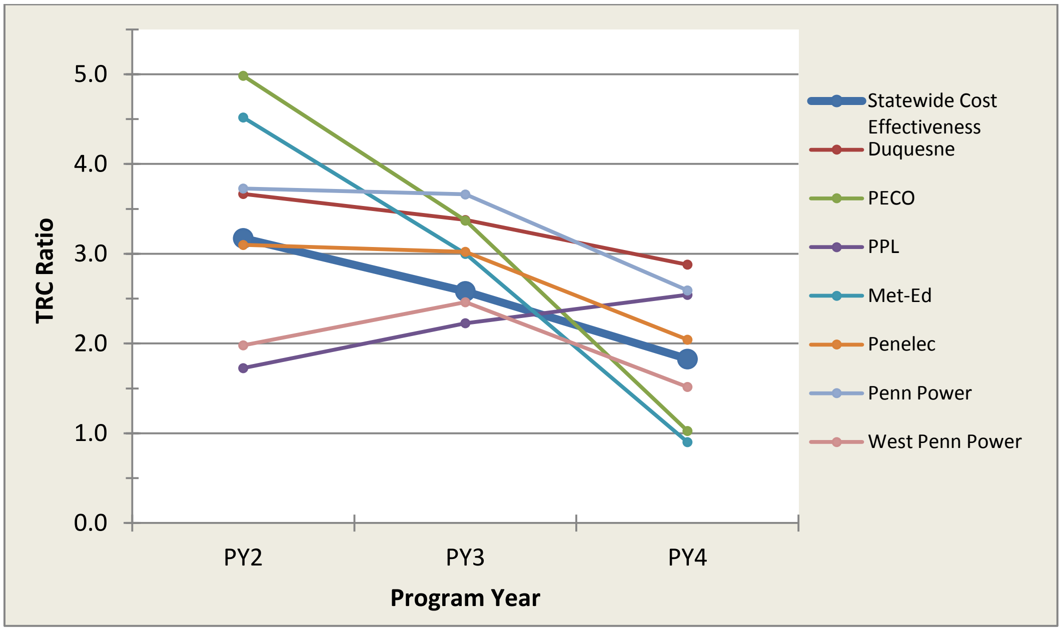
Statewide, Phase I of Act 129 was a financial success from a cost-effectiveness standpoint. Collectively across all seven subject EDCs, the Phase I TRC costs were $1,755,384,000, and the benefits were $4,192,389,000. This produced a statewide gross benefit of $2.4 billion to residents of the Commonwealth with a TRC benefit-cost ratio of 2.4. As shown in Figure A-1 the TRC ratios varied across EDCs, ranging from 1.6 (Met-Ed) to 3.1 (Duquesne).

Figure A-1: Phase I Cost-Effectiveness Overview by EDC



Some of the major impacts to cost-effectiveness in Phase I were CFLs, conservation voltage reduction programs, and DR programs. Many EDCs ran CFL campaigns in PY2. Costs associated with CFLs are very low (prices are comparable to or sometimes even less than for incandescent lamps), which produces high TRC benefit-cost ratios. The CFL programs that ran in PY2 had TRC ratios that ranged between 7 and 12. Conservation voltage reduction programs also provided numerous benefits at minimal costs. PECO ran a conservation voltage reduction program in PY2 that saw a TRC ratio of 262.4. Similarly, West Penn Power also ran this program in PY4, capturing a TRC ratio of 58.1. Conversely, DR programs, which were offered by all seven EDCs in PY4 only, were expensive to administer and accrued benefits for only one program year, causing them to have very low TRC ratios. The effects of the DR programs can be seen inFigure A-2, which details the change in TRC ratios over Phase I for all EDCs.

Figure A-2: Variations in Phase I Cost-Effectiveness by Year



Other factors contributed to the general downward trend of the statewide TRC, most notably the depletion of the "low-hanging fruit." Alongside CFLs, T8 upgrades are one of the most cost-effective measures to implement. As more and more customers have already completed this upgrade, the remaining EE upgrades available are more expensive and have lower TRC ratios. EDCs are forced to go deeper into customers' homes and businesses to achieve savings, and this leads to increased costs for both program administrators and participants.

Another trend to note in Figure A-2 is the tightness of the spread of numbers among EDCs, which is detailed in Table 5-1.

Table 5-1: Statewide Cost-Effectiveness Spread across Phase I

Program Year	Max TRC	Min TRC	Delta
PY2	4.52	1.73	**2.79**
PY4	3.14	1.01	**2.13**

As the TRM becomes more sophisticated, the TRC numbers should vary less across EDC. The TRM aims to standardize savings calculations and measure lives, which are key components of the numerator of the TRC ratio. As more deemed values, such as measure lives and incremental costs, get added into the TRM, comparison of TRC ratios between EDCs will be more of an "apples to apples" comparison. However, measure mix, measure adoption, measure penetration, and incentive amounts will continue to introduce variation in TRC ratios across the state.

One caveat that should be noted regarding Phase I TRC ratios is that hindsight has shown that the avoided costs used for PY1-PY4 were largely overstated based on market developments over the past five years. EDCs developed avoided cost estimates in 2008-2009 and filed them with their EE&C plans based on the best information available at the time. Since then, an economic recession, the explosion of cheap natural gas from the Marcellus formation in western Pennsylvania, and the proliferation of DR programs in competitive markets have all exerted downward pressure on energy and capacity prices in the region. As discussed in Section 6.3.5, EDC avoided cost estimates in Phase II EE&C plans were 25% to 40% lower than Phase I avoided costs for the same years. A reduction in avoided cost values would decrease TRC ratios for EDC EE&C plans if all other inputs were held constant.

5.4 Recommendations for Program Improvements for Subsequent Act 129 Phases

Below are recommendations from the SWE for improving programs in subsequent Act 129 Phases based on its work and review of the EDCs' evaluator reports and recommendations.

5.4.1 Recommendations for Program Improvements for Residential Programs

The SWE recommends that all EDCs consider increased cross-promoting of all residential programs. Upon review of the several EDC process evaluations for residential programs, the SWE found that many participants of one residential program (for example: appliance recycling) had not heard of other EDC programs. The SWE therefore recommends that EDCs consider including promotional materials about other residential programs, along with the rebate forms or materials distributed to program participants.

5.4.1.1 *Recommendations for Program Improvements for Residential Appliance Recycling Programs*

- The SWE commends all EDCs on the high levels of participation in appliance recycling programs statewide. The SWE recommends that EDCs continue using bill inserts as the primary marketing tool for this program, as it has proven effective in reaching customers.

- The SWE recommends that EDCs reevaluate the incentive offered for appliance recycling programs. EDC process evaluations have shown that customers may be willing to participate in the program for a lower incentive. This should be considered, as it could substantially reduce the budget for the program while still meeting energy savings goals.

- The SWE recommends that EDCs increase clarity on program requirements on promotional material. This will decrease the number of appliances that are not operational at the time of program participation.[316]

5.4.1.2 *Recommendations for Program Improvements for Residential Efficient Products and Lighting Programs*

[316] This only affected a small percentage of appliances in PY4.

- The SWE recommends that future evaluations investigate whether program measures are replacing high-efficiency measures, such as new CFLs replacing CFLs that have reached the end of their useful life. This issue will have increased importance in future phases and will provide valuable feedback about measure saturation. Also, evaluations should investigate and account for whether measures offered free of charge through low-income programs are replacing comparatively inefficient measures or are being installed by participants as incremental energy users.
- The SWE recommends that EDCs maintain open communication with retailers, trade allies, and contractors, to ensure that efficient products programs are being adequately communicated with customers.
- The SWE recommends that all EDCs use the changing EISA standards in January 2014 as an opportunity to increase customer participation in lighting programs, by communicating the availability and diversity of eligible bulbs.
- The SWE recommends that EDCs work with contractors for lighting programs to ensure that contractors provide detailed and transparent databases to both the EDC and the SWE in order to perform a thorough audit of the material.

5.4.1.3 *Recommendations for Program Improvements for Residential New Construction Programs*

- The SWE recommends discussions with the program evaluators and new construction program conservation service providers (CSPs) to explore improving process and accuracy for estimating and reporting energy and demand savings from lighting and appliances using the TRM algorithms instead of output from REM/Rate. One improvement, for example, could be to have the certified Home Energy Rating System (HERS) rater record information required as inputs to the TRM algorithms for lighting and appliances (e.g., fixture counts, refrigerator configuration). Participant and builder surveys could then be used to supplement and check the recorded HERS rater information, rather than using the surveys as the main source of information for the input to the TRM's algorithms for calculating energy and demand savings from lighting and appliance installations.
- The SWE recommends discussion with the program evaluators and CSPs to explore the feasibility of the CSP reporting the ex-ante demand savings for each home calculated using the TRM algorithms rather than based on output from REM/Rate. This would improve on the current process, which requires a significant adjustment to the sampled homes' demand impacts and extrapolating that adjustment to the entire program.
- The SWE further recommends a review of the TRM's demand savings algorithms for residential new construction, in light of the high demand realization rate for the New Construction

Program. The algorithms appear to take a non-conservative approach in applying the over-sizing factor for the baseline home, which results in an over-estimated baseline demand and thus over-estimated demand savings. The review should include consideration of the demand savings calculations used by REM/Rate and should result in a reduction of the over-estimated demand savings produced by the TRM.

5.4.2 Recommendations for Program Improvements for Commercial and Industrial Programs

- The SWE found that program evaluators using interview hours of use or logging results to evaluate non-residential lighting projects had inconsistent approaches to evaluating the peak demand savings for such projects. Program evaluators either used the TRM deemed CF for the appropriate building type or calculated custom CFs using the interview lighting hours of use or logging results and a tool such as the Act 129 Demand Savings Calculator for Non-Weather Dependent Custom Measures. Requiring custom CFs could be cumbersome for implementers, but using TRM CFs can create a disconnect between the hours of use and the CF. For example, a warehouse that is illuminated 24 hours a day, every day of the year, has a TRM CF of 0.85 but would have a CF of 1.0 based on interview or logging results. The SWE recommends that the PEG investigate this matter further and issue formal guidance in order to standardize evaluation approaches.

- The SWE found that in Phase I, program evaluators' site inspection reports and analyses differed in comprehensiveness, documentation, and transparency, particularly for custom projects. The SWE recommends that, in collaboration with the PEG, high-level guidance be issued that provides minimum requirements of site inspection reports and analyses. For example, the SWE found that in some cases the source of estimates of key savings parameters was undocumented. Having basic requirements in place for site inspection reports will afford greater transparency and consistency and expedite the SWE's review process.

- More than 80% of the energy and peak demand savings achieved by Phase I non-residential EE programs came from the installation of efficient lighting technologies. As EISA regulations transform the lighting marketplace and Act 129 programs reduce the amount of inefficient lighting equipment available for replacement, EDCs should actively pursue savings from non-lighting measures. This will mean going deeper into customer facilities and embracing more complex technologies.

- Realization rates significantly different from 1.0 are an important evaluation finding and may indicate that the ex-ante assumptions were questionable. Evaluator discussion of what led to poor correlation between ex-ante and ex-post was often limited. A more thorough discussion of these discrepancies would help the SWE and TUS target measures that need to be revisited during the TRM update process.

- Estimating peak demand impacts has consistently proved more challenging than estimating energy savings based on the observed relative precision values for non-residential programs. The transition from the top 100 hours definition of peak to the PJM peak demand window of 2:00-6:00 p.m. on non-holiday weekdays in June, July, and August will help mitigate this uncertainty to some extent, but EDCs should make an effort to capture interval data on high-impact measures to improve verified demand savings estimates and for use in the TRM update process.

- Increased customer-specific data collection is needed for high-impact projects within non-residential programs. These projects typically have a very low sampling weight and carry a large share of program impacts, so the use of deemed TRM assumptions instead of customer-specific information increases the uncertainty of savings estimates. In the 2014 TRM, the Commission approved "thresholds" above which customer-specific data collection is required in order to increase the amount of M&V conducted on large projects. The SWE recommends that EDCs make a concerted effort to partner with customers having projects above the thresholds and incorporate data collection protocols early in the project's planning phase.

- Participation in most EDC non-residential programs in Phase I was skewed toward large customers. This is not uncommon, because small business owners often lack the time and capital to undertake EE projects in their facilities. EDCs will need to accept a greater role in the identification of savings opportunities and pay a larger share of the incremental cost to achieve savings potential from this customer segment in future phases. Several EDCs have added small business direct install programs to their EE&C plans for Phase II of Act 129 in an effort to reach this subset of their customer base.

6 Phase II

This section discusses Phase II of Act 129, including the mandated targets and the programs the electric distribution companies (EDCs) are implementing to achieve them. This section also discusses the net-to-gross (NTG) research performed by the EDCs during Phase I and how it was used to inform Phase II programs. The information in this section is included in this report per guidance from TUS Staff.

6.1 Introduction

The Pennsylvania General Assembly charged the Commission with evaluating the costs and benefits of an energy efficiency and conservation (EE&C) program by November 30, 2013, and every five years thereafter.[317] If the Commission determines that the benefits of the EE&C program exceed the costs, than the Commission must adopt incremental consumption reduction requirements.[318] In support of the Commission's determinations, the Statewide Evaluator (SWE) performed separate residential, and

[317] 66 Pa. C.S. §2806.1(c)(3).
[318] ibid.

commercial and industrial (C&I), baseline studies to gather data on the state of electricity usage by end-use customers in the state and the saturation of energy efficient (EE) equipment.[319] This information was used in the SWE Electric Energy Efficiency Potential Study, which assessed the opportunities for incremental cost-effective energy reductions in each EDC service territory.[320]

Based on the SWE's Electric Energy Efficiency Potential Study, the Commission found that the benefits of incremental reductions in consumption will exceed the costs, and therefore adopted incremental consumption reduction targets for Phase II of Act 129.[321] The three-year EE reduction compliance targets are listed in Table 6-1. Savings in excess of the 3% consumption reduction targets in Phase I can be credited toward EDC Phase II targets. The Commission allowed "banking" of savings to mitigate program slowdowns, customer confusion, and increased administrative costs during the transition between Phase I and Phase II if any EDCs had achieved their 3% reduction target prior to the end of Phase I.[322]

Table 6-1: Phase II Three-Year Compliance Targets

EDC	Three-Year % of 2009/2010 Forecast Reductions	Three-Year MWh Value of 2009/2010 Forecast Reductions
Duquesne	2.0%	276,722
PECO	2.9%	1,125,851
PPL	2.1%	821,072
Met-Ed	2.3%	337,753
Penelec	2.2%	318,813
Penn Power	2.0%	95,502
West Penn	1.6%	337,533

Compliance with Phase II consumption reduction targets will be based on gross verified savings. During Phase I of Act 129, the Commission required that EDCs conduct NTG research and report NTG ratios (NTGRs) in annual reports, but compliance with consumption reduction targets was also based on gross verified savings. The Phase II Implementation Order declared that the same requirement will apply in Phase II, such that NTG research will be conducted to inform program design and implementation, but will not determine compliance.[323] The Commission supported continuing to use an NTGR of 1.0 for compliance purposes for several reasons, including:

- If an NTGR of less than 1.0 is used, it raises the acquisition cost per kilowatt-hour saved to the EDC, which would require that the consumption reduction targets be reduced since the targets are based on the 2% budget cap.

[319] Phase II Implementation Order, p. 11. These studies are summarized in Appendix C of this report.
[320] The SWE Electric Energy Efficiency Potential Study is summarized in Appendix C of this report.
[321] Phase II Implementation Order, p. 13.
[322] ibid., pp. 58, 60.
[323] Phase II Implementation Order, p. 82.

- Determining NTGRs is inherently difficult and the results uncertain. The Commission believes that many NTG effects are offsetting, such that the NTGR ends up being close to 1.0 anyway. Therefore the Commission questions the cost-effectiveness of using rate-payer resources only to validate that the NTGR is close to 1.0.[324]

As in Phase I, an annual budget cap equaling 2% of each EDC's total annual revenue as of December 31, 2006 limits the recoverable costs associated with implementation and management of its Phase II EE&C plan.[325] [326] The Commission will continue to have the authority to direct an EDC to terminate any part of an approved plan if it is determined that an EE or conservation measure is not cost-effective.[327]

While energy consumption reductions in excess of an EDC's Phase I 3% reduction target can be "banked" for Phase II, any Phase I funds collected can be used only to account for Phase I measures, which are defined as being installed and commercially operable on or before May 31, 2013. Phase I funds may not be carried over to support Phase II measures, and thus any unused Phase I funds must be refunded to the appropriate rate classes.[328] In addition, regardless of an EDC's Phase I spending or whether energy consumption reductions are "banked" from Phase I, each EDC will receive its full Phase II budget. The Commission believes that allowing EDCs to spend Phase I budgets to achieve savings in excess of Phase I compliance targets without reducing Phase II budgets decreases the risk of potential penalties to EDCs in Phase II. The policy also promotes a smooth transition of programs from Phase I to Phase II, which is beneficial to ratepayers and the EDCs.[329]

The Commission set the duration of Phase II at three years, from June 1, 2013 through May 31, 2016. The rationale behind adopting a three-year cycle was to allow flexibility to comply with Act 129's mandate that, should additional peak demand reductions prove cost-effective, incremental targets shall be established and achieved no later than May 31, 2017.[330] The Commission noted that a three-year phase "will enable the potential introduction of a peak demand reduction program for the start of a Phase III, thereby allowing budgets and plans for consumption and peak demand reduction programs to be considered in totality at the beginning of a new phase."[331] In order to inform cost-effectiveness evaluation, on March 4, 2011 the Commission issued a Secretarial Letter directing the SWE to analyze the costs and benefits of compliance with the current peak demand reduction legislative requirements and of potential improvements to the peak demand reduction structure.[332] Because the Commission would not receive information on Phase I peak demand reduction programs cost-effectiveness until the

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[324] ibid., p. 83.
[325] Exclusive of expenditures on Low-Income Usage Reduction Programs established under 52 Pa. Code § 58. 66 Pa. C.S. §2806.1(g).
[326] Phase II Implementation Order, p. 101.
[327] ibid., p. 103.
[328] ibid., p. 107.
[329] ibid., p. 105.
[330] ibid., p. 22.
[331] Phase II Implementation Order, p. 22.
[332] ibid., pp. 32, 33.

end of 2012, and the SWE's report would not be complete until 2013, there was not enough information to definitively determine whether peak demand reduction programs would be cost-effective in Phase II.[333] In addition to the SWE's study analyzing the costs and benefits of the Phase I demand reduction requirements, the SWE's Phase II contract responsibilities include a demand response (DR) market potential study that will help gauge potential benefits and costs of future peak demand reduction programs in the Commonwealth and help establish any future reduction targets.[334]

Though there are not demand reduction compliance targets in Phase II, the Commission did direct EDCs to continue to track and report the demand reduction benefits associated with installing EE measures in Phase II.[335] Also, the Commission will allow EDCs, at their discretion, to continue residential direct load control programs in Phase II using Act 129 funding in order to "minimize confusion or adverse customer reaction" to starts and stops to such programs.[336]

In addition to the cumulative three-year consumption reduction targets listed in Table 6-1, the Act 129 Phase II Implementation Order requires that EDCs submit EE&C plans that are designed to achieve at least 25% of the target three-year reductions in each program year. The requirement is limited to Commission review and approval of EE&C plans, and EDCs are not subject to penalties under Section 2806.1(f) of the Act if actual annual consumption reductions are not at least 25% of the three-year targets.[337]

As in Phase I, Phase II contains a consumption reduction carve-out for government, non-profit, and institutional (GNI) entities. A minimum of 10% of each EDC's consumption reduction requirements must be obtained from the GNI sector. The Commission determined that failure to achieve the prescribed reduction from this sector does not subject an EDC to penalties under Section 2806.1(f) of the Act. However, EDCs can be subject to penalties contained in Chapter 33 of the Pennsylvania Public Utility Code, 66 Pa. C.S. §3301(a).[338]

Phase II of Act 129 also maintains the provision from Phase I that "each EDC EE&C Plan must include specific energy efficiency measures for households at or below 150 percent of the federal poverty income guidelines, in proportion to that sector's share of total energy usage in the EDC's service territory."[339] Furthermore, EDCs in Phase II must obtain a minimum of 4.5% of their consumption reduction requirements from the low-income sector. As with the GNI carve-out, failure to comply with

[333] ibid., p. 33. The SWE Demand Response Study is summarized in detail in Appendix C of this report.
[334] ibid., p. 33.
[335] ibid., p. 41.
[336] ibid., pp. 42, 43.
[337] ibid., p. 28.
[338] ibid., p. 46.
[339] Phase II Implementation Order, p. 53.

the low-income carve-outs does not subject an EDC to penalties under Act 129, but EDCs can incur penalties under Chapter 33 of the Pennsylvania Public Utility Code, 66 Pa. C.S. §3301(a).[340]

The Commission's Phase II Implementation Order also emphasized that EDCs should make efforts to provide programs to multi-family housing.[341] No funding was specifically allocated to multi-family housing in Phase II or targets prescribed, but the Commission believes that EDCs should recognize the available potential for energy savings and develop strategies to tap the potential from the sector. To alleviate barriers such as meter classifications, the Commission will not require multi-family properties to be owned by a non-profit or government entity to qualify under the GNI sector so long as the properties are financed under a federal or state affordable housing program and have long-term use restrictions in place.[342]

As in Phase I, the Commission is directing each EDC to offer at least one EE program to each customer class in Phase II of Act 129.[343] In addition, EDCs are encouraged to offer more comprehensive measures in Phase II as compared with Phase I. The Commission stated that "it is in the public interest for EDCs to adopt more comprehensive measures including whole house treatments." Therefore, each EDC is required to include at least one comprehensive measure for residential and small commercial rates classes in EE&C plans going forward.[344]

6.1.1 2012 Pennsylvania TRC Test

The 2012 PA Total Resource Cost (TRC) Test Final Order was approved by the Commission on August 30, 2012. As in Phase I, the Commission chose to use *The California Standard Practice Manual – Economic Analysis of Demand-Side Programs and Project*[345] as the basis for the 2012 PA TRC Test.[346] However, the PA TRC Test requires periodic update to address issues that arise that are specific to Pennsylvania. The TRC test for Phase II is applicable for the duration of Phase II, concluding May 31, 2016.[347] The 2012 PA TRC Test Final Order made refinements to the Phase I TRC test[348] for use during Phase II of Act 129, which began June 1, 2013. A description of the refinements to the Phase I test follows.

6.1.1.1 *Demand Response*

While there are no peak demand reduction targets for Phase II of Act 129, the Commission did deem that EDCs are allowed to voluntarily propose cost-effective DR programs, such as direction load control, in their EE&C plans.[349] Therefore, the Commission did address some topics related to demand response

[340] ibid., pp. 53, 55, 56.
[341] ibid., p. 49.
[342] ibid., p. 50, 51.
[343] ibid., p. 88.
[344] ibid., p. 20.
[345] *The California Standard Practice Manual – Economic Analysis of Demand Side Programs and Projects*, July 2002, p. 18. See http://www.calmac.org/events/SPM_9_20_02.pdf.
[346] 2012 PA TRC Test Order, p. 2.
[347] ibid., p. 3.
[348] Docket No. M-2009-2108601 on June 23, 2009 (2009 PA TRC Test Order).
[349] Phase II Implementation Order, pp. 42, 43.

in the 2012 TRC Order, though it will await the results of the DR study to propose a PA TRC methodology for DR programs, if such programs are determined to be cost-effective for a subsequent phase of Act 129.[350]

The Commission made the following determinations with regard to DR programs:

- EDCs can include avoided marginal transmission and distribution (T&D) costs in the PA TRC calculations for any proposed residential DR program, though the Commission did not prescribe a specific calculation methodology.
- Benefits of price suppression from proposed residential DR programs may be included in the benefits of PA TRC calculations, but again, the Commission did not prescribe a specific methodology to quantify the benefits.[351]

6.1.1.2 *Low-Income Savings Compliance Target*

Phase II of Act 129 requires that each EDC obtain a minimum of 4.5% of its consumption reduction requirement from the low-income sector.[352] Phase I did not include such a requirement, though the Act 129 Low-Income Working Group concluded that including energy savings from low-income participation in general residential programs could be used "to gauge the effectiveness of programs for low-income households and serve as a basis for recommendations to make adjustments to those programs."[353] EDCs estimated low-income participation in general residential program using various methods. In Phase II, the Commission is requiring methodology standardization in order to promote consistency and transparency. EDCs shall estimate low-income savings from non-low-income programs by conducting annual, SWE-approved surveys.[354] An EDC can only allocate savings from non-low-income programs toward its 4.5% low-income target if surveying is employed. Unlike in Phase I, no other estimation methodologies will be permitted.

In Phase I any low-income savings reported from non-low-income programs had the associated costs reported in EDC annual reports only as part of the respective general residential programs' reporting. While the savings were differentiated, the costs were not in any way to distinguish the costs of the low-income savings from general residential programs.[355] In Phase II, the Commission requires that EDCs provide benefit and costs data for both low-income and estimated non-low-income residential program savings in their annual reports, though a low-income sector TRC need not be calculated. As with the savings estimate, the cost estimates should follow from the approved survey results.[356]

6.1.1.3 *Incentive Payments from Sources Outside Act 129*

[350] 2012 PA TRC Test Order, p. 61.
[351] ibid., p. 60.
[352] Savings toward the compliance target includes participation in income-qualified low-income programs and low-income participation in general residential programs.
[353] Report of the Act 129 Low-Income Working Group, Docket No. 2009-2146801 (March 19, 2010), p. 3.
[354] 2012 PA TRC Test Order, pp. 48, 49.
[355] ibid., p. 50.
[356] 2012 PA TRC Test Order, pp. 52, 53.

The issue of inclusion of incentive payments in the PA TRC Test from sources outside of Act 129 was first addressed in the 2009 PA TRC Final Order. In Phase I federal tax credits and the American Recovery and Reinvestment Act of 2009 (ARRA) incentive payments were considered benefits in the PA TRC Test. Including these payments was considered to be a truer reflection of Act 129 program costs and benefits to Pennsylvania residents and businesses and ensured that ratepayer funds were used most prudently. However, the Gross Receipts Tax and Act 1 incentive payments were excluded from Act 129 PA TRC Test calculations because they would be cancelled out by tax payments by Pennsylvania residents and businesses over time.[357] Regardless of the treatment of payments, EDCs were able to fully include a measure's benefits in the PA TRC Test if any portion of the measure was attributable to Act 129.[358]

In Phase II, to the extent that the outside incentives are knowable and quantifiable, all outside incentives, whether rebates or tax incentives, are to be included in TRC test calculations as a reduction in program costs. EDCs are not free to simply exclude outside incentives based on the costs of tracking such incentives.[359] Also, as in Phase I, EDCs can claim the full benefit of a measure for TRC purposes if a customer is a recipient of an incentive or rebate from an Act 129 program and a program outside of Act 129 for the same measure.[360]

6.1.1.4 *Avoided Costs in Benefit-Cost Calculations in Approved EE&C Plans*

The 2012 PA TRC Test Final Order resolved the issue of which avoided costs forecast EDCs should use for all programs at the beginning of Phase II and when updated forecasts should be applied during Phase II. All Phase II programs, including existing Phase I programs carried over to Phase II, shall use the vintage of avoided costs forecasts when approved for Phase II. Any change to an existing program during the course of Phase II shall use the avoided cost forecast from when the program was initially approved. Only new programs introduced after the initial Phase II plan approval are required to use the most up-to-date avoided cost forecast. However, EDCs can use updated avoided cost information for all programs if they so choose, but they must be consistent about using updated cost information for all programs in the plan, clearly delineate their methodology for when to use updated avoided cost information, and provide the rationale behind the methodology.[361]

6.1.1.5 *Avoided Costs of Supplying Electricity*

During Phase I the avoided costs of supplying electricity were calculated based on a maximum 15-year measure life, broken down into three segments of 5 years. The Phase I avoided supply cost calculation methodology is described in Appendix F, section F.7 of this report.

The Phase II TRC test modified the Phase I approach by allowing New York Mercantile Exchange (NYMEX) PJM EDC Zone futures prices, to the extent they are knowable, to be used for the first five-year period. The Commission's rationale for modifying the Phase I approach is that the new approach already

[357] 2009 PA TRC Test Order, pp. 23, 24.
[358] 2012 PA TRC Test Order, p. 19.
[359] ibid., p. 21.
[360] ibid., p. 20.
[361] ibid., pp. 40, 41.

accounts for delivery to the EDC zone and eliminates the need to benchmark PJM Western Hub prices. Alternatively, when zonal futures prices are not available, EDCs can adjust PJM Western Hub prices to reflect EDC Zone delivery prices using the proximate month EDC Zone to PJM Western Hub price ratios. In the event that such zone-specific indicators are not available to a specific EDC, that EDC may revert to the Phase I methodology of adjusting the PJM Western Hub futures indicators based on historical basis differentials.[362]

Because of the decreased liquidity of the NYMEX natural gas market for delivery four to five years in the future relative to delivery in the same time frame, the Commission adopted the spark price spread methodology for year five of the first five-year period.[363] In addition, the Commission also directed EDCs to use separate heat rates for spark price spread calculations for on- and off-peak periods as opposed to using a single heat rate as was done in Phase I. The Commission stated that the heat rate of an nth-of-a-kind conventional combustion turbine shall be used for on-peak periods and the heat rate of an nth-of-a-kind conventional gas/oil combined cycle turbine shall be used for off-peak periods.[364]

The final modification the Commission made to the Phase I avoided cost calculation methodology was to use the spark price spread methodology used for the second five-year period for the third five-year period as well. The new methodology uses NYMEX futures natural gas prices rather than Energy Information Administration (EIA) Annual Energy Outlook (AEO) energy cost projections, which provides consistency in projections for years 5 through 15. If NYMEX data is not available, then EDCs shall use EIA AEO natural gas price projections in the spark price calculations for years 11 through 15.[365]

6.1.1.6 *Transmission, Distribution, and Capacity Costs*

The Phase I TRC benefit-cost test provided that transmission prices to the EDC zone, as set by the Federal Energy Regulatory Commission (FERC) distribution rates, capacity prices, and known, generally accepted ancillary service rates were included in the TRC calculation. For years 5 through 10 the Commission allowed EDCs to use the Bureau of Labor Statistics (BLS) Electric Power Generation Transmission Distribution (GTD) sector price index as a proxy escalation rate for these prices.[366] For Phase II, the Commission directs EDCs to use the five-year rolling average of the BLS factor as the escalation rate of transmission, distribution, capacity, and ancillary services costs for years that such price data are unavailable through year 15.[367]

6.1.1.7 *Compliance with AEPS Act*

Previous PA TRC tests did not prescribe a methodology for calculating the avoided cost of compliance with the Alternative Energy Portfolio Standard (AEPS) because of the reduction in energy consumption related to Act 129 programs. In Phase II the Commission directs EDCs to determine the avoided AEPS

[362] 2012 PA TRC Test Order, pp. 28, 30, 31.
[363] ibid., p. 31.
[364] ibid., p. 31.
[365] ibid., p. 32.
[366] ibid., p. 33.
[367] ibid., p. 34.

compliance costs by multiplying the projected reduction in required alternative energy credits (AECs) by the estimated unit costs of all such required credits. When unit cost data are unavailable, the AEC price shall be escalated using the 5-year rolling annual growth rate in the BLS index.[368]

6.1.2 2013 TRM Order

The annual Technical Resource Manual (TRM) update process serves the dual purpose of adding new measures and technologies as well as updating existing measure savings protocols based, for example, on recent research, studies, and Pennsylvania-specific data. The 2013 Annual Update Final Order was approved December 20, 2012. The 2013 TRM will be effective for the first year of Phase II, from June 1, 2013 to May 31, 2014. No new protocols were added to the 2013 TRM, but there were several updates to existing measures from the 2012 TRM. Among the updates to the residential protocols were the following:

- The Commission updated the heating and cooling equivalent full load hours (EFLH) to account for the fact that residential heating, ventilation, and air conditioning (HVAC) units are often over-sized. The electric HVAC protocols were modified using modeling software to account for the fewer hours that an over-sized HVAC unit will run as compared with a perfectly sized unit.[369] The change in EFLH affected the following protocols: Electric HVAC, Furnace Whistle, Programmable Thermostat, Ductless Mini-Split Heat Pumps, Fuel Switching: Electric Heat to Gas Heat, and Ceiling, Wall, and Attic Insulation.
- The 2012 TRM compact fluorescent lamps (CFLs) daily hours of use (HOU) value was 3.0. The 2012 TRM Final Order directed the Technical Working Group to "monitor and review studies related to CFL HOU values in markets similar to Pennsylvania's and provide recommendations for future TRM updates."[370] The SWE Program Evaluation Group (PEG) and the Commission reviewed seven metering studies and considered the length of the study, number of homes, number of meters installed, and geographical location of the study. In addition, the CFL HOU from seven TRMs from other states and regions were reviewed. The preponderance of evidence supported a CFL HOU of less than 3.0. Ultimately the Commission adopted 2.8 HOU, supported by a 2009 New England study "given that New England is geographically proximate to Pennsylvania and the Study deployed more loggers and metered for a longer duration than all other regional studies analyzed combined."[371] The revised HOU value affected the following protocols: Home Energy Conservation Kits, ENERGY STAR LEDs, Residential Occupancy Sensors, and Low Income Lighting.
- The assumed daily hot water usage per household was adjusted from 64.3 gallons to 50 gallons based on a more recent U.S. Department of Energy-supported assumption as compared with the

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[368] 2012 PA TRC Test Order, pp. 44, 45.
[369] 2013 TRM Final Order, p. 21.
[370] See *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update* Order at Docket No. M 00051865, entered December 16, 2011, p. 43.
[371] 2013 TRM Tentative Order, pp. 16, 17.

2012 TRM, which used the assumption from the 1998 electric water heater testing protocols. This change affected the following protocols: Efficient Electric Water Heaters, Heat Pump Water Heaters, Solar Water Heaters, Electric Water Heater Pipe Insulation, Fuel Switching: Domestic Hot Water Electric to Gas, and Fuel Switching: Heat Pump Water Heater to Gas Water Heater.[372]

- The deemed energy savings for refrigerator replacements and retirements were revised using a regression analysis, based on the U.S. Department of Energy's Uniform Methods Project regression equation of metered data from other states.[373] The deemed savings for freezer replacements and retirements were revised based on the regression equation in the Cadmus Memo for the 2013 TRM.[374] [375] Inputs to the regression equations were based on the average values of each independent variable for the entire fleet of refrigerators and freezers, respectively, removed for all Pennsylvania EDCs during Program Year 3 (PY3) of Act 129. The independent variables included appliance age, configuration (e.g., side-by-side refrigerator and freezer), size, location (conditioned or unconditioned space), and part-use factor.[376]

Among the updates to the non-residential protocols were the following:

- The Commission staff and SWE conducted a cross-sectional study to compare the 2012 TRM lighting HOU and coincidence factor (CF) values, which were based on data from a 1999 Pacific Gas and Electric study for several building types, with TRMs from other states. The Commission found that the 2011 Mid-Atlantic TRM was the most appropriate source for updating the HOU and CF values for 11 building types in Pennsylvania's 2013 TRM. The Mid-Atlantic TRM values were derived from the California 2006-2008 Commercial Lighting Study supplemented by the 2008 California Database for Energy Efficiency Resources (DEER). It was determined that the California results were most appropriate given that the study was the largest of its kind, consisted of metered data as compared with customer reports or modeling, was recently completed, was transparent and vetted by stakeholders in California, and provided HOU estimates for almost all of the 12 critical building types in the Pennsylvania TRM with high precision and confidence.[377] In addition to the 11 existing building types updated using the Mid-Atlantic TRM, six other building types for which HOU and CF values were not available in the 2011 Mid-Atlantic TRM were updated using TRMs and measure savings databases from other states. The 11 building types from the 2012 TRM remained unchanged.[378] Three new building

[372] 2013 TRM Final Order, pp. 56, 57.
[373] ibid., pp. 43, 44.
[374] 2013 TRM Final Order, p. 47.
[375] See Cadmus Memo, August 20, 2012 Technical Memo from the Cadmus Group to the Michigan Evaluation Working Group on the topic of Appliance Recycling Measure Savings Study. This memo summarizes research on the energy savings of recycled refrigerators and freezers conducted by The Cadmus Group, Inc. and Opinion Dynamics (together known as the evaluation team) on behalf of Consumers Energy (Consumers) and DTE Energy (DTE).
[376] 2013 Technical Reference Manual, pp. 95-98.
[377] 2013 TRM Final Order, pp. 84, 85.
[378] 2013 TRM Final Order, p. 86.

types were added, derived from the 2011 Mid-Atlantic TRM. While the Commission believes the 2013 TRM is an improvement relative to the values in the 2012 TRM, it also supports obtaining Pennsylvania-specific data via a metering study for future TRM updates.[379]

- The Commission expanded the number of lighting control technologies in the 2013 TRM by 13 relative to the 2012 TRM, based on a 2011 comprehensive study from Lawrence Berkley National Laboratory.[380]
- The Commission updated the energy savings factor (ESF) and demand savings factor (DSF) values for variable frequency drives (VFDs) using the 2012 Connecticut TRM as the primary source. The ESF and DSF values in the 2012 TRM were based on the 2011 Mid-Atlantic TRM, which incorrectly listed values from the 2009 Connecticut TRM. Therefore the 2012 Connecticut TRM was used to update VFD ESF and DSF values. It was also used to update the motor and VFD operating hours. The Commission proposed running computer model simulations for future TRM updates to further increase the accuracy of ESF, DSF, and hours values.[381]

Finally, the Commission reaffirmed both in the Phase II Implementation Order and the 2013 TRM Final Order that the TRM will continue to be updated annually, so as to maintain up-to-date information that reflects the most accurate measure energy savings possible.[382] While the TRM is updated annually, the Commission is confident that the 25% increase in acquisition costs that the SWE included in its Market Potential Study and was used to establish Phase II compliance targets will help account for annual modifications to the TRM.[383] The Commission emphasized that the TRM is “first and foremost a measurement tool used to determine, in a reasonably cost-effective way, the actual energy savings achieved by specific measures after they have been installed or implemented.” [384] The 2013 TRM Final Order reiterated that the TRM is a guidance tool that reduces the risk of any challenges to the credibility of energy savings attributable to EDCs’ plans in a future proceeding, but that EDCs are always free to use any method to determine energy savings, so long as the method can be supported by “substantial credible evidence, if necessary.”

6.2 SWE Baseline and Energy Efficiency Potential Studies

Below are descriptions of the SWE Residential Baseline Study, SWE Commercial and Industrial Baseline Study, and SWE Energy Efficiency Potential Study. These studies were used to inform the Commission’s decision on Act 129 Phase II targets.

6.2.1 SWE Residential Baseline Study

The residential end-use saturation study provided a baseline of the existing residential market energy uses and housing characteristics and was conducted primarily by onsite consumer surveys and data

[379] ibid., p. 90.
[380] ibid., p. 90.
[381] ibid., pp. 95, 96.
[382] Phase II Implementation Order, p. 75, and 2013 TRM Final Order, p. 119.
[383] 2013 TRM Final Order, p. 120.
[384] ibid., p. 119.

gathering in the seven subject EDC territories during the fall of 2011. The study included a total of 488 individual surveys focused on existing equipment, envelope characteristics, and behavior patterns, among other details. These survey results serve as a platform for residential housing baseline statistics for the entire state of Pennsylvania. Details on the SWE Residential Baseline Study can be found in Appendix C, section C.2.

6.2.2 SWE C&I Baseline Study

The C&I baseline study was performed between October 2011 and February 2012, with the primary survey format being onsite customer surveying with some follow-up data gathering. The focus of the study was to determine the energy usage characteristics of Pennsylvania's C&I building portfolio and reveal a sample of the end uses of energy as best possible. The study included a total of 418 surveys and served as a platform for C&I energy usage statistics for the state of Pennsylvania. Details on the SWE C&I Baseline Study can be found in Appendix C, section C.2.

6.2.3 SWE Energy Efficiency Potential Study

The SWE was required to evaluate and assess the financial viability of Act 129 of 2008 in order to capture a realistic view of the program's success in 3-, 5-, and 10-year periods beginning June 1, 2013. The statistical and analytical methods used varied but included TRC testing and review of other potential studies to analyze the residential, commercial, and industrial markets. The final purpose of the market potential study was to diagram the feasibility of the demand reduction goals of the program based on perceived data and impact to the utilities, which could then be adjusted to maximize the energy savings potential of Act 129. Details on the SWE Energy Efficiency Potential Study can be found in Appendix C, section C.3.

6.3 Summary of Phase II EE&C Plans and Programs by EDC

The EE&C Plans submitted by the EDCs for Phase II were based on the successfully implemented EE&C plans of Phase I. They include a combination of programs continued from Phase I and new programs developed based on results and review of best practices from Phase I, Commission requirements, and Commission recommendations.

Table 6-2 through Table 6-8 show the breakdown of projected Phase II annual MWh and kW savings for each EDC's EE&C plan portfolio by sector, as they were estimated in the amended Phase II EE&C plans submitted in January and February of 2013. All savings estimates in these tables are cumulative, annualized savings.

Table 6-2: Duquesne Phase II Cumulative Savings Estimates

MWh and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	14,085,512		14,085,512		14,085,512	
Residential Sector[2] (Exclusive of Low-Income)	46,318	2,115.7	92,636	4,231.4	138,954	6,347.1
Residential Low-Income Sector[2]	4,981	250.3	9,962	500.7	14,943	751.0
C&I Small Sector[2]	5,085	919.3	10,171	1,838.6	15,256	2,757.9
C&I Large Sector[2]	43,236	7,413.8	86,471	14,827.5	129,707	22,241.3
GNI Sector[2]	11,069	1,645.1	22,138	3,290.1	33,207	4,935.2
EE&C Plan Total	**110,689**	**12,344**	**221,378**	**24,688**	**332,066**	**37,032**
EE&C Plan Total – Percentage of Target to Be Met	40%		80%		120%	
Estimated Phase I Carryover						
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**110,689**	**12,344**	**221,378**	**24,688**	**332,066**	**37,032**
Percentage Reduction from Baseline	0.8%		1.6%		2.4%	
Commission-Identified Goal					**276,722**	
Projected Savings as Percentage of Commission Goal					**120%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

Table 6-3: PECO Phase II Cumulative Savings Estimates

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	38,809,100		38,809,100		38,809,100	
Residential Sector[2] (Exclusive of Low-Income)	134,220	17,000	266,612	34,884	399,299	52,081
Residential Low-Income Sector[2]	16,432	1,058	32,877	2,117	49,364	3,142
C&I Small Sector[2]	80,761	17,647	161,727	35,349	242,723	53,042
C&I Large Sector[2]	99,425	21,833	198,941	43,702	298,283	65,510
GNI Sector[2]	34,239	11,549	68,821	23,214	103,748	34,995
EE&C Plan Total	**365,077**	**69,088**	**728,978**	**139,267**	**1,093,417**	**208,771**
EE&C Plan Total – Percentage of Target to Be Met	32%		65%		92%	
Estimated Phase I Carryover	30,335		60,670		91,005	
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**395,412**	**69,088**	**789,648**	**139,267**	**1,184,422**	**208,771**
Percentage Reduction from Baseline	1.0%		2.0%		3.0%	
Commission-Identified Goal					**1,125,852**	
Projected Savings as Percentage of Commission Goal					**105%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

Table 6-4: PPL Phase II Cumulative Savings Estimates[385]

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	38,214,368		38,214,368		38,214,368	
Residential Sector[2,3]	109,510	17,496	258,522.64	41,111	377,671	59,291
Residential Low-Income Sector[2,4]	4,906	477	12,481	1,283	22,091	2,340
C&I Small Sector[2]	51,949	9,060	105,336.24	18,336	157,774	27,476
C&I Large Sector[2]	49,794	8,349	132,611.09	22,398	191,583	32,450
GNI Sector[2]	30,009	4,947	65,037.96	10,593	92,835	15,205
EE&C Plan Total	**246,169**	**40,329**	**573,989**	**93,721**	**841,953**	**136,762**
EE&C Plan Total – Percentage of Target to Be Met	30%		70%		103%	
Estimated Phase I Carryover	110,000		110,000		110,000	
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**356,169**		**683,989**		**951,953**	
Percentage Reduction from Baseline	0.9%		1.8%		2.5%	
Commission-Identified Goal					**821,072**	
Projected Savings as Percentage of Commission Goal					**116%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.
3. Excludes low-income programs (income qualified). Includes low income participation in residential programs (49,192 MWh/yr).
4. Includes only the savings for income-qualified programs. Additional 49,192 MWh/yr from low-income participation in residential programs.

[385] PPL submitted a Petition to revise its Phase II EE&C Plan in November 2013. At the time this report was prepared, the PUC had not issued an Order on this Petition.

Table 6-5: Met-Ed Phase II Cumulative Savings Estimates

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	14,865,036		14,865,036		14,865,036	
Residential Sector[2] (Exclusive of Low-Income)	82,462	6,328	128,469	8,486	173,865	10,639
Residential Low-Income Sector[2]	10,704	928	14,183	1,253	18,902	1,615
C&I Small Sector[2]	18,784	2,302	41,889	4,951	64,885	7,582
C&I Large Sector[2]	17,471	2,425	34,990	4,853	52,297	7,245
GNI Sector[2]	12,173	1,271	26,844	2,721	41,502	4,169
EE&C Plan Total	**141,593**	**13,254**	**246,376**	**22,264**	**351,451**	**31,250**
EE&C Plan Total – Percentage of Target to Be Met	42%		73%		104%	
Estimated Phase I Carryover						
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**141,593**	**13,254**	**246,376**	**22,264**	**351,451**	**31,250**
Percentage Reduction from Baseline	1.0%		1.7%		2.4%	
Commission-Identified Goal					**337,753**	
Projected Savings as Percentage of Commission Goal					**104%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

Table 6-6: Penelec Phase II Cumulative Savings Estimates

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	MWh/yr	MWh/yr	kW	MWh/yr	kW
Baseline[1]	14,399,289		14,399,289		14,399,289	
Residential Sector[2] (Exclusive of Low-Income)	73,981	5,796	115,480	7,632	156,691	9,527
Residential Low-Income Sector[2]	11,718	999	15,472	1,386	21,124	1,836
C&I Small Sector[2]	18,458	2,128	43,686	4,848	68,800	7,548
C&I Large Sector[2]	12,624	1,696	26,194	3,515	39,588	5,304
GNI Sector[2]	10,439	1,035	24,601	2,310	38,741	3,582
EE&C Plan Total	**127,220**	**11,654**	**225,433**	**19,691**	**324,944**	**27,797**
EE&C Plan Total – Percentage of Target to Be Met	40%		71%		102%	
Estimated Phase I Carryover						
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**127,220**	**11,654**	**225,433**	**19,691**	**324,944**	**27,797**
Percentage Reduction from Baseline	0.9%		1.6%		2.3%	
Commission-Identified Goal					**318,813**	
Projected Savings as Percentage of Commission Goal					**102%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

Table 6-7: Penn Power Phase II Cumulative Savings Estimates

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	4,772,937		4,772,937		4,772,937	
Residential Sector[2] (Exclusive of Low-Income)	18,529	1,313	30,721	1,884	42,771	2,451
Residential Low-Income Sector[2]	2,424	219	3,383	325	4,661	441
C&I Small Sector[2]	7,198	734	15,154	1,590	23,078	2,439
C&I Large Sector[2]	3,051	402	7,310	947	11,534	1,486
GNI Sector[2]	4,031	358	8,886	813	13,738	1,267
EE&C Plan Total	**35,231**	**3,026**	**65,455**	**5,559**	**95,782**	**8,084**
EE&C Plan Total – Percentage of Target to Be Met	37%		69%		100%	
Estimated Phase I Carryover						
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**35,231**	**3,026**	**65,455**	**5,559**	**95,782**	**8,084**
Percentage Reduction from Baseline	0.7%		1.4%		2.0%	
Commission-Identified Goal					**95,502**	
Projected Savings as Percentage of Commission Goal					**100%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

Table 6-8: West Penn Power Phase II Cumulative Savings Estimates

MWh/yr and kW Cumulative Projected Portfolio Savings	Program Year 2013		Program Year 2014		Program Year 2015	
	MWh/yr	kW	MWh/yr	kW	MWh/yr	kW
Baseline[1]	20,938,650		20,938,650		20,938,650	
Residential Sector[2] (Exclusive of Low-Income)	73,682	5,723	106,244	7,402	139,317	9,159
Residential Low-Income Sector[2]	9,256	801	12,746	1,078	16,907	1,382
C&I Small Sector[2]	24,287	3,143	50,161	6,507	75,914	9,851
C&I Large Sector[2]	19,986	2,618	41,131	5,372	62,135	8,103
GNI Sector[2]	17,044	1,815	35,506	3,808	53,927	5,794
EE&C Plan Total	**144,255**	**14,101**	**245,788**	**24,169**	**348,200**	**34,289**
EE&C Plan Total – Percentage of Target to Be Met	43%		73%		103%	
Estimated Phase I Carryover						
Total Cumulative Projected Phase II + Estimated Phase I Carryover	**144,255**	**14,101**	**245,788**	**24,169**	**348,200**	**34,289**
Percentage Reduction from Baseline	0.7%		1.2%		1.7%	
Commission-Identified Goal					**337,533**	
Projected Savings as Percentage of Commission Goal					**103%**	

1. As defined in the Phase II Implementation Order.
2. Adjusted for weather and extraordinary load as applicable.

6.3.1 Duquesne

Table 6-9 shows Duquesne's proposed programs for Phase II of Act 129. It comprises a combination of Phase I programs that have been refined based on their performance during PY2 and PY3 and some new programs added in response to the Commission's Phase II Implementation Order. The new programs are briefly discussed below.

Table 6-9: Duquesne Phase II Programs by Sector (as of 2/7/2013 EE&C Plan)

Residential Portfolio Programs (Exclusive of Low-Income)
Residential Energy Efficiency Program
Whole House Audit/Retrofit Program*
Residential Appliance Recycling Program
Residential Home Energy Reporting Program
School Energy Pledge Program
Residential Low-Income Sector Programs
Low-Income Energy Efficiency Program
Whole House Audit/Retrofit Program*
C&I Small Portfolio Programs
Commercial Sector Umbrella Program
Commercial Upstream Lighting*
Small Commercial Direct Install*
Industrial Sector Umbrella Program
C&I Large Portfolio Programs
Commercial Sector Umbrella Program
Office Building Energy Efficiency
Healthcare Segment Energy Efficiency
Retail Segment Energy Efficiency
Commercial Upstream Lighting*
Industrial Sector Umbrella Program
Chemical Products Energy Efficiency
Mixed Industrial Energy Efficiency
Primary Metals Energy Efficiency
GNI Portfolio Programs
Multi-Family Housing Retrofit*
Public Agency Partnership Program
Education Segment Energy Efficiency

*Indicates a new program.

The Whole House Retrofit Program serves both Low Income and non-Low-Income Participants. Non-low income participants receive an incentive to offset the costs associated with a comprehensive whole house audit and also receive direct-installation of a "kit" of measures. The income-qualifying low income participant receives a comprehensive audit and an extensive list of direct install measures (including duct sealing & insulation, furnace repair/replacement, heat pump water heaters and more). Customers are also made aware of the availability of rebates for a range of measures through other Duquesne programs, and receive educational and informational materials about energy usage in their homes.

The Commercial Upstream Lighting program provides incentives for efficient lighting products directly to technology manufacturer distributors to offset the higher cost, and thereby drive uptake of the most efficient lighting equipment options. An implementation contractor will develop a distributor participation agreement, identify and enroll targeted lighting distributors, provide participating distributor training, process applications, track and report program activity, perform customer site inspections (as required), and provide program evaluation, measurement, and verification (EM&V) support.

The Small Commercial Direct Install program is a redesign of the Small Office Building and Small Retail Energy Efficiency subprograms from Phase I PY2 and PY3. Those two programs experienced low participation and savings impacts because of barriers to program participation associated with these customer sectors. This program provides direct install measures to small commercial customers at no cost, to remove the previous barriers that existed for this segment in rebate programs.

The Multi-Family Housing Retrofit program targets a subset of the residential multi-family housing stock comprising dwelling units for income-qualified occupants. The majority of the targeted building stock receives electric service under commercial tariff master-meter service accounts. Program services include the administration of EE audits, technical assistance for measure level project review and bundling, property aggregation, contractor negotiation, and equipment bulk purchasing.

6.3.2 PECO

PECO's Phase II EE&C program portfolio includes a mix of new programs and programs continued from Phase I. New programs were added to include more comprehensiveness in the residential and small commercial sectors, as well as to target the multi-family sector as encouraged by the Commission. Table 6-10 lists PECO's Phase II programs by sector, followed by a brief discussion of each new program since Phase I.

Table 6-10: PECO's Phase II Programs by Sector (as of 1/24/2013 EE&C Plan)

Residential Portfolio Programs (Exclusive of Low-Income)
Smart Appliance Recycling
Smart Home Rebates
Smart House Call Program*
Smart Builder Rebates*
Smart Energy Saver Program*
Smart Usage Profile*
Smart Multi-Family Solutions Program*
Residential Low-Income Sector Programs
Low-Income Energy Efficiency Program
C&I Small Portfolio Programs
Smart Equipment Incentives
Smart Business Solutions*
Smart Multi-Family Solutions Program*
Smart Construction Incentives
Smart On-Site
C&I Large Portfolio Programs
Smart Equipment Incentives
Smart Multi-Family Solutions Program*
Smart Construction Incentives
Smart On-Site*
GNI Portfolio Programs
Smart Equipment Incentives (GNI)

*Indicates a new program.

The Smart House Call Program was designed as part of PECO's long-term strategy to address comprehensive EE improvements for existing residential buildings, such as building shell insulation and air sealing. Participants receive discounted audits of their homes, which include installation of low-cost EE measures, and rebates for additional EE measures recommended through the audit.

The Smart Builder Rebate program was designed to promote energy efficient practices in residential new construction by providing financial incentives to builders who incorporate EE design, measures, and equipment in new homes.

The Smart Energy Saver Program was designed to educate and engage students at school and their families to reduce energy usage. Students are provided with take-home kits of low-cost EE measures and educational materials on ways to save energy.

The Smart Usage Profile program was designed to increase awareness of energy using behaviors. Participants receive home energy reports that compare their usage with the usage of similar homes, and that also provide recommendations for saving energy. The program targets behavioral changes to generate savings.

The Smart Business Solutions program was designed to encourage and assist small, non-residential customers to improve the energy efficiency in their facilities through low-cost, reliable, prescriptive EE measures. Measures offered in this program affect lighting, refrigeration, and water heating end uses.

The Smart Multi-Family Solutions Program was designed to target both residential and C&I customers to increase awareness of energy savings opportunities in multi-family buildings. Incentives are provided for retrofit and replacement projects in master-metered common areas and individually metered multi-family residences.

The Smart On-Site program was designed to assist customers interested in acting on opportunities to install combined heat and power technologies. A two-part incentive is offered to participants. Varying amounts of incentives are offered per kW, depending on the size of the installation, and a fixed performance-based $/kWh is offered for kWh generated in the first year of system operation.

6.3.3 PPL

PPL's Phase II EE&C program portfolio includes a mix of new programs and programs continued from Phase I. PPL reviewed its Phase I portfolio and removed measures with low participation, low impact, and low cost-effectiveness, and added programs consistent with the Commission's requirements and recommendations in the Phase II Implementation Order. To comply with the requirement that the plan contain at least one comprehensive measure for residential and small commercial rate classes,[386] PPL is offering the new Residential Home Comfort program and adding measures to the Prescriptive Equipment Incentive program for small C&I customers. Additionally, consistent with the Commission's recommendation to address energy efficiency within multi-family buildings in the GNI sector, PPL is implementing the new Master-Metered Low-Income Multi-Family Housing Program.

[386] Phase II Implementation Order, p. 20.

Table 6-11 shows PPL's Phase II programs listed by sector. Following the table is a list of programs continued from Phase I and new programs, excerpted from PPL's EE&C plan,[387] and a description of each new program and continued program that has undergone significant changes.

Table 6-11: PPL's Phase II Programs by Sector (as of 5/13/13 EE&C Plan)

Residential Portfolio Programs (Exclusive of Low-Income)
Appliance Recycling[388]
Residential Retail[389]
Residential Home Comfort*
Residential Energy-Efficiency Behavior and Education
Prescriptive Equipment Incentive (residential farms)
Student and Parent Energy-Efficiency Education*
Residential Low-Income Sector Programs[390]
Low-Income WRAP
Low-Income Energy-Efficiency Behavior and Education*
E-Power Wise Program
C&I Small Portfolio Programs
Prescriptive Equipment incentive
Custom Incentive
C&I Large Portfolio Programs
Prescriptive Equipment Incentive
Custom Incentive
GNI Portfolio Programs
Prescriptive Equipment Incentive
Custom Incentive
Master-Metered Low-Income Multi-Family Housing Program*
Continuous Energy Improvement*
School Benchmarking*

*Indicates new program.

Continued from Phase I to Phase II:

- Appliance Recycling
- Residential Retail (combines residential lighting and energy efficiency)
- Residential Energy-Efficiency Behavior and Education
- Low-Income WRAP (with changes)
- E-Power Wise Program

[387] PPL EE&C Plan, May 13, 2013, p. 4.
[388] All customer sectors are eligible to participate in the Appliance Recycling program.
[389] All customer sectors are eligible to participate in the upstream lighting portion of the Residential Retail program.
[390] Low-income customers are also eligible to participate in residential programs.

- Prescriptive Equipment Incentive for small C&I, large C&I, and GNI with additions and changes
- Custom Incentive Small C&I, Large C&I and GNI Program

New Programs in Phase II:

- Residential Home Comfort (hybrid combining the Phase I Audit and Weatherization Program and a portion of Phase I Residential Efficient Equipment with a new home component)
- Student and Parent Energy-Efficiency Education
- Low-Income Energy-Efficiency Behavior and Education
- Master-Metered Low-Income Multi-Family Housing Program
- Continuous Energy Improvement
- School Benchmarking

The Residential Retail program is a combination of the energy efficient products and lighting programs from Phase I.

The Residential Home Comfort program is for new and existing residential homes and encourages construction of efficient new homes by offering rebates to builders for installing packages of measures, provides customer rebates for professional home audits and insulation and duct sealing, and provides rebates for high-performance heat pumps and pool pumps.

The Student and Parent Energy-Efficiency Education program is new in the PPL Act 129 program portfolio but has been offered successfully outside of Act 129 for several years. The program includes five components, three of which provide school-based workshops for students of varying ages, one of which provides teachers with training and classroom materials, and one of which targets schools in low-income communities and provides incentives to parent-teacher organizations for inviting parents to participate EE workshops at schools in their communities.

Low-Income WRAP is a continuation of the program offered in Phase I but is changing its offerings in Phase II. In Phase I, three different groups of measures were offered – baseload, low-cost, and full-cost. In Phase II, only the baseload package of measures and heat pump water heaters are being offered through Act 129 WRAP. The other groups of measures are offered through LIURP WRAP.

The Low-Income Energy-Efficiency Behavior and Education program is an extension of the Energy-Efficiency Behavior and Education Program offered in Phase I but has been adapted for low-income customers. Qualified low-income customers will receive “report cards” that compare their energy usage with that of comparable customers and that recommend free and low-cost energy savings measures. The goal of the program is to allow low-income customers to lower their energy consumption without a large capital investment.

The Prescriptive Equipment Incentive program is a continuation of the Phase I Efficient Equipment program but is adding audits and measures that specifically targets farms in the PPL territory. For audits of farms under residential rate classes, the savings will be counted in the residential sector Prescriptive Equipment Incentive program

The Master-Metered Low-Income Multi-Family Housing Program targets EE improvements in non-profit master-metered multi-family low-income buildings. The program provides free, basic walkthrough audits followed by general analysis and reports of potential savings for building owners through direct installation and prescriptive efficiency measures. Incentives will also be provided for adoption of high-efficiency measures that address system controls, lighting, appliance, and HVAC.

The School Benchmarking program will be offered to a limited number of schools per program year and will help the school administrator evaluate total building energy use using modeling tools. School administrators will also be provided with information about PPL's rebates and incentives. There are no quantifiable savings associated with this program.

The Continuous Energy Improvement program will target a school in several school districts and help each one develop sustainable energy management plans to implement throughout the entire school district. Each target school will identify a program lead, and the leads will work together through workshops to share best practices and help each other achieve energy reduction goals. At the end of the program, each district will have energy reduction goals, a methodology for measuring savings, and a plan to continually improve energy performance.

6.3.4 Met-Ed, Penelec, Penn Power, and West Penn Power

Met-Ed, Penelec, Penn Power, and West Penn Power (the FirstEnergy Companies) are each offering the same portfolio of programs for Phase II of Act 129. The proposed plans include most of the components of the Phase I program portfolios but have been modified to provide customers more opportunities for savings and to allow the companies more implementation flexibility. Additionally, several programs from Phase I have been reorganized based on lessons learned from Phase I and to make the Phase II portfolios similar in format to program portfolios of other FirstEnergy Companies in other states, to take advantage of economies of scale in implementation and EM&V. Many of the Phase II programs include subprograms that correspond to Phase I programs that have been combined into a single program.

Table 6-12 shows the FirstEnergy Companies' Phase II programs by sector. Table 6-13 and Table 6-14 show how Phase I programs were realigned for Phase II for the FirstEnergy Legacy Companies (Met-Ed, Penelec, Penn Power) and West Penn Power, respectively. While Phase I programs were different for the FirstEnergy Legacy Companies and West Penn Power, the program offerings in Phase II are identical.

Table 6-12: FirstEnergy Companies Phase II Programs by Sector (as of 2/6/2013 EE&C Plan)

Residential Portfolio Programs (Exclusive of Low-Income)
Appliance Turn-In Program
Energy Efficient Products Program
Home Performance Program
Residential Low-Income Sector Programs
Low-Income Program
C&I Small Portfolio Programs
C&I Energy Efficient Equipment Program – Small
C&I Energy Efficient Buildings Program – Small
C&I Large Portfolio Programs
C&I Energy Efficient Equipment Program – Large
C&I Energy Efficient Buildings Program – Large
GNI Portfolio Programs
Government & Institutional Program

Table 6-13: Met-Ed, Penelec, and Penn Power Program Realignment from Phase I to Phase II[391]

Phase I Program	Phase II Program
Residential Programs (Excluding Low-Income)	
Residential Appliance Turn-In Program	Appliance Turn-In Program
Behavioral Modification and Education Program	Home Performance Program
Residential Home Energy Audits and Outreach Program	
Whole Building Program	
Residential Multi-Family Building Program	
Residential New Construction	
Residential Energy Efficient Products Program	Energy Efficient Products Program
Residential Energy Efficient HVAC Program	
Residential Low-Income Programs	
Low-Income Residential (WARM) Program	Low-Income Program
Multi-Family Tenants	
Small C&I Programs	
C&I Equipment Program – Small	C&I Energy Efficient Equipment Program - Small
Industrial Motors and Variable Speed Drives	
Multi-Family Building Program	C&I Energy Efficiency Buildings Program - Small
Large C&I Programs	
C&I Equipment Program – Large	C&I Energy Efficient Equipment Program - Large
Industrial Motors and Variable Speed Drives	
C&I Performance Contracting	C&I Energy Efficiency Buildings Program - Large
GNI Programs	
Government and Institutional Programs	Government and Institutional Program
Multi-Family Tenants	

[391] Met-Ed Phase II EE&C Plan, February 6, 2013, p. 9. This table was the same in each of the FirstEnergy Legacy Companies' EE&C plans.

Table 6-14: West Penn Power Program Realignment from Phase I to Phase II[392]

Phase I Program	Phase II Program
Residential Programs (Excluding Low-Income)	
Residential Appliance Turn-In Program	Appliance Turn-In Program
Home Performance Program	Home Performance Program
Behavior Modification and Education Program	
Residential Energy Efficient Products Program	Energy Efficient Products Program
Residential Energy Efficient HVAC Program	
Residential Low-Income Programs	
Low-Income Energy Efficiency (LIEEP) Program	Low-Income Program
Joint Utility Usage Management Program - Weatherization	
Small C&I Programs	
C&I Equipment Program – Small	C&I Energy Efficient Equipment Program - Small
Not Applicable	C&I Energy Efficiency Buildings Program - Small
Large C&I Programs	
C&I Equipment Program – Large	C&I Energy Efficient Equipment Program - Large
Not Applicable	C&I Energy Efficiency Buildings Program - Large
GNI Programs	
Government and Institutional Programs	Government and Institutional Program

6.3.5 Phase II EE&C Plan Cost-Effectiveness

Table 6-15 shows the EDCs' TRC ratio estimates by sector for Phase II of Act 129. These estimates were taken from each of the EDC's initial Phase II EE&C C plans.

Table 6-15: TRC Ratios by Sector for Each EDC, Based on Initial Phase II EE&C Plans

EDC/Sector	Duquesne	PECO	PPL[393]	Met-Ed	Penelec	Penn Power	West Penn Power
Residential (Exclusive of Low-Income)	1.4	1.3	2.5	1.4	1.4	1.2	1.1
Residential Low-Income	1.1	1.5	0.7	0.3	0.4	0.2	0.2
C&I Small	1.8	1.6	1.9	1.6	1.6	1.6	1.3
C&I Large	2.0	1.6	1.3	1.8	1.9	2.0	2.8
GNI	1.9	1.9	1.3	1.1	1.1	1.0	1.0
Total	**1.8**	**1.4**	**1.7**	**1.5**	**1.5**	**1.3**	**1.5**

392 West Penn Power EE&C plan, February 6, 2013, p. 8.
393 PPL submitted a Petition to revise its Phase II EE&C Plan in November 2013. At the time this report was prepared, the PUC had not issued an Order on this Petition.

The TRC ratios estimated for Phase II are in large part lower than reported TRC values from Phase I of Act 129. For example, TRCs for Duquesne's residential programs ranged from 2.2 to 3.4 for PY4 of Phase I but are estimated at 1.4 for Phase II. Similarly, Penn Power's small and large C&I programs carry estimated TRC ratios of 1.6 and 2.0, respectively, for Phase II, whereas these programs had reported TRC ratios of 4.1 and 2.5, respectively, for Phase I. Table 6-16 shows each EDC's appreciable reduction in TRC ratios at the portfolio level for Phase II, as compared with cumulative TRC ratios reported for Phase I.

Table 6-16: Comparison of Reported Phase I TRC Ratios and Estimated Phase II TRC Ratios

EDC	Cumulative Portfolio-Level TRC – Phase I, PY1 – PY4	Estimated Portfolio-Level TRC – Phase II
Duquesne	3.1	1.8
PECO	2.9	1.4
PPL	2.2	1.7
Met-Ed	1.6	1.5
Penelec	2.4	1.5
Penn Power	3.0	1.3
West Penn Power	2.1	1.5

There are several contributing factors to this broad reduction in cost-effectiveness estimated for Phase II of Act 129. Three significant contributing factors are discussed in the following sections.

6.3.5.1 *Revised Avoided Cost Estimates*

As part of the Phase I EE&C plans, each EDC established avoided cost forecasts for use in program cost effectiveness models. These forecasts projected the avoided costs of energy and generation capacity in accordance with the methodology prescribed by the PUC in its 2009 TRC Order. When establishing their EE&C plans for Phase II, the EDCs updated these forecasts in accordance with the methodology prescribed by the PUC in its 2012 TRC Order. Because of market conditions including the newly understood viability of shale gas extraction from the Marcellus formation, the Phase II avoided cost forecasts were substantially lower than Phase I avoided costs per kWh and kW.

Table 6-17 shows the average percent reduction in avoided energy cost estimates for 2013 to 2015 from the Phase I forecast to the forecast for Phase II. For those utilities that depicted avoided costs with peak, off-peak, and seasonal granularity, average percent reduction across all categories is depicted in the table.

Table 6-17: Phase II Average Reduction in Avoided Cost Estimates from Phase I

EDC	Average % Reduction in Avoided Cost Estimate from Phase I*
Duquesne	38.0%
PECO	41.1%
PPL	37.2%
FirstEnergy Companies	28.9%

***% Reduction averaged over seasonal and on-, off-peak variations where applicable.**

Over the three-year period coinciding with PY5, PY6, and PY7, Phase II avoided costs were estimated to be between 29% and 41% lower than the Phase I avoided cost estimates for the same years.

6.3.5.2 *Achievement of "Low-Hanging Fruit" during Phase I*

Another factor contributing to the lower cost-effectiveness estimated for Phase II is the achievement of "low-hanging fruit" measures during Phase I. Typically, the first few years of an EE program's existence net greater results in key areas where customers have strong incentive for certain upgrades and where unsaturated markets are ripe for adoption. These key areas are typically those with some of the highest TRC ratios, leading to more conservative cost-effectiveness estimates as programs mature.

PECO and West Penn Power's conservation voltage reduction (CVR) programs are examples of high TRC programs that bolstered Phase I portfolio TRC ratios. The CVR programs involve reconfiguring substation and feeder settings at the physical level to achieve energy and demand savings at key time periods. PECO's program was fully implemented by the end of PY2, achieving a total energy savings of over 320,000 MWh/yr and a capacity reduction of over 89 MW, all with a TRC ratio of 172. This substantially cost-effective program, having been fully accomplished by the end of PY2, represents an example of savings unattainable in Phase II for PECO.

Energy efficient lighting programs are also typically considered to have a great deal of "low-hanging fruit" measures. The initial years of these programs often net the greatest savings at the highest cost-effectiveness. While these programs continue to account for a substantial share of energy savings in later years, many of the larger, high-impact projects are undertaken during the initial years, maximizing the programs' cost-effectiveness. Furthermore, because of increasing efficiency of readily available lighting products on the market, baseline wattages for the most common lighting types tend to rise over time. For example, for PY2 Duquesne estimated a savings of 41 kWh/year for its measure "Interior Compact Fluorescent Fixture, 5 - 25 watts," whereas for Phase II that estimated savings was reduced to 30 kWh/year.

Appliance recycling programs have also shown diminishing cost-effectiveness over time. As these programs mature, the average age of the units being recycled gets younger and the per-unit savings achieved by the programs shrink. The United States passed legislation that increased the efficiency requirements of new units produced after January 1, 1992. This has resulted in a large reduction in savings from the recycling of units manufactured post-1992 and will continue to lower appliance recycling program TRC ratios as the proportion of pre-1992 units in programs decreases. In Pennsylvania, the prescribed savings for refrigerator and freezer recycling measures in the PA TRM was reduced by nearly 40% between PY2 and PY3 and has continued on a downward trajectory in each subsequent TRM.

6.3.5.3 *Varying Conceptions of Low-Income Residential Program*

The third contributing factor has less impact on reduced TRCs between Phase I and Phase II, but rather contributes to variations in Phase II estimated TRC ratios across each EDC's Residential Low-Income program. As shown in Table 6-15, the TRC ratios attributed to the FirstEnergy Companies' Residential Low-Income programs are less than 1, whereas PPL's Residential Low-Income TRC approaches 1. Duquesne's and PECO's exceed 1. A noteworthy reason for this variation is the variation in the types of measures included in the program each EDC characterizes as Low-Income Residential.

Duquesne's Low-Income Energy Efficiency program consists of carve-outs from its five other residential programs. Duquesne's Whole House Retrofit program offers low-income customers no-cost energy audits and direct install of qualifying equipment. This program, inclusive of non-low-income and low-income customers, has a low TRC ratio of 0.4. However, Duquesne also takes into consideration a portion of savings from each of the other four residential programs for low-income customers, buoying the estimated TRC for low-income residential to 1.1.

The FirstEnergy Companies, by contrast, administer distinct programs targeted at low-income customers. Each FirstEnergy low income program aims to provide a range of direct install and direct mail measures at no cost to the customer. FirstEnergy does not account for participation by low-income customers in its other residential program offerings.

PPL offers a suite of three programs designated specifically for the low-income sector. These include the Low-Income Winter Relief Assistance Program (WRAP); the E-Power Wise program, which offers energy efficiency kits; and the Low-Income Energy Efficiency Behavior and Education program, which offers "report card" comparisons with neighbors. According to PPL's Phase II EE&C plan, these programs are estimated to achieve 10,519, 3,378, and 8,325 MWh/yr in savings, respectively. The estimated TRC ratios for the three programs are 0.71, 1.90, and 0.93, respectively. However, in addition to these three programs specific to low-income customers, PPL also estimates that approximately 49,000 MWh/yr during Phase II will come from low-income participation in the EDC's general residential programs.

6.4 EDC Net-to-Gross Studies and Application

In the 2009 TRC Order, the Commission determined that there would be no NTGR adjustment for the first year of Act 129 programs but that a stakeholder process would be convened to examine the issues associated with developing NTGRs.[394] In the 2011 TRC Order, the Commission required that all EDCs "collect data necessary to determine the NTG ratio for their programs and to apply the ratio when determining the cost-effectiveness of future modifications of existing programs."[395] For the EDCs that had previously collected NTG data, they were to use the data to calculate the TRC for future Act 129 modifications or changes. For the EDCs that had not collected data necessary for estimating NTGRs, they were required to begin collecting data; and within six months of the date of the order, they were required to apply NTGRs for future program modifications or changes.[396]

The following sections present the NTGRs as reported in each annual report for each EDC. Since NTGR estimation was not required prior to the 2011 TRC Order, many EDCs used a value of 1.0 for their NTGRs in the PY1 and PY2 annual reports. The only EDC to submit NTG results prior to the PY3 annual reports was PPL. For each EDC, Phase I programs with low NTGRs were examined to determine if results from the NTG analyses were used to inform program planning decisions in Phase II.

[394] 2009 TRC Order, p. 27.
[395] 2011 TRC Order, p. 25.
[396] ibid.

6.4.1 Duquesne

Table 6-18 and Table 6-19 summarize Duquesne's NTG results from PY3 and PY4. Prior to PY3, all programs were assumed to have a NTGR of 1.0. Details on the specific NTGR estimation methodologies used by Duquesne can be found in Appendix E.

Table 6-18 - Duquesne PY3 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Energy Efficiency Program	24%	N/A[1]	76%
School Energy Pledge Program	14%	N/A[1]	86%
Residential Appliance Recycling Program	33%	N/A[1]	67%
Low-Income Energy Efficiency Program	26%	N/A[1]	74%
Commercial Program Group	16%	N/A[1]	83%
Industrial Program Group	31%	N/A[1]	69%
Total Portfolio			N/A[2]

[1] Spillover not estimated.
[2] Not listed.

Table 6-19 - Duquesne PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Energy Efficiency Program	50%	12.5%	62%
School Energy Pledge Program[1]	14%	N/A	86%
Residential Appliance Recycling Program	25%	0.59%	76%
Low-Income Energy Efficiency Program	50%	5.6%	56%
Commercial Program Group	50%	N/A[2]	50%
Industrial Program Group	28%	N/A[2]	72%
Total Portfolio			57%

[1] Based on PY3 results. No NTG research was conducted in PY4 because no surveys were completed for verification purposes in PY4, there were no program changes from PY3 that could affect the NTGR, and the program had limited savings and budget.
[2] Spillover not estimated.

The Duquesne programs that had relatively low NTGRs included the Residential Appliance Recycling Program and the Industrial Program Group in PY3, and the Residential Energy Efficiency Program (REEP), Low-Income Energy Efficiency Program (LIEEP), and Commercial Program Group in PY4. For REEP, free-ridership increased from 24% in PY3 to 50% in PY4, and although spillover was estimated to be 12% in PY4, the resulting NTGR of 62% was still low. Duquesne's Act 129 Phase II EE&C plan did not indicate any changes to REEP in Phase II. However, it is recommended that Duquesne look deeper into the reason for the high free-ridership values in PY4 and investigate ways to ensure that this rate does not continue to increase.

LIEEP also experienced a significant increase in free-ridership in PY4 that resulted in an NTGR of 56%. Although there were no program changes from PY3 to PY4, a possible explanation for the high free-ridership score is that LIEEP provided measures that were low in cost and were becoming more common for residential customers to install on their own without incentives. Program measures included upstream lighting, appliance recycling, and rebates for energy efficient appliances. In Phase II, LIEEP will consist of most of the program components in Phase I as well as two additional programs – Whole House Audit/Retrofit and Multi-Family Housing Retrofit.

The Whole House Audit/Retrofit program provides comprehensive home energy audits and direct install measures at no cost for income-qualifying participants. The Multi-Family Housing Retrofit program provides services such as EE audits, technical assistance for measure level project review and bundling, property aggregation, contractor negotiation, and equipment bulk purchasing. The new incentives for more cost-intensive EE measures related to the multi-family housing market should help reduce the free-ridership effect in Phase II LIEEP. However, depending on the quantity of projects and savings that come from this component, the overall free-ridership for LIEEP may or may not change from the PY4 value.

The NTGR for the Commercial Program Group decreased from 83% in PY3 to 50% in PY4. Since the NTGRs were determined solely from free-ridership scores, these results indicate that half of the program participants who received an incentive to undertake a savings measure would have procured the measure in the absence of the program in PY4. It was difficult to determine which specific commercial program(s) contributed to the lower NTGR in PY4, because the only change to the commercial programs in PY4 was an emphasis on peak period energy management. NTG methodology was the same in PY3 and PY4. Since no individual NTG analyses were conducted for the Commercial Program Group, which consisted of an umbrella program and five market segment programs, it was difficult to determine which program(s) had the highest free-ridership rates. The Commercial Program Group also incentivized a wide range of technologies that likely have varying NTGRs. Duquesne's Act 129 Phase II EE&C plan did not indicate any changes to the commercial programs in Phase II to improve free-ridership.

For Phase II evaluations, the SWE recommends focusing NTG research on high-impact measures, to explore which measures have high free-ridership and may require a change in program offerings. In other words, in addition to conducting NTG research at the program level, Duquesne should examine NTG research results on a technology level.

6.4.2 PECO

Table 6-20 and Table 6-21 summarize PECO's NTG results from PY3 and PY4. Prior to PY3, all programs were assumed to have a NTGR of 1.0. Details on the specific NTGR estimation methodologies used by PECO can be found in Appendix E.

Table 6-20 - PECO PY3 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Smart Lighting Discounts Program[1]	62.55%	0.65%	38.1%
Smart Appliance Recycling Program	36.0%	0.0%	64.0%
Smart Home Rebates Program	16.0%	6.0%	90.0%
Low-Income Energy-Efficiency Program[2]	N/A	N/A	100%
Smart Equipment Incentives – C&I[3]	30%-43%	N/A[4]	57%-70%
Smart Equipment Incentives – GNP[3]	38%-49%	N/A[4]	51%-62%
Smart Construction Incentives	70.4%	0.0%	29.6%
Total Portfolio[3]			56.8%-57.1%

[1] Based on PY2 data due to significant decrease in program bulbs because of program shift.

[2] Low -income program assumed to have NTGR of 100%; no NTG analysis was conducted.

[3] Range of possible values. Research and analysis were nearing completion at time of report filing.

[4] Spillover not estimated.

Table 6-21 - PECO PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Smart Lighting Discounts Program[1]	N/A	N/A	38%
Smart Appliance Recycling Program	44%	N/A[2]	56%
Smart Home Rebates Program	63%	12%	49%
Low-Income Energy-Efficiency Program[3]	N/A	N/A	100%
Smart Equipment Incentives – C&I[4]	N/A	N/A	78%
Smart Equipment Incentives – GNP[4]	N/A	N/A	64%
Smart Construction Incentives	56%	0%	44%
Total Portfolio			69%

[1] Based on PY2 data due to significant decrease in program bulbs in PY3 and PY4 because of program shift. Specific free-ridership and spillover values not provided.

[2] Spillover not estimated.

[3] Low-income program assumed to have NTGR of 100%; no NTG analysis was conducted.

[4] Specific free-ridership and spillover values not provided.

PECO's Smart Lighting Discounts (SLD) program, Smart Home Rebates (SHR) PY4 program, Smart Appliance Recycling (SAR) program, and Smart Construction Incentives (SCI) program had very low NTGRs. Since little or no spillover was estimated for these programs, the results indicated very high free-ridership.

The PECO evaluator did not conduct a NTG analysis for the SLD program in PY3 or PY4 due to a significant decrease in the number of program participants. Instead, PY2 NTG estimates were applied to the PY3 and PY4 distribution of standard and specialty CFL sales to arrive at the NTGs for the last two program years. No information was provided regarding whether NTG results were considered during the program planning process for Phase II. However, PECO's Act 129 Phase II EE&C plan indicated that the SLD program was incorporated into the SHR program. This change was most likely motivated by the lack of participants in Phase I. Therefore the standard and specialty CFL sales that were incentivized under the SLD program in Phase I are absorbed into the lighting component of the SHR program in Phase II. The SWE recommends that PECO and its evaluation contractor conduct an enhanced level of rigor for the Phase II evaluation, due to the lack of a recent NTG analysis conducted for the lighting program and due to the new program design. Both programs reported high free-ridership values in PY3 and PY4, and the reasons behind this should be investigated and addressed as appropriate. The SWE also recommends that PECO's evaluation contractor conduct NTG research for cross-sector sales that may have resulted from commercial customers purchasing incentivized bulbs through residential upstream lighting programs.

PECO's Phase II EE&C plan did not indicate any changes to the SAR or SCI programs. Since no spillover was estimated for these two programs, the NTGR indicated reductions in measured (gross) savings from overstating the program's influence as a result of free-ridership.

PECO's Phase II EE&C plan focused on providing a comprehensive portfolio of programs for all customers, with emphasis on residential and small business customers. This resulted in the addition of new programs such as Smart House Call and Smart Business Solutions. Smart House Call provides incentives for a variety of measures such as air sealing and insulation, duct sealing and maintenance, central air conditioning maintenance, low-flow showerheads and faucet aerators, water heater and pipe wrap, and power strips and lighting.

Smart Business Solutions offers direct installation of eligible prescriptive measures such as lighting and refrigeration with minimal cost to small business customers. PECO stated that the small business customer segment has been historically hard to reach because these customers often don't have the capital or staff to take advantage of energy saving incentives. Free-ridership is expected to be low for small business participants because it is assumed they would not have taken EE actions on their own. PECO's increased effort to attract small business customers should help reduce its overall portfolio free-ridership and increase opportunities for spillover.

6.4.3 PPL

Table 6-22 through

Table 6-25 summarize PPL's NTG results from all program years. PPL conducted NTG research in each program year of Phase I. Details on the specific NTGR estimation methodologies used by PPL can be found in Appendix E.

Table 6-22: PPL PY1 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Appliance Recycling Program	43%	N/A[1]	57%
Residential Lighting Program[397]	20%	N/A[1]	80%
Custom Incentive Program[2]	N/A	N/A	100%
Efficient Equipment Incentive	49%	N/A[1]	51%
Low-Income WRAP[3]	N/A	N/A	100%
Renewable Energy Program	73%	N/A[1]	27%
Total Portfolio			75%

[1] Spillover research conducted, but no score calculated.

[2] Assumed to be 100%.

[3] Low-income program NTGR assumed to be 100%; no NTG analysis conducted.

Table 6-23: PPL PY2 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Appliance Recycling Program	43%	3%	61%
Residential Lighting Program[398]	23%	N/A [1]	77%
Custom Incentive Program	69%	0%	31%
Efficient Equipment Incentive Program	50%	5%	55%
Efficient Equipment Incentive Program (C&I Lighting)	15%	0%	85%
E-Power Wise Program[2]	N/A	N/A	100%
Low-Income WRAP[2]	N/A	N/A	100%
Renewable Energy Program	62%	0.2%	38%
HVAC Tune-Up Program	0%	N/A [1]	100%
Home Energy Assessment and Weatherization Program	0%	2%	102%
Energy Efficiency Behavior and Education Program[3]	N/A	N/A	100%
Total Portfolio			74%

[1] Spillover research conducted, but no score calculated.

[2] Low-income program NTG ratio assumed to be 100%.

[3] No NTG calculation because savings estimates already account for free-ridership and spillover.

[397] Named the Compact Fluorescent Lighting Campaign in PY1 and PY2.

[398] Named the Compact Fluorescent Lighting Campaign in PY1 and PY2.

Table 6-24: PPL PY3 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Appliance Recycling Program	39%	2%	63%
Residential Lighting Program	44%-52%	48-56%	70%[1]
Custom Incentive Program[2]	69%	0%	31%
Energy Efficiency Behavior and Education Program[3]	N/A	N/A	N/A
Efficient Equipment Incentive Program – Residential	35%	0.1%	65%
Efficient Equipment Incentive Program – Commercial Non-lighting	67%	0%	33%
Efficient Equipment Incentive Program – Commercial Lighting	19%	0%	81%
Efficient Equipment Incentive Program – Direct Discount	10%	0%	90%
E-Power Wise Program[4]	N/A	N/A	N/A
Low-Income WRAP[4]	N/A	N/A	N/A
Renewable Energy Program	N/A	N/A	N/A [5]
HVAC Tune-Up Program[6]	0%	N/A	100%
Home Energy Assessment and Weatherization Program	18%	1%	83%
Total Portfolio			66%

[1] Evaluation estimate based on free-ridership and spillover ranges.

[2] Based on PY2 results.

[3] No NTG calculation because savings estimates already account for free-ridership and spillover.

[4] Low-income program NTG ratio assumed to be 100%.

[5] PPL indicated that sample was insufficient for conclusive results.

[6] Based on PY2 results.

Table 6-25: PPL PY4 Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Appliance Recycling Program	33%	0.77%	68%
Residential Lighting Program	61-69%	31-47%	84%[1]
Custom Incentive Program[2]	48%	0%	52%
Efficient Equipment Incentive Program – Residential	34%	5.90%	72%
Efficient Equipment Incentive Program – Commercial Non-lighting	77%	0%	23%
Efficient Equipment Incentive Program – Commercial Lighting and Direct Install	23%	0.02%	77%
Home Energy Assessment and Weatherization Program	25%	0.09%	75%
Total Portfolio			N/A[3]

[1] Evaluation estimate based on free-ridership and spillover ranges.

[2] Based on PY3 and PY4 data.

[3] Not listed.

Two of the PPL programs had consistently low NTGRs: the Custom Incentive Program (CIP), and the Efficient Equipment Incentive Program (EEIP) – Commercial Non-lighting. PPL Electric stated that market transformation and free-ridership were considered during the Phase II program planning process and that some measures were excluded as deemed appropriate.

The Custom Incentive Program for the small C&I, large C&I, and GNI sectors had high free-ridership throughout Phase I. PPL has modified its Custom program in Phase II to reduce free-ridership. Improvements include requiring pre-approval before a customer orders their equipment. The EEIP — Commercial Non-lighting had the highest free-ridership percentage (77%) of all the PPL EE programs in Phase I. PPL reported that the Phase II EEIP will continue from Phase I with changes to the program.

PPL also introduced several new programs in Phase II, most of which were focused on educational opportunities. For example, the Student and Parent Energy-Efficiency Education Program offers in-school sessions and workshops to teach children, parents, and teachers about energy efficiency. The Low-Income Energy-Efficiency Behavior and Education Program provides low-income customers with information on their energy usage compared with similar customers. Finally, the Continuous Energy Improvement Program helps selected schools develop a sustainable energy management plan. These programs promote energy efficiency and increase customer awareness of different energy-savings initiatives.

6.4.4 Met-Ed

Table 6-26 summarizes Met-Ed's NTG results from PY3 and PY4. Prior to PY3, all programs were assumed to have a NTGR of 1.0. Met-Ed conducted NTG studies only once for each program in Phase I, during PY3. Therefore, PY4 results mirror PY3 results. Additionally, NTG research was conducted for combined C&I and GNI programs and sectors. Thus each program has the same NTG ratio and caution is recommended in interpreting results for each individual non-residential sector.

Details on the specific NTGR estimation methodologies used by Met-Ed can be found in Appendix E.

Table 6-26 - Met-Ed PY3 and PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	24.8%	12.7%	87.9%
Residential Appliance Turn-In Program	38.5%	N/A[1]	61.5%
Residential Energy Efficiency HVAC Program	41.0%	0.3%	57.7%
Residential Energy Efficiency Products Program	56.5%	7.0%	50.5%
C&I Small Sector Equipment Program	43.4%	8.9%	65.5%
C&I Large Sector Equipment Program	43.4%	8.9%	65.5%
Government/Non-Profit Program	43.4%	8.9%	65.5%
Government/Remaining Non-Profit Program	43.4%	8.9%	65.5%
Total Portfolio			N/A[2]

[1] Program not designed to induce spillover.

[2] Not listed.

All of the Met-Ed programs had low NTGRs with the exception of the Residential Home Energy Audits and Outreach Program, which had an NTGR of 87.9%. Since the Residential Appliance Turn-In Program was not designed to induce spillover, the low NTGR was solely the result of relatively high free ridership in the Program. It is noted that Met-Ed's free ridership rate was consistent with the estimates from Appliance Recycling Programs implemented by other Pennsylvania EDCs and utilities around the United States. Despite the high free-ridership score for the Residential Appliance Turn-In Program, Met-Ed did not make any changes to this program in Phase II.

The Residential Energy Efficiency HVAC Program and the Residential Energy Efficiency Products Program had the lowest NTGRs of all Met-Ed programs. These two programs have been consolidated to form the Residential Energy Efficient Products Program in Phase II, with the addition of new measures. The new program contains four subprograms: HVAC and Water Heating, Appliances, Consumer Electronics, and Lighting. New measures in Phase II include whole house fan, ductless mini-split, EE office equipment, and television. The consolidation of these two programs, along with the introduction of new measures, may help reduce free-ridership. However, further investigation into the free-ridership of individual program measures would help inform how the mix of program measures could be further revised to help increase the overall program NTGR.

In Phase I, the Met-Ed evaluator conducted only one NTG analysis for all C&I and GNI programs. Met-Ed had a low NTGR that indicated relatively high free-ridership rates. In Phase II, the C&I equipment programs and the Industrial Motors and Variable Speed Drives Program were consolidated and expanded to form the C&I Energy Efficiency Equipment programs, one of which focuses on the small commercial sector and one on the large commercial sector. The C&I Energy Efficient Equipment program for the small commercial sector contains five subprograms (HVAC & Water Heating, Appliances, Food Service, Lighting, and Custom Equipment) and 15 new measures. The C&I Energy Efficient Equipment program for the large commercial sector contains three subprograms (HVAC, Lighting, and Custom Equipment) and two new measures. The C&I Performance Contracting Program in Phase I is expanded in Phase II to form the C&I Energy Efficient Buildings Programs that provide financial incentives for customers implementing building shell or system improvements. The C&I Energy Efficient Buildings Program – Small contains four subprograms (New Buildings, C&I Audits, Custom Buildings, and Kits) and four new measures. The C&I Energy Efficient Buildings Program – Large contains two subprograms (Audits and Custom Buildings) four 4 new measures. The Phase II Government & Institutional Program contains six subprograms (Outdoor Lighting, Lighting, Audits, HVAC & Water Heating, Appliances, and Multi-Family) and 14 new measures.

6.4.5 Penelec

Table 6-27 summarizes Penelec's NTG results from PY3 and PY4. Prior to PY3, all programs were assumed to have a NTGR of 1.0. Penelec conducted NTG studies only once for each program in Phase I, during PY3. Therefore, PY4 results mirror PY3 results. Additionally, NTG research was conducted for combined C&I and GNI equipment programs and sectors. Therefore each program has the same NTG ratio and caution is recommended in interpreting results for each individual non-residential sector.

Details on the specific NTGR estimation methodologies used by Penelec can be found in Appendix E.

Table 6-27 - Penelec PY3 and PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	39.6%	23.2%	83.6%
Residential Appliance Turn-In Program	35.6%	N/A[1]	64.4%
Residential Energy Efficiency HVAC Program	41.0%	0.4%	59.4%
Residential Energy Efficiency Products Program	55.6%	8.4%	52.8%
C&I Small Sector Equipment Program	31.2%	15.4%	84.2%
C&I Large Sector Equipment Program	31.2%	15.4%	84.2%
Government/Non-Profit Program	31.2%	15.4%	84.2%
Government/Remaining Non-Profit Program	31.2%	15.4%	84.2%
Total Portfolio			N/A[2]

[1] Program not designed to induce spillover.

[2] Not listed.

The Penelec programs with low NTGRs were Residential Appliance Turn-In, Residential Energy Efficiency HVAC, and Residential Energy Efficiency Products. Since all the FirstEnergy Companies have similar EE&C plans with similar program consolidation and expansions in Phase II, refer to the Met-Ed discussion in Section 6.4.4 on how NTG results were used to inform program decisions for Phase II.

6.4.6 Penn Power

Table 6-28 summarizes Penn Power's NTG results from PY3 and PY4. Prior to PY3, all programs were assumed to have a NTGR of 1.0. Penn Power conducted NTG studies only once for each program in Phase I, during PY3. Therefore, PY4 results mirror PY3 results. Additionally, NTG research was conducted for combined C&I and GNI equipment programs and sectors. Therefore each program has the same NTG ratio and caution is recommended in interpreting results for each individual non-residential sector.

Details on the specific NTGR estimation methodologies used by Penn Power can be found in Appendix E.

Table 6-28 - Penn Power PY3 and PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	22.5%	14.3%	91.9%
Residential Appliance Turn-In Program	38.3%	N/A[1]	61.7%
Residential Energy Efficiency HVAC Program	35.8%	0.5%	64.7%
Residential Energy Efficiency Products Program	69.2%	11.9%	42.7%
C&I Small Sector Equipment Program	12.5%	0.4%	87.9%
C&I Large Sector Equipment Program	12.5%	0.4%	87.9%
Government/Non-Profit Program	12.5%	0.4%	87.9%
Government/Remaining Non-Profit Program	12.5%	0.4%	87.9%
Total Portfolio			N/A[2]

[1] Program not designed to induce spillover.

[2] Not listed.

The Penn Power programs with low NTGRs were Residential Appliance Turn-In, Residential Energy Efficiency HVAC, and Residential Energy Efficiency Products. Compared with other FirstEnergy Companies, Penn Power had the highest NTGR for the C&I small and large sector equipment programs and the government/-non-profit programs. Since all the FirstEnergy Companies have similar EE&C plans with similar program consolidations and expansions in Phase II, refer to the Met-Ed discussion in Section 6.4.4 on how NTG results were used to inform program decisions for Phase II.

6.4.7 West Penn Power

Prior to its PY3 annual report, West Penn Power assumed a value of 1.0 for all NTGRs. Due to the midyear program transition after West Penn Power was incorporated into the FirstEnergy family of companies; no NTG research was conducted in PY3. Table 6-29 shows the results of West Penn Power's PY4 NTG studies. NTG research was conducted for combined C&I and GNI equipment programs and sectors. Therefore each program has the same NTG ratio and caution is recommended in interpreting results for each individual non-residential sector.

Details on the specific NTGR estimation methodologies used by West Penn Power can be found in Appendix E.

Table 6-29 - West Penn Power PY4 NTG Results

Program Name	Free-Ridership	Spillover	NTG Ratio
Residential Home Performance Program	18.1%	7.7%	89.6%
Residential Appliance Turn-In Program	34.5%	N/A[1]	65.5%
Residential Energy Efficient HVAC Program	41.5%	0.6%	58.9%
Residential Energy Efficient Products Program	57.7%	7.9%	48.2%
C&I Small Sector Equipment Program	12.0%	10.0%	97.9%
C&I Large Sector Equipment Program	12.0%	10.0%	97.9%
Government/Non-Profit Program	12.0%	10.0%	97.9%
Total Portfolio			N/A[2]

[1] Program not designed to induce spillover.
[2] Not listed.

NTG research was conducted for combined C&I and GNI sectors. The West Penn Power Programs with low NTGRs were Residential Appliance Turn-In, Residential Energy Efficiency HVAC, and Residential Energy Efficiency Products. Since all the FirstEnergy Companies have similar EE&C plans with similar program consolidations and expansions in Phase II, refer to the Met-Ed discussion in Section 6.4.4 on how NTG results were used to inform program decisions for Phase II.

6.4.8 Statewide Evaluator Recommendations

The Commission has ordered that EDCs develop NTGRs for the purpose of directing the design and implementation of future EE&C programs. The results from NTG analyses provide information on the programs' influence and cost-effectiveness and therefore should be used to inform program decisions for Phase II. However, Phase II EE&C plans for all EDCs included very limited information on how results from the NTG analyses were used in program planning.

It is recommended that program revisions be considered by the EDCs in order to reduce free-ridership and increase spillover, and to help increase program NTGRs when necessary. When possible, EDCs should evaluate free-ridership at the measure level in order to better understand measure-level behaviors that have a greater impact on NTGRs and to help inform program planning. To reduce free-ridership, the EDCs can consider capping retroactive rebates by implementing a 90-day rebate eligibility clause for the purchase of energy efficient equipment. Another way to reduce free-ridership is to increase the EE standards of rebate-eligible appliances or equipment. For example, CFLs are becoming more common in the market, and consumers are likely to purchase them without an incentive. Instead of incentivizing CFLs, EDCs can offer financial incentives for LEDs, which are less frequently purchased than CFLs and more energy efficient. Finally, free-ridership often corresponds to the level of financial incentives offered to participants. If incentives are too high, free-ridership will increase. It is recommended that the EDCs take into consideration free-ridership percentages when planning measure-level incentives.

7 Findings, Conclusions, and Recommendations

The Statewide Evaluator Team (SWE Team), the PUC Bureau of Technical Utility Services (TUS) staff, the electric distribution companies (EDCS), and the EDC program evaluators have worked hard to develop a solid foundation for the evaluation, measurement, and verification (EM&V) of the Act 129 energy efficiency and conservation (EE&C) programs.

The SWE believes that the following are important findings from Phase I:

- The total resource cost (TRC) benefit-cost ratio for the entire Phase I portfolio of programs using TRM verified energy and demand reductions is 2.39 to 1.
- Based on TRM Verified Savings for energy reductions, all EDCs except West Penn Power met the 1% 2011 energy reduction compliance target and all EDCs met the 3% entire Phase energy reduction compliance target. Additionally, all EDCs achieved 10% of TRM Verified Savings for energy reductions from the government, non-profit, institutional (GNI) sector..
- Based on TRM verified gross savings, all EDCs met the 4.5% demand reduction compliance target. Additionally, all EDCs achieved 10% of TRM verified demand reduction from the GNI sector, other than Penn Power. However, the SWE cannot say at 90% confidence that Penn Power did not achieve the 10% GNI demand reduction target.[399]

The end of Phase I caused some challenges for the SWE in performing its audit of Program Year 4 (PY4) activities. Tracking data from the fourth quarter of PY4 were due to the SWE on July 15, 2013, but the EDCs were still processing rebates for measures that were installed and commercially operable by 5/31/2013 beyond July 15. Therefore, when the SWE summed the data from the first through fourth quarters, it got numbers smaller than what were ultimately reported for most programs. For Phase II and future phases of Act 129, the SWE believes it would be helpful to its auditing process to provide the

[399] See Section 3.2 for an explanation.

EDCs with additional time to process and finalize all rebates before requesting data from the final quarter of the phase.

Based on the SWE's review of the EDC's net-to-gross (NTG) studies and research performed in Phase I, the SWE has the following findings and recommendations.

- In Phase I, NTG research was conducted at the program level, and in many cases an overall NTG ratio (NTGR) was estimated for programs that had multiple subprograms with participants from different sectors. Many of these programs also incentivized a wide range of technologies that likely have varying NTGRs. Therefore, the SWE recommends focusing NTG research on high-impact measures in these programs to explore which measures have high free-ridership and may require a change in program offerings.
- A common trend discovered in upstream residential lighting programs was cross-sector sales. Commercial customers were participating in these programs but weren't being assessed for free-ridership. The SWE recommends exploring the NTGR of these sales.
- The transparency and level of rigor of NTG analyses varied across the EDCs in Phase I. The SWE believes that a uniform NTG approach will address these issues by allowing for comparison of NTGRs across utilities and by increasing the consistency of NTG measurements.
- EDCs were directed to conduct NTG research for program planning purposes. The results of this research did not appear to have a significant role in the development of Phase II EE&C plans. There were numerous instances of programs that showed high free-ridership in Phase I being offered without modifications in Phase II. NTG research will have more value in Pennsylvania, when potential studies incorporating NTG findings inform targets for future phases of Act 129 and EDCs can incorporate the research outcomes into their program planning.

The SWE found invaluable information in the studies performed throughout Phase I. The conclusions of the five key studies are summarized below.

SWE Residential Baseline Study

The residential end-use saturation study provided a baseline of the existing residential market energy uses and housing characteristics and was conducted primarily by on-site consumer surveys and data gathering in the seven subject EDC territories during the fall of 2011. The study included a total of 488 individual surveys focused on existing equipment, envelope characteristics, and behavior patterns, among other details. These survey results serve as a platform for residential housing baseline statistics for the entire state of Pennsylvania.

SWE Commercial and Industrial Baseline Study

The commercial and industrial (C&I) baseline study was performed during the period October 2011 -- February 2012. The primary survey format was on-site customer surveys with some follow-up data gathering. The focus of the study was to determine the energy usage characteristics of Pennsylvania's C&I building portfolio and reveal a sample of the end uses of energy as best possible. The study included a total of 418 surveys and served as a platform for C&I energy usage statistics for the state of Pennsylvania.

SWE Energy Efficiency Potential Study

The potential for electric energy efficiency in the service areas of the seven subject EDCs included in this report is significant. The statewide estimated achievable potential electricity savings for Achievable #1 scenario amounts to 6,339,540 MWh/yr on a cumulative annual basis by 2016 (a 4.3% reduction in projected 2010 baseline MWh/yr sales) and 11,996,092 MWh/yr on a cumulative annual basis by 2018 (an 8.2% reduction in projected 2010 baseline MWh/yr sales). The TRC ratios statewide for Achievable Potential #1 scenario are 1.75 (3-year time frame), 1.83 (5-year time frame) and 1.95 (10-year time frame). The TRC ratios statewide for Achievable Potential #2 scenario are 1.73 (3-year), 1.85 (5-year) and 1.97 (10-year). The three-year program potential savings is 3,313,247 MWh/yr with a corresponding three-year statewide reduction target of 2.3%. The five-year program potential savings is 5,414,343 MWh/yr with a five-year statewide reduction target of 3.7%. The results of this study demonstrate that cost-effective electric energy efficiency resources can play a significantly expanded role in Pennsylvania's energy resource mix during the next three- to five-year period.

SWE Demand Response Study

Although direct load control (DLC) programs did not prove to be cost-effective in 2012, there is indication that the programs could offer value in future phases of Act 129. Equipment purchase, customer recruiting, and installation costs result in high upfront costs for DLC programs. The SWE recommends that the Commission view the Phase I infrastructure costs of these programs as "sunk" and consider continuing the programs if the future benefits are expected to outweigh the future costs. If DLC programs are continued, the SWE believes they should be bid into the PJM capacity market and that the revenue received should count as a benefit in the TRC test.

SWE Net to Gross Study

The Commission has ordered that EDCs develop NTGRs for the purpose of directing the design and implementation of future EE&C programs. The results from NTG analyses provide information on a program's influence and cost-effectiveness and therefore should be used to inform program decisions for Phase II. However, Phase II EE&C plans for all EDCs included very limited information on whether results from the NTG analyses were used in program planning. The SWE recommends that program revisions be considered by the EDCs in order to reduce free-ridership and increase spillover, and to help increase program NTGRs when necessary. When possible, EDCs should evaluate free-ridership at the measure level in order to better understand measure-level behaviors that have a greater impact on NTGRs and to help inform program planning.

Appendix A Phase I EE&C Plans and Programs – Program Details

This appendix provides detailed descriptions of all programs that reported savings during Phase I of Act 129, including measure lists and incentive amounts.

A.1 Duquesne

A.1.1 Energy Efficiency Programs

Below are descriptions of each Duquesne energy efficiency (EE) program that reported savings during Phase I of Act 129.

Residential Energy Efficiency Program

Years Reporting Savings: Rebate Program (PY1-PY4), Upstream Lighting Program (PY2-PY4)

Program Implementer: Ecova (upstream lighting), Opower (behavioral), Duquesne Light Company (all other components)

The Residential Energy Efficiency Program (REEP) included a rebate portion, kit giveaways, an upstream lighting portion, and a behavioral modification component. Duquesne reported savings for the upstream lighting portion of the program separate from the rest of the program.

The rebate portion of the program offered rebate incentives for a variety of EE measures and provided education materials on EE options in conjunction with an online survey. Home owners answered questions about their home energy use and obtained instant results, including a list of approved measures and rebate amounts per measure to reduce the cost of replacing outdated and inefficient equipment. REEP also provided free EE kits to customers who attended community outreach events. This portion of the program has been in operation since PY1.

In July 2010, an upstream/midstream compact fluorescent light (CFL) program was initiated that targeted large retail establishments and provided point-of-purchase discounts to customers. Monthly events were held at some retail stores to educate consumers on EE products and provide a platform to educate consumers on other Duquesne program offerings.

During PY4, a behavioral modification component was added to this program. Home energy reports were provided to customers that delivered personalized information about energy usage and how it compared with that of similar customers, to encourage high energy users to make EE improvements. The reports also provided tips for energy savings.

School Energy Pledge Program

Years Reporting Savings: PY1-PY4

Program Implementer: Duquesne Light Company

The School Energy Pledge (SEP) Program was designed to teach students about energy efficiency, have them participate in a school fundraising drive, and help their families implement energy-saving measures at home. Kits of EE measures were distributed to families that signed a pledge form stating they would install the measures. Each kit contained CFLs, educational materials, and other low-cost EE measures such as nightlights. For each signed pledge form, the school received a financial incentive.

Residential Appliance Recycling Program

Years Reporting Savings: PY1-PY4

Program Implementer: JACO

The Residential Appliance Recycling Program (RARP) provided incentives to customers for turning in their inefficient but operable primary and secondary refrigerators and freezers.

Residential Low-Income Energy Efficiency Program and Residential Low-Income Energy Efficiency Program: Upstream Lighting

Years Reporting Savings: Rebate Program, SEP Program, and RARP (PY1-PY4); Upstream Lighting Program (PY2-PY4)

The Low-Income Energy Efficiency Program (LIEEP) was an income-qualified program that assisted low-income households in conserving energy and reducing electricity costs. Savings for this program were claimed as the portion of REEP Rebate Program, SEP, and RARP customers who qualified as low-income. Customers who qualified as low-income were tagged in the Duquesne tracking database and the savings attributed to them from the REEP Rebate Program, SEP Program, and RARP were reported under the Residential: Low-Income Energy Efficiency Program. The savings reported under the Low-Income Upstream Lighting program were a proportion of the Residential Upstream Lighting Program equivalent to the percentage of low-income customers making such purchases as estimated through customer surveys conducted in Duquesne's service territory at the end of PY4.

Commercial Program Group Programs

Years Reporting Savings: PY1-PY4 (see below)

Program Implementer:

- Commercial Sector Umbrella – Duquesne Light Company
- Healthcare – Duquesne Light Company
- Office Building – Large - Enerlogics Networks, Inc.
- Office Building – Small – AllFacilities Energy Group
- Retail Stores – Large and Small – AllFacilities Energy Group
- Government/Non-Profit/Institutional – Duquesne Light Company

The Commercial Program Group was a bundle of rebate programs targeted at specific commercial market segments with an umbrella program targeting all other commercial market segments. The umbrella program provided services to smaller customer segments not directly served by the specific market sector programs. All programs within the program group provided the same measures and incentive levels but were implemented by different specialized contractors and staff who had experience in each of the specific market segments. Each program offered the same services: auditing of building energy use, provision of targeted financing and incentives, project management and installation of retrofit measures, and training and technical assistance.

Below is a list of the programs that were part of the Commercial Program Group and the years they reported savings.

- Commercial Sector Umbrella (PY1-PY4)
- Commercial Sector Umbrella: Upstream Lighting (PY4)
- Healthcare (PY1-PY4)
- Office Building – Large (PY1-PY4)
- Office Building – Small (PY1-PY4)
- Retail Stores – Large and Small (PY1-PY4)
- Government/Non-Profit/Institutional (PY1-PY4)

<u>Industrial Program Group Programs</u>

Years Reporting Savings: PY1-PY4 (see below)

Program Implementer:

- Industrial Sector Umbrella – Duquesne Light Company
- Primary Metals – Enerlogics Networks, Inc.
- Mixed Industrial – Global Energy Partners
- Chemical Products – Global Energy Partners

The Industrial Program Group was a bundle of rebate programs targeted at specific industrial market segments with an umbrella program targeting all other industrial market segments. The umbrella program provided services to smaller customer segments not directly served by the specific market sector programs. The programs were intended to provide a comprehensive approach to energy savings and included a range of measures from low-cost improvements to entire system upgrades. All programs within the program group provided the same incentive levels to participants so that a participant in any of the specific sector programs or the umbrella program would have received the same incentive for the same measure. Each program within the program group offered on-site walk-through assessments and audits, provided studies and reports to identify potential upgrades that would save the most energy and therefore reduce operating costs, helped provide access to rebates and incentives, and coordinated with local chapters of key industry associations to promote EE improvements through market-transforming practices.

Below is a list of the programs that were part of the Industrial Program Group and the years they reported savings.

- Industrial Sector Umbrella (PY1-PY4)
- Primary Metals (PY1-PY4)
- Mixed Industrial (PY1-PY4)
- Chemical Products (PY2-PY4)

A.1.2 Demand Response Programs

Duquesne reported savings from two demand response (DR) programs in its PY4 annual report. Below are descriptions of these programs. Both programs reported only demand and not energy impacts.[400]

<u>Residential Demand Response</u>

Years Reporting Savings: PY4

Program Implementer: Comverge

The Residential Demand Response Program paid customers an incentive to allow for a load cycling switch to be installed on their air conditioning units and electric water heaters. The cycling switch allowed the program implementation conservation service provider (CSP) to cycle the electricity use of the air conditioning unit and/or water heater during peak periods in the summer.

<u>Large Curtailable Demand Response</u>

Years Reporting Savings: PY4

Program Implementer: EnerNOC and Clear Choice

The Large Curtailable Demand Response Program was offered to large commercial and industrial (C&I) customers and operated by load curtailment CSPs. The CSPs were responsible for running the entire program, from acquiring and installing necessary equipment for load control, to communicating with equipment during load curtailment events and handling customer service issues. Incentives were provided for customers willing to curtail load when an event was called during peak periods of the summer.

[400] The evaluation team was concerned that apparent energy savings represented energy consumption that merely might have been shifted to another time period. Also, the minimal amount of savings did not justify conducting sufficient research to verify the savings.

A.2 PECO

A.2.1 Energy Efficiency Programs

Below are descriptions of each PECO EE program that reported savings during Phase I of Act 129.

Low-Income Energy Efficiency Program

Years Reporting Savings: PY1-PY4

Program Implementer: CMC Energy Services

The Low-Income Energy Efficiency Program (LEEP), which built on the existing Low-Income Usage Reduction Program (LIURP), educated and assisted eligible residential customers with making their homes more energy efficient and decreasing their energy usage and bills. LEEP had five distinct program components: (1) providing in-home audits, education, and direct installation of measures for customers below 150% of the Federal Poverty Level (no inherent difference from LIURP); (2) increasing the number of CFLs (up to 10 total) installed in homes of LIURP participants; (3) including EE improvements (up to 10 CFLs total) with weatherization improvements provided by programs other than LIURP; (4) installing refrigerators as part of LIURP audits; and (5) making additional weatherization repairs as part of Project H.O.M.E., an organization that helps the homeless in Philadelphia.

Smart Lighting Discounts Program

Years Reporting Savings: PY1-PY4

Program Implementer: Ecova

The Smart Lighting Discounts Program provided incentives to retailers and manufacturers to sell CFLs at reduced prices, display promotional materials, and distribute informational materials to customers. Additionally, the program sponsored CFL giveaway events to increase publicity and educate consumers regarding the benefits of CFLs and energy efficiency and to promote the features of the program. In PY3, the program underwent a significant strategy change that resulted in a significant reduction of program bulb sales. The program experienced a ramp-down and shifted its focus to specialty CFL bulbs rather than all CFL bulbs.

Smart Appliance Recycling Program

Years Reporting Savings: PY1-PY4

Program Implementer: JACO

The Smart Appliance Recycling Program paid customers an incentive to recycle older, inefficient, but operable refrigerators, freezers and room air conditioners. The program had two components: recycling and retailer pickups. The program also had two major goals: removing existing secondary units from homes and apartments and preventing former primary refrigerators, freezers, and room air conditioners from being used as secondary units when customers purchased new appliances. Appliances removed by retailers were sent to a collection facility and disassembled for environmentally responsible disposal and recycling.

Smart Home Rebates Program

Years Reporting Savings: PY1-PY4

Program Implementer: Ecova

The Smart Home Rebates Program offered rebates to residential customers for the purchase of energy efficient appliances, heating and cooling equipment, and light-emitting diode (LED) lamps and lighting fixtures. The program provided promotional and marketing materials and support to participating retailers and contractors to encourage the promotion of rebated products. To receive rebates for non-lighting measures, customers submitted applications via web or mail. For lighting measures, PECO provided manufacturers with a cost-buy-down so that customers would see a discounted price at retail stores.

Smart Equipment Incentives: C&I Program

Years Reporting Savings: PY1-PY4

Program Implementer: KEMA

The Smart Equipment Incentives Program: C&I offered incentives to C&I customers who installed high-efficiency electric equipment and also engaged equipment suppliers and contractors to promote high-efficiency, incentive-eligible equipment. Incentives were offered for the following equipment categories: HVAC, lighting, drives and motors, refrigeration, and custom solutions. Incentives are also offered for ENERGY STAR appliances and HVAC equipment in multi-tenant master-metered buildings and for appliance recycling for C&I customers. For measures with deemed per-unit savings, prescriptive incentives were given to customers. For larger and more complex measures and projects, custom incentives were given on a fixed per-kWh or per-kW basis.

For evaluation purposes, this program had three subcomponents: retrofit, multi-tenant, and appliance recycling. These three subcomponents were listed as separate line items in the PECO PY3 and PY4 annual reports. While they were not listed as separate line items in the PY1 and PY2 annual reports, savings from all of the subcomponents were included in the single reported savings line item.

Smart Construction Incentives Program

Years Reporting Savings: PY2-PY4

Program Implementer: KEMA

The Smart Construction Incentives Program provided incentives to both C&I and Government, Nonprofit, and Institutional (GNI) customers to greatly improve the energy efficiency of newly constructed facilities and facilities that were being completely renovated or reconstructed. Facility designers and builders were provided with training, design assistance, and prescriptive and custom incentives to incorporate EE systems and construction practices into facilities so they would surpass state and local energy codes. Projects for GNI customers were implemented through this program but paid for and claimed by the Smart Equipment Incentives Program: GNI, whereas projects for C&I customers were paid for and claimed through this program.

Smart Equipment Incentives: Government, Nonprofit, Institutional Program

Years Reporting Savings: PY1-PY4

Program Implementer: KEMA

The Smart Equipment Incentives Program: GNI offered incentives to GNI customers that installed high-efficiency electric equipment and also engaged equipment suppliers and contractors to promote high-efficiency equipment. This program offered all of the same services as the Smart Equipment Incentives: C&I program, including HVAC, lighting, drives and motors, refrigeration, custom solutions, ENERGY STAR appliances and HVAC equipment in multi-tenant master-metered buildings, and appliance recycling. Additionally, this program enabled customers to receive incentives for retrofitting street lighting and traffic signal lights. This program further funded and claimed savings for GNI new construction projects implemented through the Smart construction Incentives Program.

For evaluation purposes, this program had four subcomponents: retrofit, multi-tenant, appliance recycling, and new construction. These four subcomponents were listed as separate line items in the PECO PY3 and PY4 annual reports. While they were not listed as separate line items in the PY1 and PY2 annual reports, savings from all of the subcomponents were included in the single reported savings line item.

Conservation Voltage Reduction Program

Years Reporting Savings: PY1-PY2

Program Implementer: PECO

The Conservation Voltage Reduction (CVR) Program achieved load reductions through a 1% decrease in voltage from historic levels at the substation or transformer level. This change involved a physical adjustment in transformer settings at some substations in the PECO territory. The voltage was monitored to ensure that levels did not drop below regulatory requirements.

This program was fully implemented by the end of PY2. Since savings from a single reduction in voltage are a one-time occurrence, no additional savings were reported after the end of PY2. In the PY1 and PY2 annual report, CVR savings were reported as a single line item. In the PY3 and PY4 reports, however, the

CVR program CPITD savings were allocated amongst each sector and reported as separate line items by sector.

A.2.2 Demand Response Programs

PECO reported savings from five DR programs in its PY4 annual report. Below are descriptions of these programs. The Permanent Load Reduction Program reported both energy and demand impacts, whereas the other programs reported only demand impacts.

Residential Smart AC Saver Program

Years Reporting Savings: PY4

Program Implementer: Comverge

The Residential Smart AC Saver Program paid residential customers an incentive to allow PECO to install a one-way digital control unit on qualified air conditioners. During peak summer hours, signals were sent to the control units installed in homes to reduce air conditioning load by cycling the units' compressors.

Commercial Smart AC Saver Program

Years Reporting Savings: PY4

Program Implementer: Comverge

The Commercial Smart AC Saver Program was available to small commercial customers with qualifying air conditioners. Customers were provided an incentive to allow PECO to install a programmable communicating thermostat (PCT) at their facility that would allow PECO to remotely adjust temperature settings to reduce air conditioning load during peak summer hours.

Demand Response Aggregator Program

Years Reporting Savings: PY4

Program Implementers: EnergyConnect, Comverge, and EnerNOC

The Demand Response Aggregator Program was a intended for large C&I customers. The demand reduction achieved by this program was based on performance contracts that PECO signed with curtailment service providers (CSPs, also referred to as aggregators). The aggregators were responsible for recruiting participants and delivering the contracted demand reduction through their own program design. Load reduction techniques included behavioral actions (e.g., turning off lights and non-critical equipment), installing energy management systems (EMSs) that automatically shed non-critical load during an event, and in some cases, using standby generation to offset some or all electric load during an event.

Distributed Energy Resources Program

Years Reporting Savings: PY4

Program Implementer: Comverge

The Distributed Energy Resources Program was a DR program that provided incentives to C&I customers who were willing to run existing standby and backup generators or willing to install other types of distributed generation systems that would run when requested by PECO during summer peak hours.

Permanent Load Reduction

Years Reporting Savings: PY4

Program Implementer: KEMA

The Permanent Load Reduction Program was a DR program targeted at C&I customers that provided incentives for permanently moving electricity usage from peak periods to off-peak periods on an on-going basis. Energy storage systems or any other technologies that permanently shifted or eliminated load from peak periods were eligible for the program. Examples of these systems and technologies were gas absorption chillers and thermal energy storage systems.

A.3 PPL

A.3.1 Energy Efficiency Programs

Below are descriptions of each PPL EE program that reported savings during Phase I of Act 129.

Appliance Recycling Program

Years Reporting Savings: PY1-PY4

Program Implementer: JACO

The Appliance Recycling Program offered residential customers[401] an incentive to recycle their operable but inefficient refrigerators, freezers, and room air conditioners. The program encouraged customers to dispose of secondary appliances that they might not need and ensured that the removed appliances were disposed of in an environmentally responsible manner. It also prevented the sale of older and inefficient appliances into the secondary market.

Residential Lighting Program[402]

Years Reporting Savings: PY1-PY4

[401] Although this program focuses on residential customers, all sectors are eligible to participate.
[402] All sectors are eligible to participate in this program. A cross-sector sales analysis was conducted by PPL's independent evaluator in PY4 to determine the proportion of bulbs installed in non-residential applications and the associated non-residential savings.

Program Implementer: Ecova

The Residential Lighting Program was designed to increase the penetration of energy efficient lighting, such as ENERGY STAR CFLs and LEDs, in the residential market. This program had two components: upstream retail lighting and give-away. The upstream retail lighting component provided incentives to CFL and LED manufacturers, therefore effectively buying down the price of the bulbs. The give-away component provided free CFLs to customers who attended events sponsored by PPL.

This program's name was originally the Compact Fluorescent Lighting Campaign but was changed to the Residential Lighting Program in the June 2012 EE&C plan update because the program also began to provide discounted LEDs.

Energy Efficiency Behavior and Education Program

Years Reporting Savings: PY2-PY4

Program Implementer: Opower

The Energy Efficiency Behavior and Education Program educated residential customers about no-cost or low-cost measures and behaviors that could reduce energy consumption or demand and encouraged them to adopt an overall more energy efficient lifestyle. Information was conveyed to customers through many different means: periodic reports comparing a customer's energy use to that of comparable households in the same geographic area, outreach programs that emphasized the importance of peak load reduction, informational materials that provided conservation tips (e.g., adjusting temperature set points, turning off lights) and low-cost energy efficiency tips (e.g., replacing incandescent light bulbs with CFLs, weather-stripping), informational materials that directed customers to the PPL website where additional information and tools are available, and in-home displays or monitors that show electricity consumption of devices in a home.

Efficient Equipment Incentive Program

Years Reporting Savings: PY1-PY4

Program Implementer: PPL, DNV-Kema, and Helgeson

The Efficient Equipment Incentive Program promoted the purchase and installation of a wide range of high-efficiency equipment to all PPL customers and sectors, including technologies appropriate to specific building types and specific sectors. The program also promoted strategies that encouraged and supported a market transformation for efficiency appliance and equipment. Customers received rebates to offset the higher cost of energy efficient equipment, including electric heating, cooling, lighting, water heating, and appliances, among other measures.

In its June 2012 amended EE&C plan, PPL added a direct install option to this program for small C&I customers (lighting and refrigeration).

In PPL's PY2 annual report, "Efficient Equipment Incentive Program (C&I Lighting)" is reported as a separate line item from the Efficient Equipment Incentive Program because C&I lighting accounted for over two-thirds of the program ex-ante savings and was therefore evaluated independently from all other program measures.

Custom Incentive Program

Years Reporting Savings: PY1-PY4

Program Implementer: PPL and DNV-Kema

The Custom Incentive Program was available to all sectors but focused largely on C&I customers interested in individual equipment measures or systems not covered by other PPL programs. The program encouraged a "whole facility" approach to energy efficiency and sought to increase customer awareness and market penetration of energy efficient equipment. To qualify for incentives, customers were required to provide documentation proving that their proposed efficiency upgrade passed certain cost-effectiveness thresholds and met technical criteria. Typical projects included retro-commissioning, equipment optimization, and operation and process improvements. The amount of incentives that a customer received was based on the avoided or reduced kWh resulting from the project, capped at 50% of the incremental cost. As part of this program, PPL also provided incentives for a portion of the cost of technical studies and sometimes provided additional reimbursement following successful implementation of a cast-effective project.

E-Power Wise Program

Years Reporting Savings: PY2-PY4

Program Implementer: Resource Action Program

The E-Power Wise Program provided residential low-income customers with energy efficiency education and low-cost EE measures for self-installation. The program aimed to train community-based organization staff or others to provide energy workshops at locations convenient to the targeted customer segment. Workshops were held at many different times to make them easily accessible to as many low-income customers as possible. One-on-one energy education sessions were also offered. Customers attending sessions were asked to complete surveys that helped evaluate various program metrics.

Additionally, customers were provided with free EE kits by attending the education sessions or via direct mail. The direct mail option was initiated with PPL's June 2012 amended EE&C plan. Kits included a variety of low-cost, easy-to-install measures such as CFLs, faucet aerators, and low flow showerheads, along with installation instructions.

Low-Income Winter Relief Assistance Program

Years Reporting Savings: PY1-PY4

Program Implementer: Various regional contractors from PPL's LIURP WRAP Program

The Low-Income Winter Relief Assistance Program (WRAP) reduced electric consumption and improved living comfort for residential low-income customers. Eligible customers received a free energy audit to evaluate their home for potential areas for energy savings. Low-cost EE measures were directly installed in a customer's home, and a predetermined list of eligible measures was used to determine if appliance or other large equipment could be cost-effectively replaced with high-efficiency equipment. Typically, outdated and inefficient equipment was replaced. The program also offered energy education to encourage customers to conserve energy.

Renewable Energy Program

Years Reporting Savings: PY1-PY4

Program Implementer: PPL

The Renewable Energy Program was available to the residential and GNI sectors and offered rebates to reduce the upfront cost of installing a solar photovoltaic array or ground-source heat pump. Customers in this program were also encouraged to reduce their load by installing other applicable EE measures prior to installing a renewable energy system. This program exceeded participation goals and exhausted funding in PY3, and therefore was not open to new applicants in PY4.

HVAC Tune-Up Program

Years Reporting Savings: PY2-PY4

Program Implementer: FDSI

The HVAC Tune-Up Program was available to customers in the small C&I and GNI sectors with existing split or packaged HVAC roof top units. The goal of the program was to increase the operating performance of the customer's HVAC system. Incentives were paid to contractors to offset the cost of diagnosing HVAC systems using a special auditing tool that reported diagnostic data and tracked work progress and then made appropriate energy-saving retrofits. The retrofit measures fell into three general categories: refrigeration measures, economizer measures, and thermostat measures.

Home Energy Assessment and Weatherization Program

Years Reporting Savings: PY2-PY4

Program Implementer: EIC

The Home Energy Assessment and Weatherization Program provided customers who live in single family residences with information on their home's energy performance and recommendations on the most effective, highest priority EE actions they could take in their homes. Customers could select between two levels of auditing: a home energy survey or a comprehensive audit. The home energy survey was a simple walk-through visual inspection of the home that evaluated major energy-using equipment and building envelope characteristics to identify areas for cost-effective upgrades. The comprehensive audit was a full audit conducted with diagnostic testing, including a blower door test and combustion efficiency testing. As part of both levels of audits, low-cost energy-saving measures were installed directly into homes to achieve instant energy savings. The program also encouraged customers to participate in other PPL programs to achieve additional energy savings.

A.3.2 Demand Response Programs

PPL reported savings from two DR programs in its PY4 annual report. Below are descriptions of these programs. Both programs reported only demand and not energy impacts.

Direct Load Control

Years Reporting Savings: PY4

Program Implementer: Comverge

The Direct Load Control Program paid incentives to customers willing to allow PPL to install control devices on central air conditioning or heat pump units, to allow the unit to be cycled on and off during peak periods of the summer. When PPL would call an event, the control devices would cycle the unit’s compressor on and off to reduce electrical demand.

Load Curtailment

Years Reporting Savings: PY4

Program Implementer: EnerNOC

The Load Curtailment Program was available to C&I customers and was managed by PPL’s Load Curtailment CSP, who decided the number of participants, number of interruptible hours per participant, and size of each participant’s load reduction. Participants were notified of events and were requested to reduce load during the event by either shifting or eliminating load or using backup or distributed generation that meets environmental regulations.

A.4 FirstEnergy Legacy Companies (Met-Ed, Penelec, Penn Power)

A.4.1 Energy Efficiency Programs

Below are descriptions of each FirstEnergy Legacy Company EE program that reported savings during Phase I of Act 129.

Home Energy Audits Program

Years Reporting Savings: Met-Ed: PY1-PY2, Penelec: PY1-PY2, Penn Power: PY1-PY2,

Program Implementer: Honeywell (audits), Power Direct (on-line audit kits), Aclara (on-line audit software)

The Home Energy Audits Program provided households with two levels of audits: (1) free, on-line, self-administered audits and (2) subsidized, walk-through on-site audits performed by a trained professional. The purpose of the audits was to identify savings opportunities, install basic low-cost measures (e.g., smart power strips, CFLs), and make customers aware of other programs offered by their utility. Customers who completed the on-line audit received an energy conservation kit of low-cost measures. Customers who participated in the on-site audit had low-cost measures directly installed in their home by the professional auditor.

In the February 2011 EE&C Plan update, this program was consolidated with the Whole Building Comprehensive Program to create the Home Energy Audits and Outreach Program.

Whole Building Comprehensive Program

Years Reporting Savings: Met-Ed: PY2, Penelec: PY2, Penn Power: PY2

Program Implementer: Honeywell

The Whole Building Comprehensive Program paid customers rebates for a whole-house, two-part (test in/test out) comprehensive audit that included blower door testing. The audit was performed by a trained professional both before (to recommend energy savings measures) and after (to verify proper installation and savings) the installation of the measures. Additionally, during the audit, various low-cost measures (e.g., smart power strips, CFLs) were directly installed throughout the home. Performance-based incentives were also provided based on the measure energy savings from measures installed in the home.

In the February 2011 EE&C plan update, this program was consolidated with the Home Energy Audits Program to create the Home Energy Audits and Outreach Program.

Home Energy Audits and Outreach Program

Years Reporting Savings: Met-Ed: PY3-PY4, Penelec: PY3-PY4, Penn Power: PY3-PY4

Program Implementer: Honeywell (audits), Power Direct (on-line audit kits), Aclara (on-line audit software)

The Home Energy Audits and Outreach Program was a consolidation of the Home Energy Audits Program and Whole Building Comprehensive Program. This program offered the same rebates and measures as the two individual programs but under a single program name.

The purpose of this program was to identify savings opportunities, install basic low-cost measures (e.g., smart power strips, CFLs), and make the customer aware of other programs offered by the utility. Energy savings opportunities were identified through three types of home energy audits: (1) on-line, self-administered audits; (2) walk-through on-site audits performed by a trained professional; and, (3) whole-house, comprehensive two-part audits. The on-line audit was free to the customer, and each customer who participated received a free kit of low-cost energy saving measures. The walk-through on-site audit was offered at a subsidized price, and low-cost measures were directly installed in the customer's home by the auditor based on the needs of the home. The comprehensive audit included diagnostic assessments of the household followed by direct installation of low-cost measures and incentives for installation of measures addressing building shell, appliances, and other energy-consuming features. Customers received a rebate for the comprehensive audit and could receive additional rebates based on the energy savings produced by the installation of energy-saving measures.

Residential Appliance Turn-In Program

Years Reporting Savings: Met-Ed: PY1-PY4, Penelec: PY1-PY4, Penn Power: PY1-PY4

Program Implementer: JACO

The Residential Appliance Turn-In Program provided an incentive to households for turning in older, inefficient appliances that were in working order. Up to two large older appliances (refrigerator or freezer) and up to two room air conditioners could be turned-in per household per calendar year. The appliances had to meet certain size requirements and be in working order. For households that were also purchasing a new refrigerator, this program was coordinated with the Energy Efficient Products Program.

Residential Energy Efficiency HVAC Program

Years Reporting Savings: Met-Ed: PY2-PY4, Penelec: PY2-PY4, Penn Power: PY2-PY4

Program Implementer: Honeywell

The Residential Energy Efficiency HVAC Program provided incentives for the implementation of contractor-installed energy efficient HVAC or other eligible systems in new or existing residential buildings. Installations were delivered by qualified local contractors identified by implementation vendors or manufacturers. Incentives were provided for high-efficiency central air conditioning units, air-source heat pumps, and ground-source heat pumps. This program also provided incentives for maintenance (tune-up) of existing central air conditioners or heat pumps and for the replacement of old furnace fans with fans that meet ENERGY STAR guidelines.

Residential Energy Efficient Products Program

Years Reporting Savings: Met-Ed: PY1-PY4, Penelec: PY1-PY4, Penn Power: PY1-PY4

Program Implementer: Honeywell

The Residential Energy Efficient Products Program provided rebates to customers who purchased energy efficient products such as ENERGY STAR-qualified appliances and CFLs. The program also provided mark-downs or buy-downs on certain measures, including CFLs, to reduce the prices seen by the consumer at the store. It also provided support to retailers who sold energy efficient products, including promotional support, point-of-sale materials, training, promotion events, and up-stream product buy-down rebates to retailers, distributors, or manufacturers for certain appliances. The program also supported other sales and distribution channels that could reliably document effective distribution of energy efficient products, such as catalog sales.

Residential New Construction Program

Years Reporting Savings: Met-Ed: PY2-PY4, Penelec: PY2-PY4, Penn Power: PY2-PY4

Program Implementer: Performance Systems Development (PSD)

The Residential New Construction Program provided incentives to builders for achieving ENERGY STAR Homes status or the Home Energy Rating System Program (HERS) rating associated with a highly energy efficient home. This program supported the implementation of contractor-installed HVAC, solar, and other energy efficient systems, as well as measures addressing building shell, appliances, and other energy-consuming features of a home. It also supported the sale of high-efficiency ENERGY STAR-compliant equipment through local builders. A participant received a rebate based on the amount of energy saved compared with a code-standard new home, and also received rebates through other residential rebate programs for measures such as high-efficiency appliances.

Residential Behavioral Modification and Education Program

Years Reporting Savings: Met-Ed: PY4, Penelec: PY4, Penn Power: PY4

Program Implementer: Opower, Honeywell

The Residential Behavioral Modification and Education Program educated residential customers about no-cost or low-cost measures and behaviors that could reduce energy consumption or demand and encouraged them to adopt an overall more energy efficient lifestyle. Information was conveyed to customers through many different means: periodic reports comparing a customer’s energy use with that of comparable households in the same geographic area, outreach programs that emphasized the importance of peak load reduction, informational materials that provided conservation tips (e.g., adjusting temperature set points, turning off lights), and provided low-cost energy efficiency tips (e.g., replacing incandescent light bulbs with CFLs, weather-stripping), and informational materials that directed customers to each of the FirstEnergy Legacy EDCs’ websites, where additional information and tools are available.

Residential Multiple Family Program

Years Reporting Savings: Met-Ed: PY2, PY4, Penelec: PY2, PY4, Penn Power: PY2, PY4

Program Implementer: Power Direct Energy

The Residential Multiple Family Program leveraged the audit services already provided by the Pennsylvania Housing Finance Agency (PHFA) by marketing to property managers and owners who had participated and completed the PHFA audits. It also used other PHFA resources to help target property managers and owners who had not yet participated in the audits. Tenants in these multi-family buildings were provided energy conservations kits at no cost (included CFLs and other low-cost energy efficiency measures such as faucet aerators), and incentives were provided to building owners for installing energy conservation measures in building common areas.

Residential Low-Income Programs (WARM Programs)

Years Reporting Savings: Met-Ed: PY1-PY4, Penelec: PY1-PY4, Penn Power: PY1-PY3

Program Implementer: FirstEnergy Administration and RFP-winning contractors/agencies selected as implementers

The Residential Low-Income Programs were three distinct programs offered only to the low-income sector: the WARM Extra Measures Program, WARM Plus Program, and Low-Income, Low-Use Program.

The two WARM-related programs are expansions of the original Low-Income Usage Reduction Program (LIURP) established prior to the Act 129 programs, known as WARM. The WARM Extra Measures Program provided additional electric energy savings measures and services to low-income customers, including CFLs, LED nightlights, furnace whistles, and smart power strips. The WARM Plus Program was an expansion of the WARM program that allowed additional homes to receive comprehensive treatments as would be received under the WARM program.

The Low-Income, Low-Use Program provided CFLs, faucet aerators, LED nightlights, furnace whistles, and energy education materials to low-income customers who did not meet the minimum usage threshold of 600 kWh/month to qualify for the WARM program.

Commercial and Industrial Small Sector Energy Audit and Technical Assessment Program

Years Reporting Savings: Met-Ed: PY2, Penelec: PY2, Penn Power: PY2

Program Implementer: SAIC

The Commercial and Industrial Small Sector Energy Audit and Technical Assessment Program provided two levels of audits to small-sector C&I customers: a simple on-line or walk-through audit for small businesses with non-complex loads, and a more comprehensive audit for medium to large non-residential customers. The goal of the audits was to help identify existing energy consumption patterns and opportunities to achieve energy savings. The audits also helped guide customers to other FirstEnergy Legacy EDC rebate programs. This program also provided unlimited coupons for reduced-price CFLs to replace existing incandescent lamps. The savings from these CFLs were reported under the Commercial and Industrial Small Sector Equipment Program, even prior to consolidation.

In the February 2011 EE&C plan update, this program was absorbed into the Commercial and Industrial Small Sector Equipment Program.

Commercial and Industrial Small Sector Equipment Program

Years Reporting Savings: Met-Ed: PY3-PY4, Penelec: PY3-PY4, Penn Power: PY3-PY4

Program Implementer: SAIC/CLEAResult, Matrix & Roth

The Commercial and Industrial Small Sector Equipment Program provided rebates to small C&I customers to support the installation and implementation of cost-effective, high-efficiency measures and projects. Rebates and incentives were provided to reduce the cost of the equipment or installation. This program included several components: standard lighting, non-standard lighting, HVAC, motors and drives, and specialty equipment and custom projects.

In the February 2011 EE&C plan update, this program absorbed the Commercial and Industrial Small Sector Energy Audit and Technical Assessment Program. Therefore, from February 2011 onward, it also provided two levels of audits to small C&I customers: a simple on-line or walk-through audit for small businesses with non-complex loads, and a more comprehensive assessment for medium to large non-residential customers, to help identify existing end uses of energy and help find ways in which energy savings could be achieved.

Commercial and Industrial Large Sector Industrial Motors and Variable Speed Drives Program

Years Reporting Savings: Met-Ed: PY2, Penelec: PY1-PY2, Penn Power: PY2,

Program Implementer: SAIC

The Commercial and Industrial Large Sector Industrial Motors and Variable Speed Drives Program provided incentives to replace existing motors with NEMA Premium motors and to install variable speed drives (VSDs) on motors that did not previously have a drive. The VSD portion of the program was specifically designed for customers whose motors were handling high operating hours and a high variability of loads on their system.

In the February 2011 EE&C plan update, this program was consolidated with the Commercial and Industrial Large Sector Performance Contracting/Equipment Program to create the Commercial and Industrial Large Sector Equipment Program.

Commercial and Industrial Large Sector Performance Contracting and Equipment Program

Years Reporting Savings: Met-Ed: PY1-PY2, Penelec: PY1-PY2, Penn Power: PY1-PY2

Program Implementer: SAIC

The Commercial and Industrial Large Sector Performance Contracting/Equipment Program allowed large C&I customers to secure demand-side management/energy efficiency (DSM/EE) services through an energy services company (ESCO) that identified savings opportunities, implemented retrofits, and attained payment through the savings generated by the project over time. Additionally, large C&I customers received incentives for implementing their own energy efficiency measures through the same incentive programs offered to small C&I customers: standard lighting, non-standard lighting, HVAC, motors and drives, and specialty equipment and custom projects.

In the February 2011 EE&C plan update, this program was consolidated with the Commercial and Industrial Large Sector Industrial Motors and Variable Speed Drives Program to create the Commercial and Industrial Large Sector Equipment Program.

Commercial and Industrial Large Sector Equipment Program

Years Reporting Savings: Met-Ed: PY3-PY4, Penelec: PY3-PY4, Penn Power: PY3-PY4

Program Implementer: SAIC

The Commercial and Industrial Large Sector Equipment Program was a consolidation of the Commercial and Industrial Large Sector Industrial Motors and Variable Speed Drives Program and the Commercial and Industrial Large Sector Performance Contracting/Equipment Program. This program offered the same rebates and measures as the two programs that were consolidated but under a single program name.

The Performance Contracting and Equipment portion of the program allowed large C&I customers to secure demand-side management/energy efficiency (DSM/EE) services through an energy services company (ESCO) that identified savings opportunities, implemented retrofits, and attained payment through the savings generated by the project over time. Additionally, large C&I customers received incentives for implementing their own energy efficiency measures through the same incentive programs offered to small C&I customers: standard lighting, non-standard lighting, HVAC, motors and drives, and specialty equipment and custom projects.

The Industrial Motors and VSD portion of the program provided incentives to replace existing motors with NEMA Premium motors and to install variable speed drives (VSDs) on motors that did not previously have a drive. The VSD portion of the program was specifically designed for customers whose motors were handling high operating hours and had a high variability of loads on their system.

Government/Non-Profit Street Lighting Program

Years Reporting Savings: Met-Ed: PY2-PY4, Penelec: PY2-PY4, Penn Power: PY2

Program Implementer: SAIC

The Government/Non-Profit Street Lighting Program provided incentives to municipalities to convert existing street lights to high-pressure sodium units for all municipalities regardless of ownership of the street lights. The program also provided options for municipalities to upgrade existing outdoor lights to high-pressure sodium units and traffic and pedestrian signals to LEDs.

Government/Non-Profit Program

Years Reporting Savings: Met-Ed: PY2-PY4, Penelec: PY1-PY4, Penn Power: PY2

Program Implementer: SAIC

The Government/Non-Profit Program targeted customers on special non-profit rates, including volunteer fire companies, ambulance associations, some schools, and municipal customers. These customers were eligible for all incentive programs offered to small and large C/I customers, such as standard lighting, non-standard lighting, HVAC, motors and drives, and specialty equipment and custom projects. In late PY2, the program also began to include opt-in CFL kits, allowing customers enrolled in this program to receive CFL kits at no cost.

Governmental/Remaining Non-Profit Program

Years Reporting Savings: Met-Ed: PY1-PY4, Penelec: PY1-PY4, Penn Power: PY2-PY4

Program Implementer: SAIC

The Governmental/Remaining Non-Profit Program offered the same incentive programs as the small and large C/I sectors, including standard lighting, non-standard lighting, HVAC, motors and drives, and specialty equipment and custom projects, to customers in the government and non-profit sectors not participating in the Governmental/Non-Profit Program (i.e., not on special non-profit rates). In late PY2, the program also began to include opt-in CFL kits, allowing customers enrolled in this program to receive CFL kits at no cost.

A.4.2 Demand Response Programs

Met-Ed, Penelec, and Penn Power (FirstEnergy Legacy Companies) implemented the same programs during Phase I of Act 129 and are therefore discussed together in this section. Two DR programs reported savings in each FirstEnergy Legacy company’s PY4 annual report. Both programs reported only demand impacts.

Residential Demand Reduction Program

Years Reporting Savings: Met-Ed: PY4, Penelec: PY4, Penn Power: PY4

Program Implementer: BPL Global (Met-Ed), Honeywell (Penelec, Penn Power)

The Residential Demand Reduction Program paid incentives to customers who agreed to have controls installed on their central air conditioning systems, and in some instances electric water heaters or pool pumps, to allow the EDC to limit operation during peak load periods. While the load control technology used at Met Ed was different than that used for Penelec and Penn Power, once the devices were installed, the EDC had the ability to cycle the compressor or motor of the system or reset temperatures during an event.

Commercial and Industrial Large Sector Demand Response Program – CSP Mandatory and Voluntary Curtailment Program

Years Reporting Savings: Penn Power: PY4, Penelec: PY4, Met-Ed: PY4

Program Implementer: FirstEnergy and various CSPs

The Commercial and Industrial Large Sector Demand Response Program – CSP Mandatory and Voluntary Curtailment Program ("PJM Demand Response") allowed each FirstEnergy Legacy company to contract with PJM CSPs or customers acting as their own CSPs to deliver peak load reductions during the top 100 hours. The program has two general variations: voluntary and mandatory.

In the voluntary program, a CSP was in charge of calling its own events. If a load reduction was within the top 100 hours, a CSP received payment from the FirstEnergy Legacy EDC, and if a load reduction was outside the top 100 hours, a CSP did not receive payment from the FirstEnergy Legacy EDC. Under the mandatory program, each FirstEnergy Legacy company called events, and the CSPs were required, by contract, to deliver a certain average demand reduction. Each FirstEnergy Legacy EDC was required to give day-ahead notice to CSPs, and penalties existed for CSP underperformance. CSPs in the mandatory program could also have participated in the voluntary program on top 100 hours days when the FirstEnergy Legacy EDC did not call events.

A.5 West Penn Power

A.5.1 Energy Efficiency Programs

Below are descriptions of each West Penn Power energy efficiency program that reported savings during Phase I of Act 129.

<u>Compact Fluorescent Lighting Rewards Program</u>

Years Reporting Savings: PY1-PY2

Program Implementer: West Penn Power

The Compact Fluorescent Lighting Rewards Program provided mail-in and retailer point-of-sale rebates to overcome the higher cost of a CFL bulb compared with an incandescent bulb. Additionally, West Penn partnered with local retailers on buy-downs of CFLs, which in turn reduced the prices that customers saw at the stores and negated the need for customers to follow through with the mail-in rebate process.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Residential Energy Efficient Products Program after the EE&C plan update.

<u>Residential Energy Star and High Efficiency Appliance Program</u>

Years Reporting Savings: PY1-PY2

Program Implementer: West Penn Power

The Residential Energy Star and High Efficiency Appliance Program provided rebates for purchasing energy efficient appliances that met or exceeded ENERGY STAR or other energy efficiency ratings standards. Mail-in rebates were offered for clothes washers, clothes dryers, dishwashers, refrigerators, freezers, programmable thermostats, and room air conditioners. This program also offered rebates for turning in old refrigerators, freezers, and air conditioners. In order to receive a rebate on a new refrigerator or freezer, the customer had to turn in his or her old appliance.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The appliance turn-in rebates offered in this program prior to the EE&C plan update were offered in the Residential Appliance Turn-In Program after the EE&C plan update, and the appliance rebates offered in this program prior to the EE&C Plan update were offered in the Residential Energy Efficient Products Program after the EE&C plan update.

Residential Home Performance Program

Years Reporting Savings: PY1-PY4

Program Implementer: West Penn Power (PY1-PY3), Honeywell and Power Direct Energy (PY4)

In PY1-PY2, the Residential Home Performance Program offered an on-line audit measure and consumer efficiency measure to customers. Customers who participated in the on-line audit received a number of free CFLs for completing the audit and received information and tips on energy efficiency and how to improve their home's overall energy efficiency. The consumer efficiency measure studied customer demographics and performed bill analysis on a number of customers in order to provide them with a report containing efficiency education and opportunities to reduce energy consumption. The consumer efficiency measure also offered various delivery channels for receiving free low-cost measures, such as CFLs (a small quantity of lime lights and smart strips were also distributed). These delivery channels included giveaway events, school kits, and kits distributed via mail.

As part of the August 2011 EE&C plan update to make West Penn's programs more consistent with those of the other FirstEnergy Company plans, this program began offering three levels of audits consistent with the Residential Home Energy Audits and Outreach Program of the three FirstEnergy Legacy companies. The three levels of audits were: (1) online self-administered audit; (2) walk-through on-site audit performed by a trained professional; and (3) whole-house comprehensive two-part audit. The online audit was free to the customer, and each customer who participated received a free kit of low-cost energy saving measures. The walk-through on-site audit was offered at a subsidized price, and a kit of low-cost measures was sent to the customer upon completion of the audit. The comprehensive audit included diagnostic assessments of the household followed by direct installation of low-cost measures and incentives for installation of measures addressing building shell, appliances, and other energy-consuming features of the home. Customers received a rebate for the comprehensive audit and could receive additional rebates based on the energy savings produced by the installation of energy saving measures. As it did prior to the August 2011 EE&C plan update, this program continued to offer various delivery channels for free CFL bulbs.

This program additionally implemented a Behavior Modification and Education element in PY4 that focused on ways that customers could implement no-cost or low-cost measures and behaviors to reduce energy consumption or demand.

Residential HVAC Efficiency Program

Years Reporting Savings: PY1

Program Implementer: West Penn Power

The Residential HVAC Efficiency Program offered rebates for the purchase of high-efficiency central air conditioners and heat pumps by units. To qualify for a rebate, the installation had to be completed by a certified contractor and a programmable thermostat had to be installed. This program was expanded in the September 2010 EE&C plan update by offering rebates for additional measures and changed its name to the Residential Whole Home Appliance Efficiency Program.

Residential Whole Home Appliance Efficiency Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

The Residential Whole Home Appliance Efficiency Program was a modification of the Residential HVAC Efficiency Program as part of the September 2010 EE&C plan changes. The rebates offered for installation of high-efficiency central air conditioners and heat pumps with programmable thermostats by a certified contractor were replaced with rebates for HVAC tune-up and maintenance. Additionally, this program began offering rebates for ENERGY STAR domestic hot water storage type units.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The non-HVAC measures offered in this program prior to the EE&C plan update were offered in the Residential Energy Efficient Products Program after the EE&C Plan update, and the HVAC measures offered in this program prior to the EE&C plan update were offered in the Residential Energy Efficient HVAC Equipment Program after the EE&C Plan update.

Residential Low-Income Home Performance Check-Up Audit and Appliance Replacement Program

Years Reporting Savings: PY1-PY2

Program Implementer: West Penn Power with Dollar Energy

The Residential Low-Income Home Performance Check-Up Audit and Appliance Replacement Program allowed for the direct installation of low-cost measures into low-income customer's homes, energy education for the customers, and the replacement of qualified refrigerators, freezers, and air conditioners. For customers with non-electric water heating, up to six CFLs could be installed. For customers with electric water heating, up to six CFLs, three faucet aerators, and a low-flow showerhead could be installed. While on site, the auditor determined if the refrigerator, freezer, or any room air conditioners were eligible for turn-in and replacement based on age and operational effectiveness. If deemed appropriate for replacement, an equivalent size ENERGY STAR appliance was provided for the customer free of charge. Up to two room air conditioners could be replaced.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Limited Income Energy Efficiency Program after the EE&C Plan update.

Residential Low-Income Joint Utility Usage Management Program

Years Reporting Savings: PY2-PY4

Program Implementer: West Penn Power with Dollar Energy

The Residential Low-Income Joint Utility Usage Management Program (JUUMP) was an expansion and enhancement of the existing Low-Income Usage Reduction Program (LIURP) and provided additional electric energy savings measures and services to low-income customers with gas heating through partnerships with natural gas distribution companies and the Department of Community and Economic Development Weatherization Assistance Program (WAP). Savings kits were offered to customers who did not accept in-home services or when their usage was too low to qualify them for LIURP or WAP.

Limited Income Energy Efficiency Program

Years Reporting Savings: PY3-PY4

Program Implementer: West Penn Power with Dollar Energy

The Limited Income Energy Efficiency Program (LIEEP) was an expansion and enhancement of the existing Low-Income Usage Reduction Program (LIURP) and provided additional electric energy savings measures and services to low-income customers. Extra measures such as CFLs and smart strips were provided to LIURP participants, and for customers who could not qualify for LIURP, energy efficiency kits of low-cost measures were distributed. LIEEP also absorbed the Low Income Home Performance Check-Up Audit and Appliance Replacement Program and continued to offer the measures associated with the old program.

Government/Non-Profit Lighting Efficiency Program

Years Reporting Savings: PY1-PY2

Program Implementer: West Penn Power

The Government/Non-Profit Lighting Efficiency Program offered incentives for installing T8 lamps (replacing T12 lamps), LED exit signs (only shipping costs), LED traffic signals (retrofit of existing incandescent units), and CFLs (no cost to customer).

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Government and Institutional Program after the EE&C plan update.

Government and Institutional Program

Years Reporting Savings: PY3-PY4

Program Implementer: SAIC

The Government and Institutional Program provided prescriptive and performance-based incentives to reduce the cost of high-efficiency equipment for GNI customers. The program supported the implementation of cost-effective, high-efficiency non-standard equipment through authorized contractor networks and traditional channels, as well as the implementation of cost-effective, high-efficiency standard and non-standard measures through a CSP for government buildings or institutional customers. All measures offered in the Government/Non-Profit Lighting Efficiency Program prior to the August 2011 EE&C plan update were offered in this program.

The Street Lighting portion of this program was offered to municipalities regardless of the ownership of the street lights and sought to convert street lights to high-pressure sodium bulbs. The Traffic Signal portion of this program was also targeted at local governments and sought to convert vehicular traffic signals and pedestrian/cycling signals to LED technology. The Lighting portion of this program sought to convert inefficient lighting technologies to energy efficient lighting technologies through an implementation provider and/or program manager that provided diagnostic assistance, technical support, and the necessary rebates for the customer to install the appropriate measure.

Commercial HVAC Efficiency Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

In PY1, the Commercial HVAC Efficiency Program offered rebates to small and large C&I and GNI customers to purchase unitary air conditioners and heat pumps that were more energy efficient than federal standards, but no savings were reported for this program in PY1. In the September 2010 EE&C plan update, this program changed its offerings to a rebate for the maintenance of existing HVAC units instead of the purchase of new HVAC units.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Commercial and Industrial Equipment Program – Small after the EE&C plan update.

Commercial Lighting Efficiency Program

Years Reporting Savings: PY1

Program Implementer: West Penn Power

The Commercial Lighting Efficiency Program encouraged small and large C&I customers to upgrade to energy efficient lighting technologies. The program provided rebates for T8 lamps (replacing T12 lamps), T5 lights (replacing high-intensity discharge high-bay lights), occupancy sensors, and LED exit signs (replacing incandescent exit signs). This program was expanded in the September 2010 EE&C plan update by offering rebates for additional measures and changed its name to the Commercial Products Efficiency Program.

Commercial Products Efficiency Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

The Commercial Products Efficiency Program was an expansion to the Commercial Lighting Efficiency Program offered in PY1 and provided rebates for small and large C&I customers to upgrade to energy efficient lighting technologies. The program offered the same rebates as the Commercial Lighting Efficiency Program (T8 lamps, T5 lights, occupancy sensors, and LED exit signs), and additionally offered rebates for smart power strips and CFLs (to replace incandescent bulbs).

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Small and Large Commercial and Industrial Equipment Programs after the EE&C plan update.

Custom Technology Applications Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

The Custom Technology Applications Program was targeted at small and large C&I and GNI customers consuming between 1 million and 2.5 million kWh annually. The goal was to reduce energy and demand through improving the energy efficiency of specific processes and applications identified and verified through an on-site audit. Customers directly contracted with third parties to identify energy savings opportunities in applications such as lighting systems, compressed air, chillers, refrigeration, variable speed drives (VSDs), motors energy management systems (EMSs), fan/pump systems, renewable energy, and combined heat and power systems. Customers submitted their projects to West Penn and, pending approval, were awarded an incentive based on the cost of the project, up to a certain amount. There was no limit to the eligible measures, but they had to consume electricity and individually be cost-effective.

This program also encouraged government customers to pursue whole facility savings opportunities by provided additional incentives for the completion of qualified energy audits and increased incentives for selected projects that involved Guaranteed Energy Savings Agreements (GESAs) and other funding sources for whole facility projects.

In the September 2010 EE&C plan update, this program began offering the measures that had previously been offered in the Commercial and Industrial Drives Program.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Small Commercial and Industrial Equipment Program after the EE&C Plan update.

Custom Applications Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

The Custom Applications Program was targeted at large C&I customers consuming greater than 2.5 million kWh annually. The goal of the program was to reduce energy and demand through improving the energy efficiency of specific processes and applications identified and verified through an on-site audit. The program first provided an incentive for a targeted energy audit and then provide additional incentives and rewards if a customer followed through and installed energy saving measures recommended by the audit, on a per-kWh basis. Common processes and applications for energy savings measures included lighting systems, compressed air, chillers, refrigeration, variable speed drives (VSDs), motors, energy management systems (EMSs), fan and pump systems, and combined heat and power systems.

In the September 2010 EE&C plan update, this program began offering the measures that had previously been offered in the Commercial and Industrial Drives Program.

After the incorporation of West Penn into the FirstEnergy family of companies in February 2011 and the approval of the August 2011 EE&C plan update, this program was discontinued. The measures offered in this program prior to the EE&C plan update were offered in the Large Commercial and Industrial Equipment Program after the EE&C plan update.

Commercial and Industrial Drives Program

Years Reporting Savings: PY2

Program Implementer: West Penn Power

The Commercial and Industrial Drives Program provided rebates for retrofitting existing motors that drove variable torque loads and were within certain specific guidelines for application, size, operating hours, and load duty cycle. New installation of drives for motors and maintenance were not covered in this program.

After the September 2010 EE&C plan update, this program was discontinued and the measures that had been offered in it were offered in the Custom Technology Applications Program and Custom Applications Programs. Since some savings were generated by this program prior to being discontinued, it is still reported as savings in West Penn Power's PY2 annual report.

Residential Appliance Turn-In Program

Years Reporting Savings: PY3-PY4

Program Implementer: JACO

The Residential Appliance Turn-In Program provided a small incentive to households for turning in older, inefficient appliances that were in working order. Up to two large older appliances (refrigerator or freezer) and up to two room air conditioners could be turned in per household per calendar year. The appliances had to meet certain size requirements and be in working order. For households that were also purchasing a new refrigerator, this program was coordinated with the Energy Efficient Products Program.

This program was implemented as part of the August 2011 EE&C plan update, after the incorporation of West Penn into the FirstEnergy family of companies in February 2011. Prior to the EE&C plan update, the measures offered by this program were included as part of the Residential Energy Star and High Efficiency Appliance Program.

Residential Energy Efficient Products Program

Years Reporting Savings: PY3-PY4

Program Implementer: Honeywell

The Residential Energy Efficient Products Program provided rebates to customers who purchased energy efficient products, such as ENERGY STAR-qualified appliances and CFLs. It also provided support to retailers who sold energy efficient products. This included promotional support, point-of-sale materials, training, promotion events, and up-stream product buy-down rebated to retailers, distributors, or manufacturers for certain appliances. The program also supported other sales and distribution channels, such as catalog sales, that could reliably document effective distribution of energy efficient products. Additionally, this program distributed CFLs through giveaway events and through appliance recycling (the appliance recycling implementer gave out eight CFLs for each appliance pick-up).

This program was implemented as part of the August 2011 EE&C plan update, after the incorporation of West Penn into the FirstEnergy family of companies in February 2011. Prior to the EE&C plan changes, some of the measures offered by this program were included as part of the Residential Energy Star and High Efficiency Appliance Program, Compact Fluorescent Lighting Rewards Program, and Residential Whole Home Appliance Efficiency Program.

Residential Energy Efficient HVAC Equipment Program

Years Reporting Savings: PY3-PY4

Program Implementer: Honeywell

The Residential Energy Efficiency HVAC Program provided incentives supporting the implementation of contractor-installed HVAC or other eligible systems in new or existing residential buildings. This program promoted the sale of high-efficiency, ENERGY STAR-compliant equipment through contractors selling to residential customers. Incentives were provided for the following HVAC equipment: high-efficiency central air conditioning units, air-source heat pumps, and ground-source heat pumps. This program also provided incentives for maintenance (tune-up) of existing central air conditioners or heat pumps and toward the replacement of old furnace fans with fans that met ENERGY STAR guidelines.

This program was implemented as part of the August 2011 EE&C plan update, after the incorporation of West Penn into the FirstEnergy family of companies in February 2011. Prior to the EE&C plan update, some the measures offered by this program were included as part of the Residential Whole Home Appliance Efficiency Program.

Commercial and Industrial Small Sector Equipment Program

Years Reporting Savings: PY3-PY4

Program Implementer: SAIC

The Commercial and Industrial Small Sector Equipment Program provided prescriptive and performance-based incentives to reduce the cost of energy efficient equipment and thereby encourage the adoption of higher efficiency equipment. This program also supported the implementation of cost-effective, high-efficiency non-standard equipment through authorized contractor networks and traditional channels for job scopes including but not limited to lighting, motors, variable speed drives, food service, HVAC, and custom measures. Additionally, this program delivered energy efficiency kits of low-cost measures to small C&I customers and master metered multi-family customers.

This program was implemented as part of the August 2011 EE&C plan update, after the incorporation of West Penn into the FirstEnergy family of companies in February 2011. Prior to the EE&C plan update, some the measures offered by this program were included as part of the Custom Technology Applications Program, Commercial Products Efficiency Program, and Commercial HVAC Efficiency Program.

Commercial and Industrial Large Sector Equipment Program

Years Reporting Savings: PY3-PY4

Program Implementer: SAIC

The Commercial and Industrial Large Sector Equipment Program provided prescriptive and performance-based incentives to reduce the cost of energy efficient equipment and thereby encourage the adoption of higher efficiency equipment. This program also supported the implementation of cost-effective, high-efficiency non-standard equipment through authorized contractor networks and traditional channels for job scopes, including but not limited to lighting, variable speed drives, and custom measures.

This program was implemented as part of the August 2011 EE&C plan update, after the incorporation of West Penn into the FirstEnergy family of companies in February 2011. Prior to the EE&C plan changes, some the measures offered by this program were included as part of the Custom Applications Program, and Commercial Products Efficiency Program.

Conservation Voltage Reduction Program

Years Reporting Savings: PY4

Program Implementer: West Penn Power

The Conservation Voltage Reduction Program incorporated voltage reduction techniques on select distribution circuits that result in a lower service voltage level, causing a non-transparent reduction of energy consumption and demand by customers. Select substations were recalibrated to deliver a 1.5% lower voltage. The voltage was monitored to ensure that voltage levels did not drop below regulatory requirements.

A.5.2 Demand Response Programs

West Penn Power reported savings from two DR programs in its PY4 annual report but implemented three programs. The impacts from the Customer Load Response Program were reported under the Customer Resources Demand Response Program. Below are descriptions of these programs. Both programs reported demand impacts, and energy impacts were only reported for the Residential Critical Peak Rebate program.

Residential Critical Peak Rebate Rate

Years Reporting Savings: PY4

Program Implementer: West Penn Power

The Residential Critical Peak Rebate Rate was a voluntary DR program that encouraged customers to lower their demand during peak load hours by offering a rate discount or rebate based on a customer's actual demand reduction. The reductions occurred in both predefined and notified peak hours. Customers under this rate needed to have smart meters installed.

Customer Load Response Program

Years Reporting Savings: PY4

Program Implementer: West Penn Power

The Customer Load Response Program allowed West Penn to contract with C&I and GNI customers for demand response during the top 100 hours. West Penn acted as a CSP under PJM Load Management Programs and assisted customers by actively educating and provided help with the transition to market prices, load shaping, and participating in PJM markets. Customers received incentives based on their actual hourly load reduction calculated from their baseline during events called by West Penn. Customers were required to have a smart meter installed in order to participate in the program and were allowed to select the number of hours they wished to reduce demand. The impacts of this program are combined and reported with the impacts of the Customer Resources Demand Response Program.

Customer Resources Demand Response Program

Years Reporting Savings: PY4

Program Implementer: West Penn Power

The Customer Resources Demand Response Program focused on reducing demand during peak hours for small and large C&I and GNI customers through third-party CSPs. West Penn contracted with CSPs to deliver a specific amount of curtailable load, and the CSPs would structure their individual contracts with customers to respond to events from the CSP and called by West Penn. Customer load curtailment amount and hours committed were determined between the customer and the CSP. Three different options were available to CSPs: Mandatory 100 Hour Curtailment Option, Mandatory 50 Hour Curtailment Option, and Voluntary Curtailment Option. The option selected by the CSP determined the type of contract with West Penn, as the CSPs were obligated to perform according to the contracted option. The demand impacts reported for this program also included the impacts of the Customer Load Response Program.

Appendix B Phase I EE&C Plans and Programs – Implementation and Process

This appendix discusses how Phase I was implemented by the electric distribution companies (EDCs) and the statewide evaluator (SWE) and the processes involved in Phase I's implementation, including evaluation activities, meetings, and reporting requirements.

B.1 Introduction

The Pennsylvania Public Utility Commission (PA PUC, PUC, or Commission) was charged by the Pennsylvania General Assembly pursuant to Act 129 of 2008 (Act 129) with establishing an energy efficiency and conservation (EE&C) program. The seven EDCs subject to Act 129[403] were Duquesne Light Company (Duquesne); PECO Energy Company (PECO); PPL Electric Utilities (PPL); the FirstEnergy Legacy Companies – Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), and Pennsylvania Power Company (Penn Power); and West Penn Power Company (West Penn or West Penn Power). In order to fulfill this obligation, on January 16, 2009 the Commission entered an Implementation Order at Docket No. M-2008-2069887.

The Implementation Order required that each EDC file an EE&C plan for approval by the Commission. The filing had to include the following:[404]

1. A detailed plan addressing each of the requirements in 66 Pa. C.S.§ 2806.1(b)(1)(i).[405]

[403] EDCs within the Commonwealth of Pennsylvania with over 100,000 customers are subject to the energy efficiency targets outlined in Act 129.
[404] Implementation Order of 2009, pp. 10-11.
[405] In addition to meeting the requirements laid out in 66 Pa. C.S. §§ 2806.1(a), 2806.1(c) & 2806.1(d), and this Implementation Order, the plans must include the following:
(a) Specific proposals to implement EE&C measures that at least achieve the required consumption reductions.
(b) Specific proposals to obtain 10% of required consumption reductions from units of federal, state, and local governments, to include municipalities, school districts, institutions of higher education, and non-profit entities.
(c) An explanation of how quality assurance and performance will be measured, verified, and evaluated.
(d) A statement delineating the manner in which the plan will achieve the requirements of the program under 66 Pa. C.S. §§ 2806.1(a), 2806.1(c) & 2806.1(d).
(e) Contract(s) with one or more CSPs selected by competitive bid to implement all or part of the plan as approved by the Commission.
(f) Estimates of the cost of implementing the EE&C measures.
(g) Specific measures for households at or below 150% of the federal poverty income guidelines, the number of which shall be proportionate to those households' share of the total energy usage in the service territory.
(h) A proposed cost-recovery mechanism, in accordance with Section 1307, 66 Pa. C.S. § 1307, to fund the EE&C measures, to include administrative costs.
(i) A demonstration that the plan is cost-effective through a TRC test approved by the Commission and that provides a diverse cross-section of measures for customers of all rate classes.
(j) A statement delineating how an annual independent evaluation of cost-effectiveness will be accomplished, as well as a full review of the results of each five-year plan; also, to the extent practical, a description of how the plan will be adjusted as a result of these evaluations.

2. Sufficient supporting documentation and verified statements or testimony or both.
3. Approved contract(s) with one or more conservation service providers (CSPs).
4. Description of the work and measures being performed by CSPs and by the EDC, along with a justification for the allocation.
5. A budget showing total planned expenditures by program and customer class.
6. Tariffs and a Section 1307 cost-recovery mechanism.
7. The Commission-approved consumption forecast for the period June 1, 2009 -- May 31, 2010.
8. A weather-adjustment calculation that meets the requirements outlined in Section H of this Implementation Order.
9. The Commission-approved average of the EDC's 100 highest peak hours during the period June 1, 2007 -- September 30, 2007.
10. A description of the EDC's method for monitoring and verifying plan results.

As noted above, Act 129 required each EDC's EE&C plan to "include a contract with one or more conservation service providers selected by competitive bid to implement the plan or a portion of the plan as approved by the Commission."[406] The Act defined a CSP as "an entity that provides information and technical assistance on measures to enable a person to increase energy efficiency or reduce energy consumption and that has no direct or indirect ownership, partnership or other affiliated interest with an [EDC]."[407] Many programs in the EDCs' Phase I EE&C portfolios were fully implemented through CSPs.

Additionally, each EDC's EE&C plan was required to have "an annual independent evaluation of its cost-effectiveness and a full review of the results of each five-year plan…and, to the extent practical, how the plan will be adjusted on a going-forward basis as a result of the evaluation."[408]. To accomplish this, each EDC contracted with a CSP for evaluation, measurement, and verification (EM&V). Table B-1 lists each EDC and its primary EM&V CSP.

Table B-1: EDCs' Primary EM&V CSPs

EDC	EM&V CSP
Duquesne Light Co.	Navigant Consulting, Inc.
PECO Energy Co.	Navigant Consulting, Inc.
PPL Electric Utilities	The Cadmus Group, Inc.
Metropolitan Edison Co.	ADM Associates, Inc.
Pennsylvania Electric Co.	ADM Associates, Inc.
Pennsylvania Power Co.	ADM Associates, Inc.
West Penn Power Co.	ADM Associates, Inc; Tetra Tech, Inc.

(k) An analysis of the EDC's administrative costs associated with implementing the plan.
406 66 Pa.C.S. § 2806.1(b)(1)(i)(e).
407 66 Pa.C.S. § 2806.1(m).
408 66 Pa.C.S. § 2806.1(b)(1)(i)(J).

Each EM&V CSP was responsible for performing independent evaluations of the EDC programs. These evaluations included impact evaluations, process evaluations, and cost-effectiveness evaluations. The EM&V CSPs were also responsible for performing net-to-gross (NTG) studies to inform decisions about future program modification or changes, as per the 2011 TRC Order.

For each program in an EDC's portfolio, the EM&V CSP developed an EM&V plan that was reviewed by the SWE Team. Each EM&V plan provided a brief description of the program and described the methodologies to be used for its evaluation. In general, the plans included the methodology for estimating savings, planned on-site audit activities, sampling approaches, process evaluation methodologies, NTG issues and methodologies, and cost-effectiveness evaluation issues and methodologies.

The implementation and EM&V processes for all programs generally followed the same steps:

1. Program implementation
2. EDC EM&V CSP evaluation
3. SWE evaluation

Program implementation involved the installation of measures and completion of projects, including estimation of unverified gross savings.

The EDC EM&V CSPs were responsible for providing each EDC with independent and unbiased feedback on program implementation and process, as well as verifying gross savings and evaluating cost-effectiveness calculations. The independent audit consisted of three major components: impact evaluation, cost-effectiveness evaluation, and process evaluation. The EM&V CSPs were also heavily involved with the NTG studies performed by the EDCs and required by the Commission through the 2011 TRC Order.[409]

The SWE conducted audits of the implementation and evaluation of each EDC program. This included oversight of program delivery mechanisms and verification of all results and evaluation processes conducted by each EDC evaluator, to evaluate the credibility and accuracy of the published EDC results. SWE audit findings were used to inform EDC evaluation teams when conducting their actual program evaluations, as well as assess the quality and validity of EDC program evaluations. The SWE audit consisted of three major components: impact evaluation audit, cost-effectiveness audit, and process evaluation audit. The SWE additionally reviewed the NTG analyses performed by each EDC.

[409] See 2011 TRC Order, p. 25.

B.1.1 Guidance Memos

Throughout Phase I, the SWE Team issued 21 Guidance Memos to address issues that were uncovered throughout the EE&C program portfolio implementation process. The Guidance Memos underwent an iterative review process with input from EDC teams and Bureau of Technical Utility Services (TUS) staff. Guidance Memos were not binding as they were not officially adopted by the Commission and may not have reflected the opinions, regulations, or rulings of the Commission.

Table B-2 lists the topics covered in the 21 Guidance Memos.

Table B-2: SWE Phase I Guidance Memo Topics

Guidance Memo Number	Guidance Memo Topic
001	Treatment of LED Lighting
002	Custom Measure Process
003	Sampling Resolutions
004	Calculating Coincident Demand for Non-Weather-Dependent Custom Measures
005	SWE Functional Roles
006	Report Timing Issues
007	Savings Accrual
008	Interim TRM Protocol Approval Process
009	Impact of EISA 2007 on CFL Programs
010	Appliance Recycling
011	Interim Measure Protocol Approval Process
012	Calculating Peak Savings for Weather-Sensitive Measures
013	Clarification for Meter Level and System Level Savings
014	Clarification of SWE Site Inspections
015	C&I Site Inspection Process
016	Sampling Approach
017	Low-Income Savings and Costs Reporting
018	Statistical Reporting of Phase I Savings
019	Application of 15-year Avoided Cost Streams
020	SWE Memorandum Regarding CFLs and Cross-Sector Sales
021	Reporting of Unverified Energy and Demand Savings in Phase I

B.2 Impact Evaluation Process

Table B-3 summarizes the impact evaluation process used throughout Phase I of Act 129.

Table B-3: Impact Evaluation Process

Level	Description	Requirements/Discussion Points
1. Program Implementation • Deemed savings • Partially deemed • Custom/unspecified	M&V protocols and site-specific M&V plans are used to calculate claimed savings • TRM protocols • Interim TRM protocols • Custom measure protocols	1. TRM protocols are used for prescriptive measures 2. Implementers approve M&V protocols for customer measures 3. Savings are claimed using approved protocol
2. EDC Impact Evaluation	EDC evaluator samples program data and calculates realization rate with approved EM&V protocols	1. Statistical sample of participants analyzed 2. Field engineering and site-specific analysis 3. Calculation of realization rates
3. SWE Audited Impact	SWE works with EDC evaluators to audit and ensure accuracy of reported savings and realization rate, or conducts independent sample if needed	1. Collaboration with EDC impact evaluation activities (e.g., joint site visits) 2. Independent site visits and field verification 3. Recommendations to adjust realization rates

Three types of savings protocols could be used to determine unverified gross savings at the program implementation level:

- Technical Reference Manual (TRM) protocols; standard protocols approved by the Commission and in the TRM.
- Interim measure protocols (IMPs); standard protocols approved by the SWE but not yet formally approved by the Commission.
- Custom measure protocols (CMPs); protocols not suitable for the TRM that involve unique variables or whose results are measured directly.

The TRM is a Commission-approved document that is updated and adopted each year as a component of the EE&C program evaluation process and contains protocols that determine savings for "standard measures that warrant standard energy efficiency calculation methods and assumptions,"[410] by either deeming savings or providing an algorithm with open variables to calculate savings.

The original TRM, the *Energy-Efficiency and DSM Rules for Pennsylvania's Alternative Energy Portfolio Standard, Technical Reference Manual*, was adopted by the Commission for implementation of the Pennsylvania Alternative Energy Portfolio Standards Act[411] (AEPS). The Commission had directed the Bureau of Conservation, Economics, and Energy Planning[412] (CEEP) to oversee the implementation, maintenance, and periodic updating of the TRM. With the 2009 Implementation Order, the Commission adopted the TRM as a component of the EE&C program evaluation process, and soon thereafter initiated a collaborative process to review and update the TRM with the purpose of supporting both the AEPS Act and the Act 129 EE&C program.

The Commission ordered an annual update of the TRM, which occurred through the typical stakeholder process, following a Tentative Order, Comment Period, Final Order procedure. For each update cycle of the TRM, a Technical Working Group (TWG) meeting was held to discuss potential changes with stakeholders and other interested parties. Additionally, TRM updates for each year were discussed in detail at Program Evaluation Group (PEG)[413] meetings. All changes made during the TRM update process were prospective and thus did not retrospectively affect savings determinations of program years already completed.

IMPs were standard savings protocols that had been approved by the SWE but not formally adopted into the TRM by the Commission. When the 2009 TRM was developed, not all measures offered in the EDCs' EE&C portfolios were represented in savings protocols in the TRM. Given the research required by the TWG to develop sufficient protocols, the process required by the Commission to issue an order, and the time required by EDCs to update programs consistent with TRM updates, many measures were not adopted in the first TRM update as part of the 2010 TRM Order.[414] Parties expressed concerns that EDCs would be hesitant to offer some measures that could potentially achieve cost-effective savings because without approved protocols, the measures would need to be classified as "custom measures," adding significant complexity, time, and cost to the evaluation and possibly discouraging customer participation in the programs offering these measures. To address these concerns, the IMP approval process was established. It was designed as an informal process intended to minimize the risk for EDCs planning to offer measures that did not have approved TRM savings protocols.

The IMP approval process was described in SWE Guidance Memo 008 (GM-008) and modified in SWE GM-011. The IMP process as described in GM-008 was:

1. EDC submits interim TRM protocols to the SWE Team.

[410] 2009 TRM Order, p. 10.
[411] 73 P.S. §§ 1648.1 – 1648.8.
[412] This bureau is now known as the bureau of Technical Utility Services (TUS).
[413] The PEG comprised TUS staff, SWE Team members, EDCs, and EDC evaluation team members.
[414] Order entered on June 8, 2010, at Docket M-00051865.

2. Protocols undergo iterative review process between the SWE and TWG, and once approved by SWE, achieve “interim approved TRM protocol” status.
3. Interim approval is formalized through e-mail and protocols posted to the SWE SharePoint site.
4. Protocols are included in the next TRM update for formal approval, where they are subject to public comment and additional review.

GM-008 also distinguished between “new measure interim protocols” and “TRM modification interim protocols.” New measure interim protocols were completely new protocols that did not already exist in some form in the TRM or additions that expanded the applicability of an existing protocol, provided the additions did not change the existing algorithms and deemed savings estimates. For this type of interim protocol, approved protocols applied for the entire program year during which it was approved. TRM modification interim protocols were modifications to already existing TRM protocols, when the existing TRM algorithm or deemed savings estimates were affected. Since interim protocols did not have the same legal standing as a protocol in the Commission-approved TRM, this type of interim protocol could not override the TRM protocol and could only be used to inform the next TRM update.

Prior to SWE GM-011, the SWE had been reviewing and approving IMPs in bulk as part of the TRM update process. The EDCs raised concern that reviewing IMPs in bulk during the TRM approval process led to significant delays in IMP approval, and thus a new IMP approval process was established in GM-011. The new process established an IMP tracking spreadsheet, and gave the SWE 10 business days to review an IMP once it was submitted and to suggest revisions to the EDC that submitted it. The EDC then had five business days to submit reply comments to the SWE before the protocol would receive SWE approval. Approved IMPs were filed on the SWE SharePoint site.

Custom measures were defined as measures for which savings calculation methods were not described in the TRM. Generally, this included complex measures requiring metering, logging, modeling, or billing analysis to determine impacts. The initial process for CMP approval was based on the 2009 TRM Order, which stated that the “determination of energy and demand savings for EE&C program custom measures will be based on the M&V protocols as determine by the Commission.”[415] The 2009 SWE Audit Plan set forth the specific CMP approval process by stating

> “[i]t is the intention of the SWE to work with the EDCs, EDC Evaluation Contractors and Conservation Service Providers (CSP’s) in the development of the M&V Plans for custom measures in order to address potential issues before the plans are implemented… Once the SWE approves the M&V Plans, the Commission Officer will verify the approval and the EDC can begin the credible EM&V work. The SWE will maintain a catalog of custom measure protocols and M&V plans in order to expedite the process of developing custom M&V plans for future projects.”[416]

[415] Docket No. M-00051865, May 28, 2009, p. 11.
[416] SWE Audit Plan, December 1, 2009, p. ii. Further details were provided on pp. 118-119.

Under this process, EDCs needed to wait for SWE and Commission approval before implementing a custom measure project.

This original CMP approval process had several issues, as described in SWE GM-002. The first issue was that the original CMP process required that reported and verified savings be determined using the same methodology. This reduced the value of the third-party evaluations to a duplication of the efforts of the program implementation CSP. Since a truly independent evaluation was an important aspect of verifying savings, severing the link between the reported and verified savings of a custom measure resulted in more accurate and unbiased verified savings.

The second issue was that the CMP process in Pennsylvania was not consistent with the industry practices at the time. A more common framework in other jurisdictions was an environment that allowed EDCs to approve or reject custom measures as participants submitted applications, with no state-level requirement of CMP approval prior to implementation. The measure would be implemented with gross savings estimated by the implementation CSP and then verified by the EDC's EM&V CSPs using site-specific EM&V plans. The revised process in Pennsylvania more closely followed these practices.

The third issue was that the original CMP process precluded many projects from being implemented for more than six months, partially due to the difficulty of reaching consensus on a generic savings estimation methodology adequate for all EDCs. Custom measures were defined in the 2009 TRM Order as "more complex measures" involving "unique variables and/or whose results are measured directly,"[417] thus implying that a generic method was not and could not be expected. The approval of a generic CMP prior to approving projects was a formidable barrier to participation and implementation.

The new CMP process, as described in SWE GM-002, did not require EDCs to submit CMPs for each measure and technology type, but gave the SWE the right to audit and review claimed and verified impacts of all custom measures. The EDCs were allowed to report gross savings according to methodologies used by the customers or contractors and approved by EDC implementers but that were subject to general guidelines developed by the SWE Team. The EDCs' EM&C CSPs were then responsible for verifying impacts for a sample of projects using site-specific EM&V plans (SSEMVP) for each project, developed using their professional judgment. The SWE Team then randomly selected a sample of projects to audit the engineering analysis performed and realization rates calculated by the EM&V CSPs.

B.2.1 EDC EM&V CSP Impact Evaluation

The purpose of the EDC independent evaluator impact evaluation was to determine unbiased, program-specific induced benefits. In Phase I, the EM&V CSPs performed gross impact evaluations by using data collected during program implementation or by conducting independent data gathering if the data collected by program implementers were unreliable or insufficient. M&V activities included surveys and direct observation and measurement of equipment performance at a sample of participant sites and

[417] Docket No. M-00051865, May 28th, 2009, p. 10.

balanced the costs of M&V, determined by the level of evaluation detail (rigor), with the value-of-information (VOI) received. Impact evaluations were conducted on an annual basis, and each year the EDCs' EM&V CSPs reported findings for realization rates and thus gross verified savings for each active program.

One of the primary research objectives of an impact evaluation is to calculate the verified gross savings of a program, which are the savings directly achieved by program benefits validated by an independent third-party evaluator. The EM&V contractors verified savings for a statistically significant sample of sites and calculated realization rates which were then applied to the population at large to determine verified gross savings. The types of activities performed to verify the savings depended on the type of measures in the program. Savings protocols for specifics measures were listed in the TRM. The methods of quantifying savings in the TRM fell into three general categories:

- Deemed measures
- Partially deemed measures
- Custom measures

Deemed measures only required a quantification of the number of measures installed to determine savings. The baseline, hours of operation, and total energy and demand impacts were all assumed. Examples of fully deemed measures included residential CFLs and appliances.

Partially deemed measures required quantification of more than one variable to determine savings; the savings algorithms included more than one open variable.[418] Examples of partially deemed measures included commercial and industrial (C&I) lighting and C&I motors. While the baseline conditions and some other variables were assumed, other variables such as number, type, and hours of operation were open.

Custom measures required site SSMVPs for the quantification of savings of a project. Any project with unspecified savings protocols and large, complex projects fell into this category of measures. Some examples included large lighting projects, variable frequency drive (VFD) projects, energy management systems (EMSs), and controls.

EM&V contractors were required to design SSMVPs for each custom measure or project to define how a savings protocol would be implemented in practice, including specifying the data to be gathered and stored for each field measurement. The protocols followed in each SSMVP were within the guidelines established by the International Performance Measurement & Verification Protocols (IPMVP). SSMVPs described the specific M&V methods chosen for each project, field monitoring data points, on-site sampling approaches, and data analysis procedures and algorithms to be used in the verification of project savings.

[418] An open variable can take on more than one value.

In addition to the type of measure, the level of engineering rigor was an important factor in the EM&V CSPs impact evaluation. The level of engineering rigor was defined as the level of detail involved in the verification of the EDC-reported impacts and defined the minimum allowable methods to be used by the EM&V CSPs to verify the savings claimed by the EDC. Two levels of rigor were defined in the evaluation protocols, basic and enhanced. A basic level of rigor required less time and cost than an enhanced level of rigor. The choice between basic and enhanced depended on the type of measure, relative complexity of savings calculations, level of uncertainty, and most important, savings impact. For example, for programs with relatively low impact and high complexity and uncertainty surrounding savings estimation, the additional cost to perform an enhanced instead of a basic rigor evaluation was not worth it from a VOI standpoint. In general, deemed measures followed a basic level of rigor, whereas custom measures followed an enhanced level. Partially deemed measures followed either a basic or enhanced rigor depending on the level of impact and issues surrounding the specific measure.

For energy savings verification, a basic rigor evaluation entailed either verification-only analysis or use of a simple engineering method. Verification-only analysis was performed for TRM deemed measures and involved verifying the number of installations, stipulated operating hours, and other assumptions and inputs used in the TRM savings protocols. Simple engineering methods involved any M&V activities equal to IPMVP Option A for TRM partially deemed measures. Measurements of open variables and other site-specific stipulations in the TRM were taken and applied where appropriate.

For energy savings verification, an enhanced rigor evaluation involved using retrofit isolation engineering methods, fully specified regression analyses, and building energy simulations. Retrofit isolation engineering methods, as described in IPMVP Option B, required full field measurement of all parameters used in estimating the energy use of the system. A fully specified regression analysis, as described in IPMVP Option C, involved analysis of utility billing data, including weather adjustments and adjustment of other key variables that change over time and are potentially correlated with savings, for a program participant to determine the savings from a measure or project. A building energy simulation, as described in IPMVP Option D, involved using computer software to model and predict both baseline energy usage and savings for the participant or project.

For demand savings verification, a basic rigor evaluation required, at minimum, estimating peak savings based on an allocation of gross energy savings through the use of allocation factors, coincidence factors, or end-use load shapes. An enhanced rigor evaluation required primary data from the program participants, whether from interval-metered data, TOU consumption billing data, field measurement, or other methods of primary data collection.

B.2.2 SWE Impact Evaluation

The SWE impact evaluation audit involved reviewing and assessing the realized savings impacts of the EDC EE&C programs. It was segmented into several procedural categories, including:

- Standardizing evaluation protocols.
- Reviewing EM&V plans for completeness and consistency.

- Auditing M&V activities for quality control, accuracy, and mitigation of uncertainty.
- Assessing the achievements of each EDC, and the EDCs combined, in order to evaluate progress toward meeting Act 129 goals.

The standardization of evaluation protocols was outlined in the SWE Audit Plan. The ultimate goal of this process was to continually work toward development of a standardized set of EM&V protocols so that EDC program evaluation could be similar among EDCs. The protocols were developed collaboratively with the EDCs and PUC based on the guidelines outlined in the TRM and TRC Orders.

The review of EM&V plans was an ongoing process through which the SWE worked with EDCs and EDC evaluators to realize the common goal of accurately tracking and reporting realized energy and demand savings.

The SWE audit of EDC EM&V activities included any necessary audit activities required to assess the quality control, accuracy, and uncertainty of EDC EM&V activities and evaluations. The SWE audited both sampled and non-sampled projects in an EDC program, and for a subset of projects, it accompanied EDC evaluators in the field for site inspections or performed independent site inspections. SWE audits also included a review of engineering and statistical calculations and the transference of data into the EDC-specific data tracking and reporting systems. Additionally, for custom projects or instances where there was potential for uncertainty in pre-installation variables, the SWE reviewed project applications and materials to determine the appropriateness of the pre-installation assumptions.

In general, the audit efforts were focused on programs with the highest impact, but the SWE reviewed components of all programs. The level of rigor of the audit activities was ultimately determined by the program design, anticipated impacts, and ultimately, the VOI of performing such audit activities. The audits were performed in an ongoing manner, to mitigate the risk of rejecting any EDC evaluation presented in the final annual report.

Based on the specific audit activities performed and the findings for a particular program, the SWE assessed the EDC-reported impacts both qualitatively and quantitatively depending on the actual audit activities performed and level of rigor. The SWE approved, partially approved, or rejected an EDC’s annual evaluation report. In Phase I there were no instances of partial approval or rejection of annual evaluation reports for any EDC.

During Phase I, the SWE performed annual audit activities on the following types of programs: Residential Lighting, Residential Appliance Recycling, Residential Products Programs and Rebate Programs, Residential New Construction, Residential Low-Income, and Non-Residential. The following sections describe the impact evaluation audit activities performed by the SWE for each of these types of programs in Phase I.

B.2.2.1 Residential Lighting Programs

B.2.2.1.1 Program Year 1

In Program Year 1 (PY1), the SWE team conducted the following activities to verify the savings from residential lighting programs.

1. A review of the savings calculation method, in which the SWE verified that the savings per bulb were calculated using the stipulated method in the TRM

Very few discrepancies were found in this review, and the differences uncovered amounted to less than a 1% savings difference associated with the particular program. The few discrepancies cited by the SWE include a few bulbs in which the savings were calculated in a method not in accordance with the respective algorithm in the TRM.

Based on these findings, the SWE team did not recommend revisions to the reported PY1 verified savings. However, the SWE recommended that each EDC take actions to ensure that any errors identified in the review process do not reoccur in subsequent program years.

2. A review of the base incandescent equivalent assumptions used by each EDC to calculate the savings per bulb based on the TRM savings algorithm

The SWE team verified the assumptions, for a sample of 20 bulbs, against manufacturer specifications when available. Alternatively, the equivalency assumptions were verified against the ENERGY STAR CFL savings calculator, which assumes an equivalency factor of 4.6,[419] or the ENERGY STAR equivalency guidelines.

One discrepancy was found in this review, which affected 5,502 bulbs in the PECO Smart Lighting Discounts Program. PECO assumed a 15W bulb equivalent for the Phillips 75W R30 bulb. According to the manufacturer's specifications and the ENERGY STAR equivalency guidelines, the CFL equivalent for a 75W incandescent should fall between an 18W and 25W CFL. This resulted in a difference of 15.19 MWh/yr (-<0.01% kWh/yr difference) for the Smart Lighting Discounts Program. Based on these findings, the SWE Team did not recommend revisions to the reported PY1 verified savings. However, the SWE Team recommended that each EDC take actions to ensure that any errors identified in the review process do not reoccur in subsequent program years.

3. A database quality review

The SWE Team reviewed each EDC's database for quality and accuracy. The review included a verification of invoice bulb counts and type. Additionally, the SWE Team noted any anomalies or discrepancies that were found during the review.

[419] The incandescent wattage equivalent can be estimated by multiplying the CFL bulb wattage by a factor of 4.6.

The SWE Team found that in the West Penn Power database, 69% of models had unknown or undocumented manufactures and 29% of models had undocumented wattages. The SWE Team learned from this review that West Penn Power assumed 13W CFLs and two bulbs per pack for undocumented wattages or counts by bulb type. Therefore any potential savings associated with discrepancies due to unknown wattage types or multi-pack bulb counts is unknown. The SWE acknowledged these assumptions and, although it prefers accurate counts and wattages, understood that West Penn Power took a reasonably conservative approach in its assumptions.

Additionally, the SWE Team found two duplicate entries and two incorrect bulb counts in the PPL database, and five entries in the FirstEnergy database with negative bulb counts but positive savings values. This resulted in a difference of 43,284 MWh (-0.07% kWh difference) for PPL's Compact Fluorescent Lighting Campaign, 292 MWh (0.09% kWh difference) for Met-Ed's Energy Efficient Products Program, and 68 MWh (0.01% kWh difference) for Penn Power's Energy Efficient Products Program.

Based on these findings, the SWE Team did not recommend revisions to the reported PY1 verified savings. However, the SWE Team recommended that each EDC take actions to ensure that these errors do not reoccur in subsequent program years.

B.2.2.1.2 Program Year 2

In PY2, the SWE Team conducted the following activities identical with those activities in PY1 to verify the savings from residential lighting programs.

1. A review of program databases to verify the accuracy of a sample of measures rebated against invoices

The SWE conducted a thorough review of program databases for rebated measures and compared them against invoices. No issues were identified.

2. A review of the savings calculation method, in which the SWE verified that the savings per bulb were calculated using the stipulated method in the TRM

The SWE conducted a thorough review of savings calculations for each EDC. No issues were identified.

3. A verification of the total measure counts as reported in the EDC's respective annual report

The SWE verified the total bulb counts for each EDC. No issues were identified.

4. A database quality review

The SWE reviewed each EDC's database for quality and accuracy. The review included a verification of invoice bulb counts and type. Additionally, the SWE noted any anomalies or discrepancies that were found during the review.

Several minor issues were identified in the review of Duquesne's database. However, these issues were resolved with Duquesne before publication of the SWE PY2 annual report.

Another issue identified was the demand reduction reported for PECO was a rounded value of the demand reduction reported in PECO's database. The SWE Team did not recommend adjustments to this value in PECO's PY2 annual report, but recommended that PECO increase the granularity of its reported demand reduction so the database matches.

Based on these findings, the SWE Team did not recommend revisions to the reported PY2 verified savings. However, the SWE Team recommended that each EDC take actions to ensure that these errors do not reoccur in subsequent program years.

B.2.2.1.3 Program Year 3

In PY3, the SWE team conducted the following activities identical with those activities in PY1 and PY2 to verify the savings from residential lighting programs.

1. A review of the savings calculation method, in which the SWE verified that the savings per bulb were calculated using the stipulated method in the TRM

The SWE conducted a thorough review of the data tracked in each EDC's database and tracking system to verify they were using the correct savings calculations from the 2011 TRM. No issues were identified.

2. A review of baseline assumptions for a sample of 10 bulbs

The SWE selected a sample of 10 bulbs for the review of baseline assumptions to ensure that CFL wattages fell within the ranges specified in the TRM for each EDC. No issues were identified.

3. A verification of the total measure counts as reported in the EDC's respective annual report

The SWE Team selected five retail invoices per quarter from each EDC's buy-down program to review and verify that the bulb counts were accurately tracked in the EDC's database and tracking system. No issues were identified.

4. A database quality review

The SWE Team reviewed each EDC's database for quality and accuracy. The review included a verification of invoice bulb counts and type. Additionally, the SWE noted any anomalies or discrepancies that were found during the review. The SWE found that all EDCs used the correct values and algorithms, and the correct baseline assumptions from the 2011 TRM.

B.2.2.2 Residential Appliance Recycling Programs

B.2.2.2.1 Program Year 1

In PY1, the SWE Team conducted the following activities to verify the savings from the appliance recycling programs.

1. A review of the savings values within the EDC databases to ensure all values match the appropriate TRM deemed savings value

The SWE confirmed that all EDCs were using the updated values for energy savings of replaced and retired refrigerators from the Pennsylvania TRM. No issues were identified.

2. A verification of participants between each EDC's JACO Work Orders and corresponding database entries

The SWE found a few minor discrepancies in which the data on the JACO Work Order were not consistent with the information in the EDC database. All database errors were communicated with the EDCs and corrected by the time of this report.

B.2.2.2.2 Program Year 2

In PY2, the SWE Team conducted the following activities identical with those in PY1) to verify the savings from the appliance recycling programs.

1. A review of the savings values within the EDC databases to ensure all values match the appropriate TRM deemed savings value

The SWE confirmed that all EDCs were using the updated values for energy savings of replaced and retired refrigerators from the Pennsylvania TRM. No issues were identified.

2. A verification of participants between each EDC's JACO Work Orders and corresponding database entries

The SWE confirmed that all participants' data were consistent in all EDCs. No issues were identified.

B.2.2.2.3 Program Year 3

In PY3, the SWE Team conducted the following activities identical with those in PY1 and PY2) to verify the savings from the appliance recycling programs.

1. A review of the savings values within the EDC databases to ensure all values match the appropriate TRM deemed savings value

The SWE confirmed that all EDCs were using the updated values for energy savings of replaced and retired refrigerators from the Pennsylvania TRM. No issues were identified.

2. A verification of participants between each EDC's JACO Work Orders and corresponding database entries

The SWE confirmed that all participants' data were consistent in all EDCs. No issues were identified.

B.2.2.3 Energy Efficient Products Programs and Rebates Programs

B.2.2.3.1 Program Year 1

In PY1, the SWE Team conducted the following activities to verify the savings from the energy efficient products programs.

1. A review of the savings calculation method or deemed savings value, in which the SWE verified that the savings per rebated measure were calculated using the stipulated method or deemed savings value in the TRM

The SWE found that all EDCs used the appropriate TRM savings value where applicable. The SWE was able to verify that the savings values for energy efficient products programs in the EDCs' annual reports were representative of the respective savings in the EDC databases.

2. A review of 20 rebate applications and corresponding documents against the database entries for each of the seven subject EDCs

The SWE found a few quality control discrepancies between the information presented on the customer's rebate application and the information in the EDC's database. For each discrepancy, the SWE communicated with the EDC and the issue was resolved by the time of this report. Such errors included customers never being rebated for their purchased product; duplicate entries for rebated products, resulting in doubled savings reported for the product; and errors with consistency across product information on the rebate applications and in the EDC database. Since this review, PPL has implemented a "Duplicate Account Number Control" in order to avoid these issues in the future.

3. A verification of total measure counts as reported in the annual report for each EDC

The SWE confirmed that all EDCs used the correct total measure counts as reported in the annual report. No issues were identified.

B.2.2.3.2 Program Year 2

In PY2, the SWE Team conducted the following activities identical with those in PY1) to verify the savings from the efficient products programs.

1. A review of the savings calculation method or deemed savings value, in which the SWE verified that the savings per rebated measure were calculated using the stipulated method or deemed savings value in the TRM

The SWE found that all EDCs used the appropriate TRM savings value where applicable. The SWE was able to verify that the savings values for energy efficient products programs in the EDCs' annual reports were representative of the respective savings in the EDC databases.

2. A review of the program databases, verifying the accuracy of a sample of measures rebated against rebate applications for each of the seven subject EDCs

The SWE found a few quality control discrepancies between the information presented on the customer's rebate application and the information in the EDC's database. For each discrepancy, the SWE communicated with the EDC and the issue was resolved by the time of this report. For example, in Duquesne's quarter one check, the SWE found a customer that had two appliances on his rebate application and only one corresponding receipt for one appliance. Duquesne's database only had record of one appliance. The SWE informed Duquesne and the other EDCs in the latter part of PY2 that the SWE would be using the EDCs' residential database to choose the sample in order to get a higher level of confidence.

3. A verification of total measure counts as reported in the annual report for each EDC

The SWE confirmed that all EDCs used the correct total measure counts as reported in the annual report. No issues were identified.

B.2.2.3.3 Program Year 3

In PY3, the SWE Team conducted the following activities identical with those in PY1 and PY2) to verify the savings from the efficient products programs.

1. A review of the savings calculation method or deemed savings value, in which the SWE verified that the savings per rebated measure were calculated using the stipulated method or deemed savings value in the TRM

The SWE found that all EDCs used the appropriate 2011 TRM savings value where applicable. The SWE was able to verify that the savings values for energy efficient products programs in the EDCs' annual reports were representative of the respective savings in the EDC databases.

2. A review of the program databases, verifying the accuracy of a sample of measures rebated against rebate applications for each of the seven subject EDCs

The SWE requested samples of each EDC's customer rebate applications and corresponding database entries for each quarter. The SWE checked these participants' rebate applications, including copies of receipts for purchased equipment, against the EDC's database. The SWE found that all EDCs' samples of participants had active accounts and that all measures that were rebated were on the approved list. No quality control errors were found in the PY3 samples.

3. A verification of total measure counts as reported in the annual report for each EDC

The SWE confirmed that all EDCs used the correct total measure counts as reported in the annual report. No issues were identified.

B.2.2.4 Residential New Construction Programs

Only Met-Ed, Penelec, and Penn Power had active new construction programs in Phase I of Act 129. The SWE performed a desktop audit on residential new construction programs on an annual rather than quarterly basis, as total portfolio impacts are relatively small.

At the end of each program year, the SWE selected a representative sample of homes from each EDC evaluator's sample to conduct the desktop audit. The SWE selected homes representing a variety of the builders who received incentives through new construction programs. The SWE desktop audit involved multiple steps: REM/Rate[420] verification; demand savings verification; appliance and lighting savings verification; and construction verification. In general, the SWE checked for consistency with TRM standards in the baseline model, for proper calculation and accuracy of REM/Rate results, for proper usage of TRM algorithms, and for proof of completed construction through builder certificates and on-site photographs taken by the EDCs' program evaluators.

The REM/Rate verification step required reviewing all modeling inputs and results for the selected SWE sample of homes. Per the TRM, REM/Rate is used to estimate energy savings results for weather-sensitive measures (e.g., HVAC equipment upgrades, insulation upgrades).

Demand savings verification involved checking that the algorithm provided in the TRM for estimating demand savings was being used and applied correctly.

Appliance and lighting savings verification involved checking that the methodology used by the EDC evaluator to estimate the appliance and lighting savings conformed to the TRM algorithms for high-efficiency lighting and appliances.

Construction verification involved review of builder certificates, unique premise ID numbers, and program evaluator's on-site photographs to confirm completed construction of the homes.

In its PY2 evaluation of new construction programs, the SWE found that the EDCs were not following the savings protocols in the TRM. While the TRM requires a combination of REM/Rate reported savings and TRM algorithm savings, the EDCs were only reporting REM/Rate-generated savings. Through contact with the EDCs' EM&V CSP, the SWE ensured that the proper savings protocols would be used going forward. Additionally, the SWE and EDCs' EM&V CSP found two systematic errors with the REM/Rate modeling system. The first issue was that REM/Rate was adding a fixed amount of savings to each home without mechanical ventilation by assuming that a mechanical exhaust fan existed in the baseline home but not in the as-built home. The second issue was that REM/Rate did not always properly model ground-source heat pumps. Both of these issues were corrected through communication with the program's implementation CSP.

B.2.2.5 Residential Low-Income Programs

In Phase I of Act 129 each EDC was required to offer specific energy conservation measures to low-income households that were "proportionate to those households' share of the total energy usage in the service territory." Low-income households were defined as those that were at or below 150% of federal poverty income guidelines.[421] The 2010 Low-Income Working Group used 2008 Pennsylvania State University Census Data for the number of low-income households, residential customer counts

[420] REM/Rate is a software product that can compare a newly constructed or retrofit home to a baseline home and estimate savings from installed energy efficiency measures. REM/Rate was used by the program implementer for Met-Ed, Penelec, and Penn Power to determine if homes qualified for incentives under the residential new construction programs.
[421] 66 Pa.C.S. §2806.1(b)(i)(G).

provided by the EDCs, 2009 energy usage data for residential and low-income customers, and total consumption from the 2009 annual resource planning reports to estimate the baseline usage of low-income households and the percentage of consumption attributable to low-income households for each EDC. These low-income consumption percentages, shown in Table B-4, were adopted for the duration of Phase I as the minimum percentages of specific measures that must be offered to low-income households to be compliant with Act 129.[422]

Table B-4: Low-Income Consumption Percentages by EDC

EDC	% kWh Usage Low-Income Households vs. Total Consumption
Duquesne	7.88%
PECO	8.05%
PPL	8.64%
Met Ed	7.84%
Penelec	9.51%
Penn Power	8.16%
West Penn Power	8.50%

The SWE annually verified that EDCs were in compliance with their low-income percentage of measures target by requesting a measure list from each EDC that detailed all measures offered across all programs and those measures that were offered specifically to low-income customers. These lists were checked against the percentages of low-income measures reported in EDC annual reports (and shown in Table B-4).

In addition to verifying compliance with the low-income measure target, the SWE audit of EDC low-income programs included:

- Site inspections and reviews of site inspection reports,
- Checking for consistency with the TRM and EDC custom measure protocols, and
- Ensuring that EDC database extracts were consistent with quarterly and annual reports.

The SWE conducted low-income site inspections for all EDCs in the early portion of Phase I. The site inspections were aimed at ensuring that measures were being installed correctly, invoices and site inspection findings were consistent with EDC tracking databases, energy savings opportunities were being addressed, and contractors correctly collecting information on space heating and domestic water heating fuel types. The SWE aimed to complete 10 inspections per EDC per quarter. In PY2 the SWE became aware that several EDCs were using third-party inspectors to collect information similar to that being collected during SWE inspections. After reviewing a sample of third-party inspector reports, the SWE issued guidance stating that EDCs could submit an SWE-selected sample of 10 site inspection

[422] Report of the Act 129 Working Group. March 19, 2010. Docket No. 2009-2146801.

reports per quarter for a desktop review in lieu of the SWE conducting additional site inspections. The guidance outlined the data collection requirements of the third-party inspector and the information to be provided by the EDC to meet the SWE's audit requirements. The goal was to obtain valuable site inspection information while making the most efficient use of resources. The guidance also extended the opportunity to EDCs that did not already conduct a sufficient number of site inspections of low-income installations to do so going forward, provided a third-party inspector conducted the inspections. In addition to efficiency gains, this change in site inspection practices alleviated EDCs' concerns associated with recruiting and scheduling participants for site inspections over the course of a few days. For any EDC not exercising the option to conduct the site inspections, the SWE continued to complete 10 site inspections per quarter. After the third quarter of PY3, only PECO elected to continue to have the SWE conduct low-income site inspections. All other EDCs used third-party inspectors.

After conducting site inspections or reviewing third-party inspector reports, the SWE provided feedback to the EDCs if there were consistent issues of missing measures, incorrectly installed measures, poor quality of work, poor documentation, etc. For example, in some cases the SWE found that smart strip plug outlets were installed in a manner that was not saving energy. The SWE recommended that the EDCs emphasize with CSPs the importance of installing measures correctly and educating customers on the energy saving function of the smart strip plug outlets.

The site inspection process also involved verifying that invoiced measures were correctly reported in EDC database records. The first purpose of this portion of the low-income audit was to confirm that invoice records and site visit findings were consistent with the database records in order to ensure that installed measures were being correctly reported by EDCs. The SWE generally found few inconsistencies between the invoices and database records.

The second purpose of the invoice and database review portion of the audit was to confirm that customer heating fuel information was accurately reported. Some of the EDCs had Act 129 weatherization programs that were extensions of their existing Low-Income Usage Reduction Programs (LIURPs). The M&V of energy and demand savings of those programs involved a statistical billing analysis at the job-type level. Job types were based on both the types of measures installed and heating fuel (space heating and, in some cases, water heating). Therefore, in reviewing the site inspection reports, the SWE confirmed that the heating fuel type and installed measures reported in the site inspection reports were consistent with EDCs' job-type classifications recorded in the database records.

The final step in the SWE audit involved verifying low-income measures energy and demand savings. This step included reviewing savings calculations at the measures level for all installed measures subject to site inspections, and a sample of installed measures per the database records but not subject to site inspections. For all measures with savings deemed by the TRM, the SWE verified that the energy savings calculations were in accordance with the applicable TRM. If any discrepancies were found, the SWE discussed with the EDC for resolution. Lastly, at the conclusion of each program year the SWE verified that any EDC adjustments to deemed variables in measures savings calculations were supported by EDC evaluator survey data.

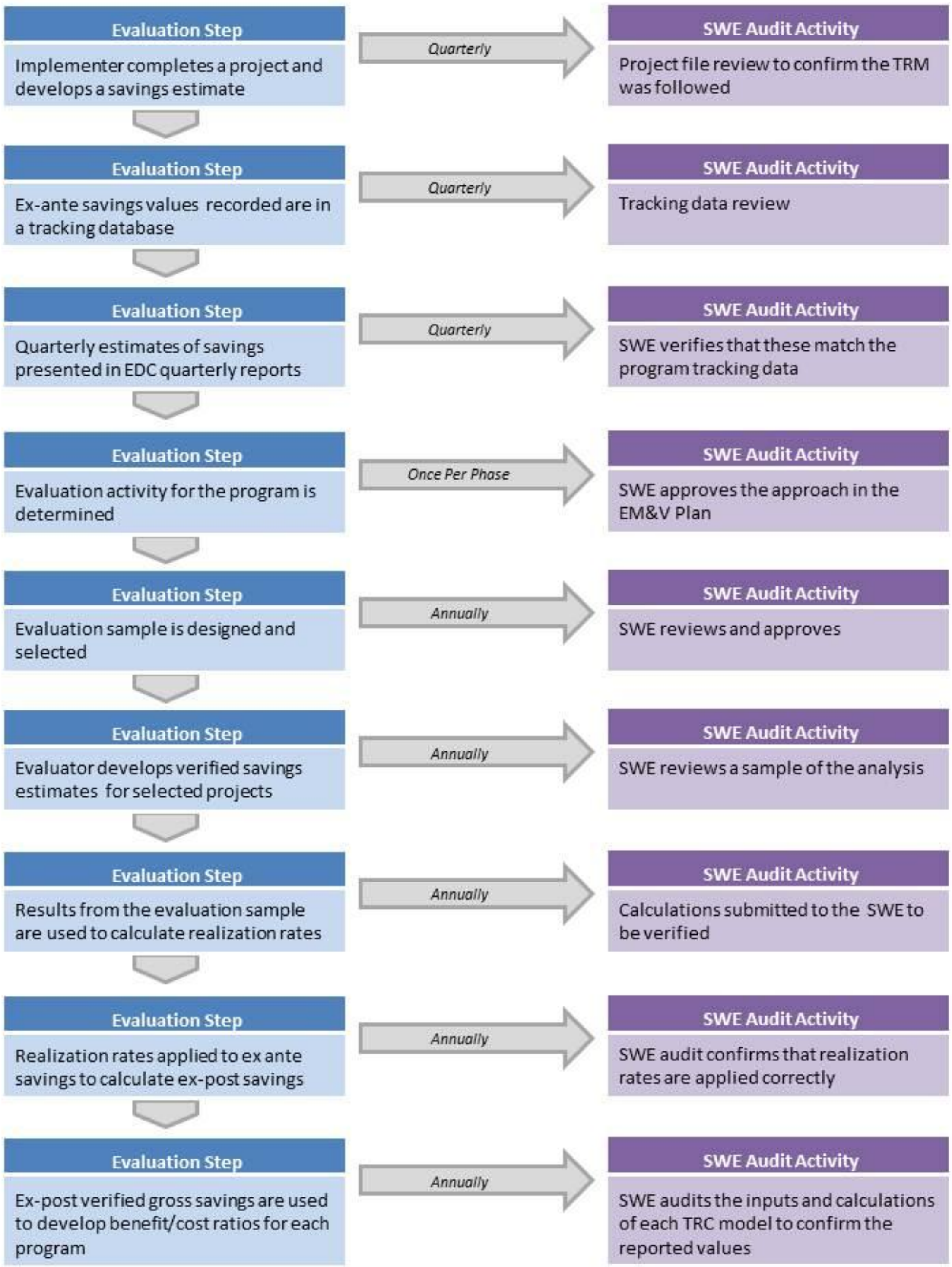
B.2.2.6 Non-Residential Programs

SWE audit activities are intended to give the Commission confidence in the accuracy and reliability of the verified energy and demand savings reported by each of the Pennsylvania EDCs toward the mandated consumption reduction targets. Moreover, the SWE audit activities ensure proper implementation of EDC EE&C programs and evaluation of such programs in a manner consistent with the 2009 and updated 2011 SWE Audit Plan. The audit plan enabled the establishment of common metrics that were used to make accurate comparisons among EDC programs. Each step of the program implementation and evaluation process was individually audited by the SWE and is diagramed in Figure Figure B-1Figure .The tasks captured in the diagram can be grouped into six general activities:

- Desk reviews of project files to verify that TRM algorithms and values were used in the reported savings calculations.
- Review of program tracking data to confirm that the data matched both: the savings impacts in the project files' supporting documentation and the ex-ante impacts reported in the EDC quarterly and annual reports.
- Review and approval of sample designs submitted by the EDCs' evaluation contractors.
- Performing ride-along and independent site inspections.
- Audit of the M&V approaches used by the EDCs' evaluation contractors to determine verified savings estimates for sampled projects.
- Verifying the inputs and calculations of program and portfolio TRC ratios.

Each of these general activities is discussed in further detail in the following subsections.

Figure B-1: SWE Audit Activities of Program Implementation and Evaluation Process



B.2.2.6.1 Project File Reviews

The SWE performed desk audits of project files that were submitted as part of the SWE quarterly data request. Project file reviews are designed to audit the accuracy of the savings values stored in the program tracking database and confirm that calculations are being performed in accordance with the applicable TRM. In the case of custom measures, where there isn't an applicable TRM protocol, the project file review focuses on whether the methodology used to calculate savings is reasonable and well documented. The uploaded project files included project-level savings calculation workbooks, specification sheets for equipment installed, invoices, customer incentive agreements, and post-inspection forms.

The SWE verified many key aspects of each project file reviewed and provided feedback and recommendations to the EDC and EDC implementer when appropriate. These key aspects included:

- Proper use of TRM: appropriate TRM version, correct algorithm, correct lookup value, etc.
- Any assumptions made were reasonable
- Equipment quantities matched on all applicable forms: invoices, calculation workbooks, incentive agreements, post-inspection forms
- Appropriate energy savings calculations and values were used for any custom measures
- Energy savings, peak demand savings, and rebate amounts called out in the project files matched what was stored in the program tracking

B.2.2.6.2 Ride-Along and Independent Site Visits

Site inspections are essential to the accurate evaluation of programs and represent a significant portion of the EDCs' EM&V efforts for non-residential programs. Because of the importance of this task, the SWE worked closely with the EDC evaluators to ensure that site inspections were carefully planned and executed. This guidance took the form of primarily two activities conducted by the SWE: joint impact evaluations, or "ride-along inspections," and independent evaluations.

In the ride-along inspections, the SWE accompanied the EDC evaluation contractors to assess performance of the evaluation activities. The SWE selected a subset of the EDC evaluation contractors' selected projects for site inspections for the ride-along inspections; the SWE selection was based on either measure diversity or high-impact projects. Ride-along inspections were valuable because the interaction between the SWE auditor and the EDC evaluation contractors proved to be constructive. SWE suggestions and corrective actions were immediately incorporated by the EDC evaluation contractors into their audit practices for all of their inspected project audits going forward. Similarly, any questions that the SWE auditor had for the EDC evaluation contractors were answered quickly and efficiently.

Following the ride-along site inspections, the SWE issued site inspection reports (SIRs) to the EDCs and the EDC evaluation contractors. The reports included site visit findings, a review of the evaluation contractor's analysis, and if necessary, recommendations for the evaluation contractor, EDC, or SWE action items. The evaluation contractor reviewed the SIRs and provided feedback to the SWE. When necessary, the evaluation contractors revised their savings calculations and the SWE subsequently revised the SIRs to reflect the changes. In many cases, SWE SIRs resulted in both quantitative and qualitative modifications to evaluation procedures, ensuring that impacts reported by EDCs were in compliance with statewide standards.

In the independent site inspections, the SWE audited projects without the EDC evaluation contractor present. The SWE selected high-impact projects to audit. The independent inspections provided a check against potential audit bias, which might occur if the SWE's presence on the ride-along inspections influenced the findings of the EDC evaluation contractors. The SWE then submitted its independent SIRs to the appropriate EDC with observations on the project's performance and energy and/or demand savings estimates for comparison with the EDC's claimed or reported savings.

When applicable, the SIRs also included recommended changes to evaluation practices. Generally, the recommendations were categorized into three groups:

- Evaluation findings are associated with ride-along site inspections, and may reflect site activities or evaluator savings calculations and/or reports.
- Process findings are associated with project applications, documents, or implementation activities.
- TRM findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

B.2.2.6.3 Program Tracking Data Review

In accordance with the data request titled "Act 129 Quarterly Data Requests – Updated C&I Sections" issued on December 7, 2011, each EDC was expected to submit its up-to-date program tracking database on a quarterly basis. Once received, the SWE checked for consistency between the project file documentation, tracking database and ex-ante impacts claimed in the EDC quarterly and annual reports. Checking for consistency between individual project file documentation and tracking systems was performed as part of the project file review discussed above in section B.2.2.6.1 of this appendix.

The consistency between the tracking system impacts and impacts noted in the quarterly and annual reports was verified for each EDC report using the following equation:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Discrepancy}$$

Discrepancies were calculated within each program and at the portfolio level for the following figures: participants, MWh, MW, and incentives. If any discrepancies were realized, the SWE investigated and discussed the nature of the root cause and, when applicable, provided recommendations for future database and report submissions.

B.2.2.6.4 Evaluation Sample Design Review

The SWE was charged with ensuring that a proper sample was selected by each EDC evaluator in accordance with the audit plan. The key pieces of each evaluation plan reviewed for compliance were:

- Achieving a minimum annual confidence and precision of 90/10 for the non-residential portfolio.
- Achieving a minimum annual confidence and precision of 85/15 for each non-residential program.
- Separation of government/education/institutional (GNI) commercial projects when the energy savings from GNI projects accounted for greater than 20% of the non-residential sector savings.
- Appropriate initial error ratio or coefficient of variation estimates based on industry standards or previous program year data.
- Appropriate stratification of programs.
- Appropriate level of rigor used in M&V activities.

After reviewing each sample plan, the SWE provided recommendations concerning corrections to the plans and improved adherence to industry standards and best practices.

B.2.2.6.5 Verified Savings Analysis

In an effort to strengthen the M&V approaches used by the EDCs' evaluation contractors to determine verified savings estimates for sampled projects, the SWE reviewed, analyzed, and provided feedback on verified savings methodologies used.

The SWE first reviewed each EDC evaluation contractor's evaluation sample as a whole. Key aspects the SWE examined included types of M&V used (e.g., simple verification, Option A, Option B, etc.), the frequency with which each M&V approach was used, and the frequency with which end-use metering was used. If stratification was used, the strata definition and size were also examined and evaluated for their impact on M&V type. The SWE also checked the evaluation sample for adherence to the previously submitted EDC EM&V plans and the audit plan.

In addition to reviewing each evaluation sample as a whole, the SWE also reviewed 5 to 10 projects from each sample in accordance with the SWE annual data request. Data requested for each specific project included SSMVPs, calculations, and site inspection photos and reports. From these materials, the SWE evaluated each EDC evaluation contractor's savings verification approach. Key elements that were reviewed included appropriate use of values and calculations, appropriate level of rigor, and administrative or calculation errors found. The SWE provided feedback on the effects these elements have on the project's ex-post savings and realization rate.

After the review, the SWE developed recommendations concerning specific project comments and general M&V approaches. The SWE's concurrent review of the evaluation samples as a whole and individual project analyses enabled the SWE to provide more relevant and useful recommendations to the EDC evaluation contractors concerning their M&V practices. The results of these EDC-specific reviews for PY4 are presented in Appendix F.3.1 of this report.

B.2.2.6.6 TRC Analysis Review

This portion of the audit process is covered in more detail in Appendix F.7 of this report.

B.2.2.7 Demand Response Programs

In Phase I of Act 129, each EDC made available some combination of the following demand response (DR) programs to its non-residential customers:

- Direct load control (DLC) switches
- Programmable communicating thermostats (PCTs)
- Load curtailment
- On-site generation

Measurement and verification of the DR programs was to be provided in accordance with PJM Manual 19, Attachment B[423] as is specified in the Pennsylvania PUC's Secretarial Letter of January 12, 2011.[424] The letter states:

> ". . . the PJM measurement and verification (PJM M&V) protocols for the PJM economic demand response programs, in effect for the PJM delivery and planning year beginning in June 2012 through May 2013, will be used as a basis for the Act 129 Statewide Evaluator's measurement and verification for Act 129 load curtailment performance."

In accordance with these protocols, the SWE performed a number of audit activities to confirm the accuracy of the savings values reported by the EDCs. On July 6, 2012, the SWE issued a data request which requisitioned the following from each of the seven subject EDCs:

- General Program Information

  Due as soon as possible, this was to include EM&V plans for each program offered within the EDC's portfolio, results of a load research study if and where applicable, program plans, program manuals, and program marketing materials.

- Program Tracking Data

  Due November 15, 2012, this was to be an MS Excel file detailing unique participant identifiers, customer names and service addresses, equipment or end-use details, customer sectors, pertinent dates (installation or removal), total incentive amounts, structures or methods for determining savings, and any other relevant customer details.

- Event-Specific Information

[423] PJM Manual 19: Load Forecasting & Analysis, is available at www.pjm.com/~/media/documents/manuals/m19.ashx.

[424] The January 12, 2011 Secretarial Letter is available at www.puc.state.pa.us//pcdocs/1118187.docx.

Due November 15, 2012, this was to be an MS Excel file detailing dates and ending hours of events called, numbers of participating devices or premises, reported or claimed demand reductions, incentive amounts paid for reductions, and pertinent weather data.

- Detailed Project Files

Due 10 business days after the sample was selected by the SWE, this was to include specification sheets of equipment installed, customer applications and work orders, methodologies used to calculate load reductions where applicable, and customer interval data.

Once all responses to the data request were received, the SWE examined the program tracking data and detailed project files for consistency across all documentation and for compliance with PJM protocols. For all programs where savings were directly measured and reported, the SWE audited the number of customers reported, number of participating devices, customer size, and weather data. In some cases, savings calculations were adjusted to account for differences in weather data between hot and humid PJM emergency event conditions and the milder conditions of the Pennsylvania top 100 hours.

Residential DR Audit Process

EDC EM&V plans and the response to the SWE DR Data Request were the primary data sources for the SWE audit activities of residential DR programs. As the residential programs primarily implemented the direct load control switches, the bulk of the returned information consisted of program and event tracking databases containing:

- The dates of the event.
- Participant information to include descriptions of the equipment being controlled.
- Event hour ending in eastern daylight.
- Control Strategy Imposed
- Number of participating devices.
- Reported demand reduction per device or deemed savings value assigned.
- Temperature (or other weather variables) used to assess load reduction during the event hour.

The SWE performed an analysis of the evaluation contractor's tracking data submittal as well as the EM&V plans submitted with the data. Multiple parallel algorithms were placed into the database extract in an attempt to match the results of the evaluation contractors' deemed or measured savings totals. In instances where the discrepancies were substantial, the SWE requested additional detail from the EDC or evaluator. Further detail for each residential demand response program is provided in Appendix B.2.2.7.

Non-Residential DR Audit Process

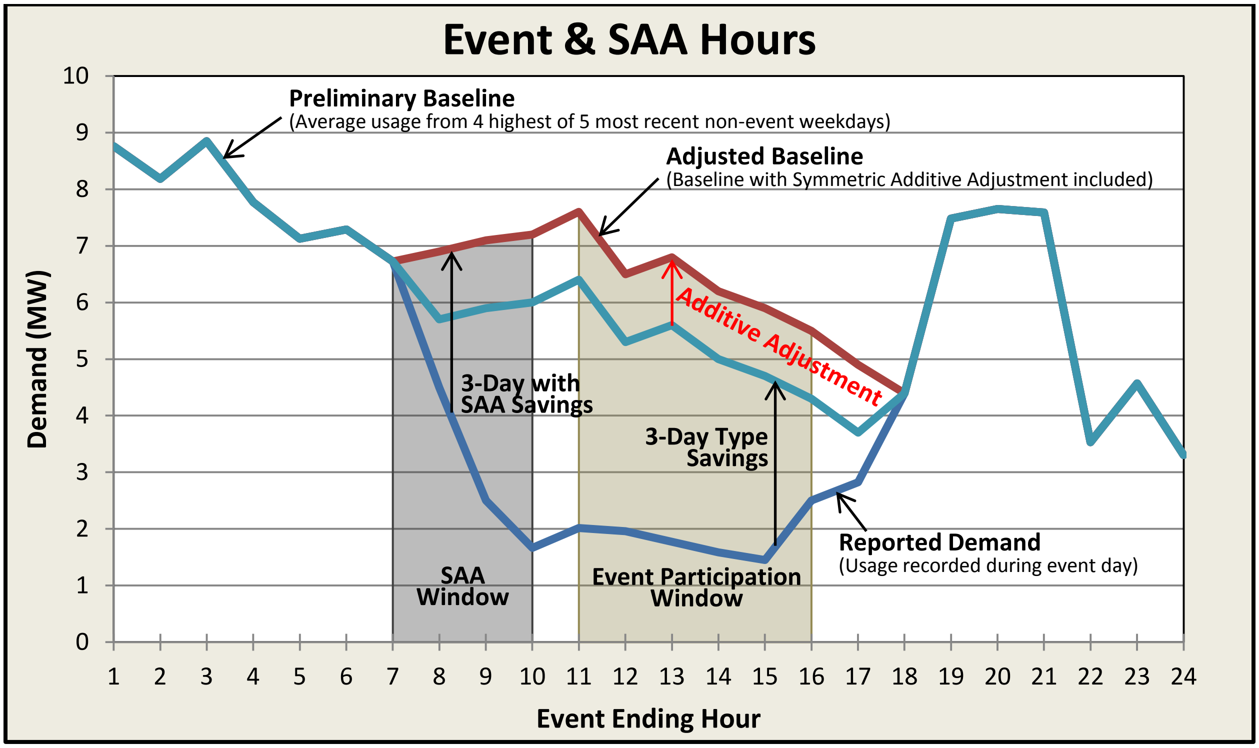
Load curtailment produced the majority of the peak demand savings achieved by non-residential DR offerings. Unlike a DLC or PCT program where an average savings per participant value is appropriate, the populations of the load curtailment programs are extremely heterogeneous, requiring each event in each facility to be analyzed individually. In order to calculate savings, a customer baseline, or estimate of how much energy the facility would have consumed if there hadn't been an event called, must be developed and compared with the actual consumption during the event. The difference between the measurement and the counterfactual estimate of load in the absence of program intervention is the load reduction estimate. Some EDCs elected to have these calculations performed both by utility staff or program CSPs and by a third-party evaluation contractor, whereas others relied solely on the outcome of the verified savings analysis of the evaluation contractor. Once all evaluations were performed and the results submitted, the SWE verified the tabulation of the reported impacts and incentive payments for all customers. The SWE also performed independent parallel analyses for each of the five largest customers within each EDC's program, using the interval load data submitted with the detailed project files.

The Operating Agreement for PJM Interconnection outlines three different methodologies for calculating customer baselines, against which the reported usage was measured and savings quantified:

- 3-day type
- 3-day type with symmetric additive adjustment (SAA)
- Custom

The standard method is the 3-day type, where usage is tabulated over the highest four of the five most recent non-event[425] weekdays. The average usage over the corresponding four non-event hours are used as the baseline for each event hour. For variable or highly weather dependent loads, the SAA can be included. The SAA takes into account the three hours ending one hour before the start of the event where usage is being ramped down from baseline to recorded usage. Figure B-2 depicts this graphically.

Figure B-2: Comparison of Customer Baseline Methodologies



The Operating Agreement of PJM Interconnection allows for a third method of baseline selection in the event that the preceding methods do not accurately reflect the end-use customer's consumption pattern. The custom method allows a customer to propose its own baseline that results in an hourly relative root mean square error of 20% or less compared with actual hourly values.

The evaluation contractors and EDCs (where applicable) provided analyses for multiple different baseline methodologies and selected those that garnered the most accurate representation of the customer load. The SWE was able to verify this in its parallel analyses. Further details on the findings of these analyses are presented in Appendix F.3.1.

B.2.2.8 Behavior Modification Programs

[425] Both Act 129 and PJM events are excluded from the calculation of customer baselines.

During PY4, the SWE reviewed savings reported by EDCs for behavior modification programs. The evaluations performed by all EDCs' EM&V CSPs were similar to the methodology described in the EM&V plan submitted by the PPL evaluator to the SWE Team for PPL's Energy Efficiency and Behavior Modification Program.

Savings for behavior modification programs were determined using regression analysis of monthly billing data for both the control group of homes and treatment group of homes.[426] The results of the regression analysis were the total savings for participants in the behavior modification program. However, the EDC could not claim all of the savings determined from the regression analysis because some of the savings were already counted in other EDC programs. For example, if a participant in the behavior modification program purchased a refrigerator through the EDC's appliance rebate program, the savings for that refrigerator might be counted twice if the control group and treatment group have disproportionate participation in that program. For programs that tracked participants, such as appliance rebate programs, finding the overlapping participants and subtracting the double-counted savings was simple and only required a check in the rebate programs' databases for overlapping participants. For programs that did not track participants, such as upstream lighting programs, estimating the overlapping participants and double-counted savings was more difficult. The EM&V Plan stated that surveys of behavior modification program participants and non-participants would be used, combined with surveys of customers purchasing CFLs through the upstream lighting program, to estimate the double-counted savings.

One of the EM&V CSPs was unable to determine the upstream CFL purchases using the process evaluation surveys already being performed as the sample size was not large enough to statistically determine the difference. The EM&V CSP performed a statistical power analysis to see what sample size would be required to statistically determine the CFL savings in the behavior modification program and determined that a significantly larger and unrealistic sample size would be required to detect the CFL savings. The EM&V CSP therefore did not subtract any savings from the regression results to account for the possibility of potential double-counted CFL savings. As part of the behavior modification program is to educate participants about CFLs and their energy efficiency benefits, the SWE Team determined that there was reason to believe that some CFL savings overlap did occur and that a different methodology for estimating the overlap was required. The EM&V CSP suggested, and the SWE Team approved of, a new, ratio-based methodology for estimating the CFL savings overlap moving forward. The new methodology estimated the CFL savings in the behavior program by multiplying the percentage of behavior program savings from rebate programs by the ratio of the percentage of residential portfolio savings from CFLs to percentage of residential portfolio savings from rebate programs.[427]

B.3 Process Evaluation

[426] The control group of homes did not receive home energy reports, which were the means through which behavior modification was achieved.
[427] Behavior program CFL savings = Behavior program rebate savings* (% of residential portfolio savings from CFL programs / % of residential portfolio programs from rebate programs).

The primary purpose of a process evaluation is to provide an assessment of one or more program-related characteristics in order to provide specific highly detailed recommendations for program changes. Process evaluations include reviewing program design, program administration, program implementation and delivery, and market response. Process evaluation recommendations are typically designed to affect areas of a program's operational practices (e.g., marketing, program delivery bottlenecks, internal communications, the incentive application process) to ensure the cost-effective achievement of savings and program goals and help highlight areas for improvement and identify best practices that can be implemented on a going-forward basis.

B.3.1 EDC Process Evaluation

Each EDC conducted process evaluations in Phase I. The evaluations used interview and survey techniques to describe and assess program operations, which were compared with original design intent, as well as to measure participant satisfaction and program performance. These results were then analyzed to identify gaps between program goals and results. This analysis provided conclusions and recommendations for enhanced program performance.

Each EDC provided Process Evaluation Reports or memos which detailed the EDC's methodologies, findings, and recommendations. The following sections present the general methodologies for each EDC. The process evaluation recommendations and actions are presented in Appendix D.

B.3.1.1 Duquesne

In PY4, Navigant evaluated Duquesne's programs based on the following information.[428]

Residential:

- Program documentation available from public utility commission filings
- Program-specific information on Duquesne's website
- Interview with Duquesne's residential coordinator
- Program logic model supplied in Duquesne's EM&V plan
- Program performance as reported in Duquesne's Project Management Reporting System (PMRS) (DSM tracking) system
- Customer surveys conducted during verification of the quarterly savings
- NTG calculations for Residential Energy Efficiency Program, Residential Appliance Recycling Program, and Low-Income Energy Efficiency Program

C & I:

- Program documentation available from public utility commission filings
- Program specific information on Duquesne's website
- Interview with Duquesne program staff and CSP staff

[428] See Duquesne PY4 Process Evaluation Report.

- Program logic model supplied in Duquesne's EM&V plan
- Customer surveys conducted during verification of quarterly savings
- Program performance as reported in Duquesne's PMRS (DSM tracking) system

B.3.1.2 PECO

The purpose of PECO's process evaluation was to examine satisfaction with and the effectiveness of:

- Program design and protocols for implementation
- Implementation of those protocols and procedures
- Marketing materials and strategies
- Outreach and recruitment activities
- Documentation and compliance with incentive eligibility requirements
- Processing and timely payment of incentives

The process evaluations conducted during the operation of the programs were used to improve program design and implementation procedures within that planning cycle. Final process evaluations were used to revise the programs, as appropriate, for the next planning period. They assessed the effectiveness of using CSPs to implement programs and identified additional opportunities for CSPs to support program development or activities (e.g., provide technical expertise, contractors/auditor/staff training, marketing strategies and materials, specific promotional events).[429]

The methodologies used included:[430]

- Interviews with a sampling of, at a minimum, participants, non-participants, contractors, and trade ally staff.
- A random sampling of customers for surveys, determined by using common statistical methods.
- Telephone, in-person, or on-line surveys of participants to understand their satisfaction with the program, why they chose to participate, how the program could be improved, and their views on the incentive levels.
- Similar surveys with non-participants to understand why they chose not to participate, their views on incentive levels (and what level of incentive would be necessary to move them to participate), and recommendations on how to improve the program. This information was valuable in understanding market barriers that inhibit greater acceptance of the measures.
- Interviews with contractors and trade allies to gauge their understanding of how the program works and to get frontline assessment of the market. Suggestions on program improvement, staff motivation, contractor incentives, and customer attitudes provided valuable feedback.
- The data were analyzed and process improvement recommendations outlined.

[429] PECO Energy Efficiency and Conservation Plan Program Years 2009-2012, p. 205.
[430] ibid, p. 205.

Table B-5 shows the evaluation activities conducted for each PECO program in PY4[431].

Table B-5: PECO Process Evaluation Activity in PY4

Program	PECO Process Evaluation Activity in PY4							
	Participant Survey	Program Staff Interviews	Tracking Data	Program Materials Review	In-Store Shelf Survey	Retailer Survey	Trade Ally Interview/ Survey	Mystery Shopper Survey
Low-Income Energy Efficiency	X	X	X	X	-	-	-	-
Smart Lighting Discounts	-	X	X	X	X	-	-	-
Smart Appliance Recycling	X	X	X	-	-	X	-	-
Smart Home Rebates	X	X	X	-	-	-	X	X
Smart A/C Saver	X	-	X	X	-	-	-	-
Smart Equipment Incentives	X	X	X	X	-	-	X	-
Smart Construction Incentives	X	X	X	X	-	-	-	-

B.3.1.3 PPL

The purpose of PPL's process evaluation was to identify opportunities and offer recommendations to improve the effectiveness of PPL's energy efficiency programs from the standpoints of design and implementation, enrollment processes, marketing and outreach, quality assurance, and other elements.

While the process evaluation activities varied by program, the main actions taken were:

- Participant and non-participant surveys
- NTG benchmarking research
- Database and records review for quality assurance (QA) and quality control (QC)
- Stakeholder interviews
- On-line trade ally survey

[431] Information in the table is from the PECO PY4 Process Evaluation Report.

Table B-6 shows the evaluation activities conducted for each PPL program in PY4[432].

Table B-6: PPL Process Evaluation Activity in PY4

Program	PPL Process Evaluation Activity in PY4					
	Participant Survey	Non-Participant Survey	NTG Research	QA/QC Review	Stakeholder Interviews*	On-line Trade Ally Survey
Appliance Recycling	X	-	X	X	-	-
Custom Incentive	X	-	X	X		X
Direct Load Control	X	-	-	X	-	-
Efficient Equipment Incentive	X	-	X	X	-	X
Energy Efficient Behavior & Education	X	X	-	X	-	-
E-Power Wise	-	-	-	X	-	-
Home Assessment & Weatherization	X	-	X	X	-	-
HVAC Tune-Up	-	-	-	X	X	-
Load Curtailment	X	-	-	X	-	-
Residential Lighting	X	X	X	X	-	-
Renewable Energy	-	-	-	X	-	-
WRAP	-	-	-	X	-	-

* PPL Programs group and EM&V staff were interviewed to discuss changes for all programs.

B.3.1.4 FirstEnergy Companies

Process evaluation methodologies were developed for residential and C&I programs, with little variation among programs.

For residential programs, the FirstEnergy program evaluator conducted the following activities:

- Program participant surveys
- Program non-participant surveys (behavioral program control group)
- Contractor surveys
- Interviews with program managers and program implementation staff
- Interviews with trade allies

For C&I programs, the FirstEnergy program evaluator included the following activities:

- Program participant surveys

432 Information in the table is from the PPL PY4 Process Evaluation Report.

- Program wait-list surveys
- Interviews with program managers and program implementation staff
- Interviews with trade allies

B.3.2 SWE Process Evaluation

In Phase I, the SWE Team was also involved in process evaluation, with the goal of producing more efficient and more cost-effective programs. The process evaluation performed by the SWE consisted of four main tasks: establishing guidelines for process evaluation in the document Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs; reviewing the annual process evaluation reports presented by each EDC; compiling all recommendations in the reports from each EDC; and following up with each EDC to determine if the recommendations had been implemented, considered, or rejected. The audit plan was designed to provide the PA PUC and other stakeholders a level of assurance that there is a minimum set of standards for process evaluation across the EDC portfolios and to allow the necessary flexibility and control for program administration and process evaluation management. The compilation of recommendations and the EDCs' responses for PY 1-PY3 were presented in the PY3 annual report "Act 129 Statewide Evaluator Annual Report Program Year 3: June 1, 2011 – May 31, 2012." In PY4, the recommendations and responses for each EDC were presented in their annual process evaluation report. A compilation of recommendations and responses from all program years, for each EDC, is presented in Appendix D.

B.4 Cost-Effectiveness Evaluation

B.4.1 EDC Cost-Effectiveness Evaluation

The cost-effectiveness evaluation performed by the EDC EM&V contractors addressed the cost-effectiveness of each EDC's portfolio of programs in accordance with the 2008 Act 129 Statue and the TRC Orders issued in June 2009 and August 2011. See Section 4 in the main body of this report for a description of the TRC test and how it was used throughout Phase I of Act 129.

B.4.2 SWE Cost-Effectiveness Evaluation

The purpose of the SWE cost-effectiveness audit was to verify the accuracy and reliability of EDC-reported TRC ratios. Audit activities included verifying program and portfolio costs, economic benefits, and savings impacts. The SWE waived the reporting requirements for the TRC test in PY1 because of pending discussions about methodology and assumptions to use for calculating the TRC ratio. During each subsequent program's impact evaluation, the SWE reviewed program costs and other inputs used in TRC calculations, along with program savings, for accuracy and validity. The SWE further reviewed TRC formulas used by the EDCs to ensure that the methodology and inputs used followed the guidelines set forth in the Commission's 2009 and 2011 TRC Orders.

Audits of TRC test calculations for each EDC found that their respective TRC models were accurate, comprehensive, and easily followed. After thorough review, the SWE confirmed that each calculator was functioning as designed with accurate inputs for PY2 through PY4. However, while calculations were being performed correctly by each EDC, it is important to note that the TRC test depends on several common assumptions, which are assessed differently by each EDC. These assumptions include the line loss factor, discount rate, participant costs, and avoided costs of energy and capacity costs. Detailed comparisons on how the different EDCs consider these unique factors can be found in Section 4.1.

B.5 Net-to-Gross Studies and Review

In the 2011 TRC Test Order, the Commission directed all EDCs "to collect data necessary to determine the net-to-gross ratio ("NTGR")[433] for their programs and to apply the ratio when determining the cost-effectiveness of future modifications of existing programs."[434]

NTGRs are used to capture two broad elements in estimating an energy efficiency (EE) or demand response (DR) program's (or measure's) net savings:[435] (1) reductions in measured (gross) savings from overstating the program's influence as a result of free-ridership, and (2) increases in such savings from understating the program's influence as a result of spillover. Free-ridership occurs when a program participant, who received an incentive to undertake a savings measure, would have undertaken the measure in the absence of the program (i.e., the participant "received the incentive but didn't need it.)"[436] Spillover occurs when persons or organizations "may hear about the benefits of the energy-efficient equipment and may install it even though they do not directly receive the program's incentives for those installations and are not recorded directly in the program's 'count' of installations."[437]

B.5.1 Estimating Net-to-Gross Ratios

The NTGR of a program can be estimated using the formula

$$NTGR = 1 - FR - SO$$

where

FR = free-ridership, which quantifies the percentage of participants who would have implemented the measure in absence of the EDC program, and

SO = spillover, which quantifies the additional reductions in energy consumption or demand influenced indirectly by the presence of an EE program (i.e., without incentives from the program).

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[433] An NTGR expresses quantitatively an estimate of the effects or influence of a program in the realization of energy or demand savings "above and beyond what would have happened without the program." Lisa A. Skumatz and Edward Vine, *A National Review of Best Practices and Issues in Attribution and Net-to-Gross: Results of the SERA/CIEE White Paper*, ACEEE Summer Study on Energy Efficiency in Buildings, 2010, p. 5-349.

[434] 2011 TRC Test Order, *p. 25.*

[435] Net savings refers to the portion of gross savings that is attributable to an EE or DR program. An NTGR is applied to adjust the verified gross savings for reducing influence (free-ridership) and/or increasing influence (spillover) to determine a program's net savings.

[436] Skumatz and Vine, op. cit., p. 5-349.

[437] ibid. Other influencing factors such as rebound (also called snap-back and take-back), persistence, and leakage may have an impact on a program's net savings, but are not typically included in NTGR analyses.

The following section discusses the NTG study completed by the SWE Team to provide the EDCs with recommendations for NTGR estimation methodologies.

B.5.2 SWE Net-to-Gross Study

The Commission ordered the SWE to conduct an NTG study that examined the methodologies used by other jurisdictions and to provide recommendations on the most appropriate methodologies for use by the PA EDCs.

Based on its research of NTGR estimation methodologies in other states, the SWE found prevalent use of six general NTGR estimating methods, some of which included various submethods. The SWE then performed a literature review of these prevalent methods and submethods and developed a set of advantages and disadvantages for each one, summarized in Table B-7.

Table B-7: Summary of NTG Estimation Methodology Advantages and Disadvantages

Method	Advantages	Disadvantages
Deemed/Stipulated	• Relatively simple • Low cost • Avoids dealing with counterfactual and control group	• Can deem an incorrect estimate • Not based on program-specific information • Cannot assign statistical precision
Survey Based		
Self-Reporting Survey	• Relatively simple • Low cost • Don't need a control group • Flexible • Can be used to track trends over time if used consistently	• Biases – non-response, sample selection • Inability of market actors to accurately recall why decisions were made • Potential problems with values assigned to responses • Asking market actors about hypothetical situations • Market actors may give "socially desirable response"
Program Delivery Staff Survey	• Can be used to obtain background information and to better understand projects and decision points	• Program staff have vested interest in obtaining high attribution credit • Not widely accepted as basis for NTG estimates
Enhanced Self-Report Approach	• Same as self-reporting survey but gets a more accurate result	• Same as survey-based but is more expensive
Expert Judgment – Delphi Panel	• Independent from evaluators • Based on expert opinion • Useful for programs with diverse or complex end-users • Good to use when no other methods are well suited for the market or programs	• Cannot assign statistical precision
Method	**Advantages**	**Disadvantages**
Econometric Modeling	• Can provide statistically valid estimates	• Data not always available • Samples are not always random • Can be difficult to find a control group • Unobserved influences can bias estimates • Large customers can bias estimate • Can be expensive

Method	Advantages	Disadvantages
Market Sales	• Assesses trends of entire market • Can be used when program participation is not well defined	• Comprehensive data must be available • Difficult to find a comparison market area
Pricing and Elasticity Analysis	• Good for use in markets where the influence is through price reductions	• Stated Preference: Customers don't always do as they say • Revealed Preference: Non-response bias can occur, and direct observance can be logistically difficult • Shelf Stocking: same biases as survey methods
Billing Analysis	• Can provide statistically valid estimates • Can be used with complex retrofit and controls projects	• Large homes may bias sample without normalization • Underestimates net effects if non-participant spillover exists • Requires 8-12 months of post-implementation data • Difficult to find a control group • Self-selection bias
Macroeconomic Modeling	• Estimates net effects of all programs cumulatively	• More error than program-specific methods • Not normally used for EE programs
Dynamic Baseline	• Can reflect difference between good and bad program design	• Requires a lot of data collection • Can be expensive • Complicated to find a baseline control group
Discrete Choice Analysis	• More accurate than normal survey methods • Can estimate total net effects	• Sample-selection and non-response biases still exist • Models can be complicated • For large studies, can be expensive
Method	**Advantages**	**Disadvantages**
Historical Tracing	• Uses information from a wide range of sources	• Difficult to determine magnitude of program effects • Cannot attach statistical significance • Not generally used for EE programs
Randomized Controlled Experiments	• "Gold standard" of research design • Limits bias and increases reliability and validity	• Ethical problems with assigning rate-payers to a control group • Cannot be applied after program implementation • Not generally used for EE programs

The SWE recommended that a "level of rigor" system, developed in California, be used to guide the scope of the EDCs' NTGR studies in the Commonwealth, as summarized in Table B-8.

Table B-8: Rigor Levels Adapted for PA EDCs from California Energy Efficiency Evaluation Protocols

Rigor Level	Methods of Net Impact Evaluation (Free-Ridership and Spillover)
Basic	• Deemed/stipulated NTG ratio • Participant self-reporting surveys • Expert judgment
Standard	• Billing analysis of participants and non-participants • Enhanced self-report method using other data sources relevant to the decision to install or adopt a measure; these could include record/business policy and paper reviews, examination of similar decisions, and interviews with multiple actors and end-users, midstream and upstream market actors, program delivery staff, etc. • Market sales data analysis • Other econometric or market-based studies
Enhanced	• Triangulation; this typically involves using multiple methods from the standard and basic levels, including an analysis and justification of how the results were combined

The SWE identified key factors that should be considered in determining the level of rigor to use to estimate an NTGR for any particular program. Examples of these factors included the contribution to total portfolio savings, number of participants, measure homogeneity,[438] existence of upstream influences,[439] and EDC budget and resources availability. The SWE also offered several recommendations to help guide the EDCs in estimating NTGRs for their EE&C plans:

- Free-ridership and participant spillover should be addressed for each program. Non-participant spillover[440] should be addressed at the discretion of each EDC. While it would be favorable to

[438] Homogeneity addresses the number of measures and the similarity of measures in an EE&C program. As examples, a lighting program with prescriptive measures has high homogeneity, whereas a custom C&I program with many different options has low homogeneity. The prescriptive measures involve incentives based on deemed, per-unit savings that are given out for relatively low-cost and simple measures. In contrast, custom measures involve incentives that are paid on a fixed per-kW or per-kWh basis and are used for more complex or custom processes with multiple EE measures.

[439] Upstream influences exist when a customer may be unaware of incentives or rebates that are given to upstream market actors, such as manufacturers or retailers. The customer therefore may not know that the program is influencing his or her decision.

[440] Non-participant spillover is energy savings resulting from a non-participant installing EE measures or applying energy savings practices as a result of the program's influence. NMR Group, Inc., *Net Savings Scoping Paper*, submitted to Northeast Energy Efficiency Partnerships: Evaluation, Measurement and Verification Forum, November 13, 2010, p.8.

the EDC to include non-participant spillover, the cost of such studies can be high. Therefore a decision to include non-participant spillover should be made based on the value of information (VOI) expected to be obtained from the study.

- The EDCs should seek to collaborate, where practical, on developing a statewide study for NTGRs, with sample stratification for EDC-specific results. As an example, conducting such a statewide study for upstream CFL rebate programs or appliance recycling programs may prove viable in this regard.
- Programs with similar characteristics, such as measure type, rebate, and delivery channel, may be evaluated as a group, subject to SWE approval.
- The SWE Team acknowledged that West Penn Power's programs would ultimately be restructured so they are similar to other FirstEnergy programs. NTGR estimates from other FirstEnergy utilities could be used for West Penn Power's program planning.
- Due to the market transformation in the lighting industry, NTGR studies for planning of lighting programs may not be an appropriate method of prospectively informing and enhancing program design and implementation.
- NTG estimation should occur more frequently for programs that target dynamic markets than for programs that target stable markets. A dynamic market is one in which factors such as technology, pricing, efficiency standards, and consumer awareness change relatively rapidly. As a result, NTGR estimates may be valid only over a short time interval.
- Computer-assisted telephone interviewing (CATI) methods are commonly used to conduct self-reporting surveys for programs that require a relatively high number of responses to closed-ended questions, have complex skip patterns, and that would not require exploratory discussions with customers, such as CFL replacements or ENERGY STAR appliance purchasing programs. Other survey approaches, such as web surveys or shopper intercepts, are also commonly used because of potentially lower costs compared with CATI, or if low telephone response rates limit the effectiveness of CATI.
- Programs for which a national consensus on methodology is apparent should be reviewed for adoption by the EDCs. For example, TetraTech, in collaboration with KEMA and the NMR Group, has done extensive work in the research and development of NTGR self-reporting surveys in Massachusetts. ADM Associates has been instrumental in developing a widely referenced standard for residential appliance recycling programs. Navigant Consulting, in collaboration with Itron, Opinion Dynamics Corporation, and Michaels Engineering, has prepared several impact evaluation reports in Illinois for ComEd in the residential and C&I sectors that helped inform the SWE Team's guideline recommendations for conducting NTG studies that are included in this report.

- Methodologies implemented by the Cadmus Group and Opinion Dynamics on behalf of PPL to estimate NTGRs for its programs are generally consistent with practices used throughout the country that have been documented in this report. EDCs are encouraged to pattern their approach after PPL's methodologies, subject to the recommendations made herein, to facilitate consistency across the Commonwealth for estimating NTGRs.

In addition the SWE recommended using an NTGR value of 1.0 for low-income programs (i.e., no influences from free-ridership or spillover should be considered), based on the literature review of expert resources and practices in other states. The SWE further recommended that EDCs should evaluate the possibility of DR program participation outside of their Act 129 programs, given the overlap with PJM programs. If significant overlap exists, an NTG study should be considered. Otherwise, NTG studies are not recommended for DR programs.

The SWE emphasized that its foregoing recommendations were meant as guidelines and were not binding; an EDC and its program evaluator could deviate from the recommendations where they feel a different level of rigor should be used based on past experience and professional judgment.

Details on the specific NTG methodologies used by each EDC can be found in Appendix E of this report. Results of the EDC's NTG studies can be found in Section 6.4 of the report.

B.6 Reporting and Data Tracking

The following sections discusses EDC and SWE reporting and data tracking during Phase I of Act 129.

B.6.1 EDC Reporting

The Implementation Order entered January 16, 2009 noted that Act 129 requires EDCs to submit an annual report documenting the effectiveness of their EE&C plans, the M&V of energy savings, the evaluation of the cost-effectiveness of expenditures, and any other information required by the Commission.[441] A Secretarial Letter was issued on May 25, 2011 by the Commission to provide guidance on annual reporting requirements moving forward, as well as to establish quarterly reporting requirements for PY3 and PY4 of Act 129.[442]

The Secretarial Letter discussed that EDCs were require to submit two annual reports each year, the first being a preliminary annual report and the second a final annual report. The Commission recognized that verification of savings requires time and that projects installed late in a program year may not be verified until after the end of the calendar program year. Thus the preliminary annual report would provide an initial look at savings information so the Commission could begin to determine compliance with Act 129 EE&C goals. The submission of a final annual report at a later time would include all verified

[441] See Pa. C.S. §2806.1(i)(1).
[442] Secretarial Letter issued on May 25, 2011, at Docket No. M-2009-2069887. pp. 1-2.

savings for each EDC's EE&C portfolio for that program year, the cost-effectiveness evaluation, the process evaluation, and any other items required.[443]

Table B-9 shows each EDC required report and its date of submittal throughout Phase I of Act 129.

Table B-9: Phase I EDC Reporting Submittal Dates

Report	Program Year 1 (6/1/09 - 5/31/10)	Program Year 2 (6/1/10 - 5/31/11)	Program Year 3 (6/1/11 - 5/31/12)	Program Year 4 (6/1/12 - 5/31/13)
Quarter 1	Not Formally Required	Not Formally Required	October 15, 2011	October 15, 2012
Quarter 2	Not Formally Required	Not Formally Required	January 15, 2012	January 15, 2013
Quarter 3	Not Formally Required	Not Formally Required	April 15, 2012	April 15, 2013
Quarter 4	Not Formally Required	Not Formally Required	July 15, 2012 (In Preliminary Annual)	July 15, 2013 (In Preliminary Annual)
Preliminary Annual	Not Formally Required	July 15, 2011	July 15, 2012	July 15, 2013
Final Annual	September 15, 2010	November 15, 2011	November 15, 2012	November 15, 2013

The SWE Team provided EDCs with quarterly and annual reporting templates. In general, quarterly reports included implementation and evaluation updates, incremental gross savings and gross savings to date, and preliminary verified savings. The preliminary annual report included gross savings as of the end of the program year, and preliminary verified savings. The final annual report included total verified savings as of the end of the program year.

B.6.2 SWE Reporting and Data Tracking

The SWE Team created a PA Act 129 SharePoint site to improve communication and coordination of activities among the SWE Team, TUS, EDCs and evaluators, and Energy Association of Pennsylvania. The site served as a depository of documents and data associated with the evaluation of the EE&C program portfolios implemented by each EDC. Access to the site was limited to persons receiving SWE and EDC approval. Each of the seven EDCs had its own password-protected section of the website. The SWE had access to each EDC's site, in addition to its own site which only members of the SWE Team could access. TUS staff had access to all sections of the site.

[443] ibid., pp. 1-2.

The SWE Team submitted quarterly and annual reports to the Commission that provided updates on impact, cost-effectiveness, and process evaluations. The reports:

- Summarized program and portfolio progress to-date for each EDC.
- Summarized energy and demand reductions.
- Identified each EDC's savings achievement levels to-date.
- Identified best practices to date.
- Identified areas for improvement.
- Identified necessary recommendations for updating targets or expectations based on current findings.
- Summarized audit activities and findings based on the audit work completed during the quarter.

The reports also included any discussion of topics relative to timing of the report, such as TRM updating issues, resolutions from Program Evaluation Group and Technical Working Group meetings, and summaries of guidance memos.

B.7 Stakeholder Groups and Meetings

The Commission recognized the need for stakeholder input when developing major Commission demand-side management (DSM) policy and chose stakeholder working groups and meetings as the main forum to solicit public input and informing stakeholders on Commission decisions, major research findings, and energy efficiency orders. Stakeholders participating in Commission energy efficiency and related working groups and meetings included private industry groups, consumer groups, non-profit groups representing various constituencies, EDCs, and government agencies.

The working group meetings included reviewing and discussing the EDCs' original EE&C programs,[444] the electric baseline studies,[445] the Fuel Switching Working Group Docket,[446] the On-Bill Financing Working Group,[447] the SWE Demand Response Study,[448] the Act 129 2014 Technical Reference Manual Update Technical Working Group,[449] and the Smart Meter Technology Procurement and Installation Working Group.[450]

B.7.1 Energy Efficiency and Conservation Programs

The Commission convened a working group meeting on December 10, 2008 to discuss an EE&C program as part of the Commission's first phase of the implementation of Act 129 of 2008. The purpose of this meeting was to provide an informal forum for the discussion of the staff draft plan for the EE&C program and the comments received on the plan.

[444] See Docket No. M-2008-2069987.
[445] See Docket No. M-2012-2289411.
[446] See Docket No. M-0051865.
[447] See Docket No. M-2012-2289411.
[448] See Docket No. M-2012-2289411.
[449] See No. M-2012-2313373; Ref. M-00051865.
[450] See Docket No. M-2009-2092655.

In addition, the Commission directed all EDCs to offer and engage in informal discussions with statutory advocates and interested stakeholders during pre-filing development of plans.[451]

The Commission staff convened an Act 129 stakeholder meeting on March 16, 2012 to allow interested parties to discuss views on possible timeline issues, additional planning and implementation, and potential energy reduction targets for Phase II of Act 129 EE&C programs.

B.7.2 Low-Income Working Group

In orders approving the EE&C plans, the Commission directed the formation of a Low-Income Working Group (LIWG) to identify the standardized data used to determine the low-income households' share of total energy usage in each EDC's service territory.[452] The Commission also gave the LIWG the discretion to address other matters that required clarification before the annual reconciliation process for Act 129 costs. At its April 22, 2010 Public Meeting, the Commission adopted a Secretarial Letter at Docket No. M-2009-2146801 that released the March 19, 2010 report of the LIWG, and adopted the recommendations contained therein. The LIWG report contained data to determine the number of low-income measures each EDC must implement to meet the "proportionate number" criteria of Act 129. The LIWG Report also stated that EDCs must report on a quarterly basis, actual energy reductions from each customer sector, including the low-income sector, and each sector's proportion of the total energy reductions.

B.7.3 Electric Baseline Studies

The Commission directed the Act 129 SWE to conduct electric baseline studies to establish baseline energy characteristics for the residential and C&I sectors. The Commission held an Act 129 stakeholders meeting on June 5, 2012 to provide stakeholders with the opportunity to participate in a question-and-answer session with the Commission's Act 129 SWE on the topics of the baseline studies.

B.7.4 Fuel-Switching Working Group

The Commission initiated the Fuel-Switching Working Group in June 2009 in the TRM proceeding[453] to identify, research, and address issues related to fuel switching, with the possibility of its inclusion in future versions of the TRM. In reviewing the EDCs' EE&C plans, the Commission directed the Fuel-Switching Working Group to provide recommendations by March 31, 2010 as to the appropriate treatment of fuel-switching programs in the context of Act 129 requirements and whether revisions to the TRM or TRC test were warranted.

The first meeting of the working group was held on January 6, 2010, where a list of questions was distributed to the group. A subcommittee was formed to prepare a fuel-switching proposal and accompanying benefit-cost analysis. The report was distributed to the group on January 25, 2010. The

[451] See EE&C Implementation Order, January 15, 2009, p. 10.
[452] The Act requires that each EE&C plan "include specific energy efficiency measures for households at or below 150% of the federal poverty income guidelines. The number of measures shall be proportionate to those households' share of the total energy usage in the service territory." 66 Pa.C.S. §2806.1(b)(i)(G).
[453] Docket No. M-00051865

working group held various meetings to address comments in the report. The staff report was completed on April 30, 2010 and released on May 21, 2010.

B.7.5 On-Bill Financing Working Group

In the Commission's Phase II Energy Efficiency and Conservation Program Implementation Order of August 2, 2012, the Commission directed TUS and the Bureau of Consumer Services to initiate a working group to investigate best practices from other states and (a) identify working models of on-bill financing and on-bill repayment; (b) determine the feasibility of including on-bill financing and on-bill repayment programs; and (c) identify potential options for customers to obtain low-cost financing for EE projects.

The initial stakeholder meeting was held on November 16, 2012. Two subsequent meetings were held, with much of the emphasis on small commercial and multi-family on-bill financing. The On-Bill Financing Working Group Staff Report was completed on October 31, 2013 and released on December 11, 2013.[454]

B.7.6 SWE Demand Response Study Stakeholders' Meetings

The Commission held three in-person stakeholder meetings to provide interested parties with information on the objectives, methodology, and results of the SWE Demand Response Study. The first meeting was held on August 7, 2012 and included an SWE presentation on the study's proposed methodology and timeline, followed by a question-and-answer session. The second meeting was held on February 21, 2013. The SWE presented preliminary results from the study and outlined the tasks remaining to be completed. The final stakeholder meeting occurred on June 11, 2013, following the release of the SWE Final Demand Response Study Report.[455] The SWE presented an overview of the findings and recommendations of the study and solicited feedback from stakeholders on the information contained within the final report.

B.7.7 2014 Technical Reference Manual Update Technical Working Group

The Commission held a working group meeting on July 15, 2013 to provide stakeholders with the opportunity to review proposed high-impact changes to residential and C&I measures, and allowed for a question-and-answer session regarding those changes to the 2014 TRM. Stakeholders were also allowed to propose any other changes they wanted to have considered in the 2014 TRM.

B.7.8 Smart Meter Technology Procurement and Installation Working Group

The Commission held a stakeholders working group meeting in Harrisburg on July 16, 2009. A Final Order was adopted on December 6, 2012.

B.8 Program Evaluation Group Meetings

The Commission recognized the importance of open communications and input from the EDCs and their evaluators, the SWE, and the PUC when administering Act 129. The Commission endeavored to achieve this communication by holding weekly conference calls with the PUC staff and SWE staff, biweekly calls with the EDCs, SWE, and PUC staffs, and monthly conference calls or in-person meetings in Harrisburg

[454] http://www.puc.state.pa.us/Electric/pdf/Act129/OBFWG_Report_103113.pdf.
[455] www.puc.pa.gov/pcdocs/1230512.docx

with the EDCs, SWE, and PUC staffs. These monthly calls or meetings were referred to as the Program Evaluation Group (PEG) meeting.

The meetings were held to discuss and resolve technical issues, improve M&V protocols, and provide clarity for EDCs and evaluators on a variety of issues. The focus of each PEG meeting varied depending on the interests and needs of the parties in attendance. Examples of meeting topics include the following:

- Updates to the TRM
- Guidance Memos
- IMPs
- Methodology for residential and C&I industrial baseline studies
- Methodology for the Statewide Energy Efficiency Potential Study, including methodology for program potential scenarios
- NTG Issues
- Audit activity findings and updates
- Act 129 Phase II planning issues
- Act 129 Tentative Implementation Order
- TRC test assumptions and calculation methods
- DR M&V protocols
- Program implementation and evaluation best practices

Most PEG meeting issues were technical in nature and required input and discussion from the technical experts among the EDC evaluators, the SWE Team, and Commission staff. These issues were not major policy issues but rather topics that provided the “how-to” so the EDC evaluators knew what level of evaluation the SWE and the PUC expected of them. The issues covered the required process to collect evaluation data, level of precision needed when conducting a survey, cost-effectiveness of certain evaluation methods, report formats, unintended consequences of EE&C or DR programs, sharing of best practices, and future planning timetables.

The Commission found that the PEG meetings were highly effective in resolving evaluation issues, minimizing uncertainty among the various parties, offering a forum for exchanging ideas on how to improve the EE&C and DR programs, and improving cost-effective program evaluation.

Appendix C SWE Compendium of Prepared Studies, Reports and Memos

This appendix includes a compendium of all studies, reports, and studies produced by the SWE Team during Phase I of Act 129.

C.1 Audit Plans

The SWE produced two drafts of the audit plan during Phase I of Act 129:

Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs, December 1, 2009[456] and November 4, 2011.[457]

As required in Act 129 and the EE&C Implementation Order, the audit plan and evaluation framework outlines the procedures of the SWE audit team and the expectations of the electric distribution companies (EDCs) to comply with the audit of the information submitted in the program. The document further explains the process for updating the Technical Reference Manual (TRM), guidelines for tracking and reporting data for the EDC, the measurement and verification (M&V) expectations of the program, and applicable deadlines. This audit plan and evaluation framework was originally released in December 2009 and was updated in November 2011.

C.2 Baseline Studies

The SWE produced both a Residential and non-Residential Baseline Study during Phase I of Act 129, these are discussed separately in the following sections.

C.2.1 Residential Baseline Study

Pennsylvania Statewide Residential End-Use and Saturation Study, April 18, 2012

The purpose of the SWE Residential Baseline Study[458] was to establish baseline energy usage characteristics for the residential sector served by the seven EDCs subject to the consumption and demand reduction mandates of Act 129.[459] The study documented the findings of the residential sector's end-use energy usage and saturation,[460] and also provided baseline energy usage characteristics for the

[456] PA PUC website, www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information.aspx.
[457] PA PUC website, www.puc.pa.gov/electric/pdf/Act129/SWE-Audit_Plan_Update_Nov11.pdf.
[458] PA PUC website, www.puc.pa.gov/electric/pdf/Act129/PA_Residential_Baseline_Report2012.pdf.
[459] The SWE did not collect primary data as part of its onsite survey for PECO, but rather relied on data collected in Spring 2010 and published as part of the 2011 baseline report for PECO published by Navigant Consulting, prepared February 7, 2011.
[460] Saturation refers to the average number of units across all homes (except lighting). For instance, a computer saturation of 149% in an EDC's territory indicates that, on average, there are 1.49 computers in residential households. Lighting saturation refers to the proportion of lighting composed of the given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding "penetration." Penetration refers to the proportion of homes assigned a given equipment type or characteristic. For instance, if computers in an EDC's

subsequent SWE Energy Efficiency Potential Study, which supported the Commission's establishment of energy consumption reduction targets for Phase II of Act 129.[461] Primary data were collected for the study during Fall 2011.[462]
This Study evaluated the characteristics of the energy using equipment and efficient electric equipment stock present in the residential sector of Pennsylvania for the seven EDC service territories. SWE Team member GDS used its experience working with the Pennsylvania EDCs (as part of the SWE Team evaluating their current energy efficiency programs) and performing previous energy efficiency potential studies to help identify the critical data collection needs from the on-site surveys that are be integral to future resource planning and energy efficiency activities in Pennsylvania.

While the Study aimed to assess current residential electric equipment stock and estimate the saturation of key energy efficiency and conservation measures as eventual inputs to the SWE Energy Efficiency Potential Study, it is also designed to serve as a stand-alone residential baseline study presenting contemporary information across the seven largest EDCs in Pennsylvania. These results can supply information that is useful for future energy efficiency and demand response program development, system planning, and obtaining a general understanding of the energy consuming equipment located throughout the Commonwealth of Pennsylvania. Based on these ultimate considerations, the following goals were identified for this study:

- Select a representative stratified random sample of residential customers within each EDC for participation in the baseline study;
- Determine the current saturation of energy using equipment in residences at the statewide and EDC level; and
- Determine the current saturation of electric efficiency measures in residences at the statewide level by housing type, as well as at the EDC level.

The results of the Study relied solely upon primary research conducted in the form of onsite customer surveys. A review of available secondary sources, such as US Census data and manufacturer product data, was also performed in an effort to clarify and compliment primary research efforts in addition to filling in gaps – either in the presence or quality of data.

The contemporary nature of the data collection effort (SWE data collection occurred during Fall 2011; PECO data collection occurred during Spring 2010) captured efficiency levels during similar periods of EDC energy efficiency program maturity. This factor helped to provide justification for the inputs to, and to instill confidence in the ultimate estimates of energy efficiency savings potential contained in, the SWE Energy Efficiency Potential Study.

service area have a penetration of 84%, it means that 84% of all homes have at least one PC (though they could have more than one).
[461] See Phase II Implementation Order, p. 11.
[462] Primary data were collected for the PECO study in Spring 2010.

Study Methodology

The SWE performed on-site surveys during Fall 2011 to collect detailed and accurate inventories of residential appliance, equipment, and housing characteristics for residential consumers throughout the Commonwealth. This Study captured a variety of energy-related data, including the penetration[463] of electric- and non-electric equipment and appliances, energy efficiency levels of electric equipment and appliances, building shell characteristics, lighting socket counts, and other relevant information.

A total of 488 site surveys (including data from the 2011 PECO Baseline Study) stratified by EDC, housing segment, and annual kWh consumption were conducted. The desired level of precision for EDC specific results, ±10% precision, with 90% confidence, necessitated a total of 70 on-site visits per EDC. The data for all EDCs were then aggregated to the statewide level, and these estimates carry precision of ±5% precision, with 95% confidence. The sample size was not large enough, nor was it intended, to provide housing segment specific results within each EDC.[464]

The survey estimates presented in the Study are necessarily subject to a certain degree of uncertainty. Practical constraints make it impossible for the SWE to conduct an on-site survey of the entire population of Pennsylvania residences, necessitating the selection of a small sample population from which to collect data. When using a sample to estimate a population metric, factors of uncertainty are introduced, primarily based on the size of the sample and the existence of biases within the sample.

The uncertainty can be described by the confidence level and margin of error. As noted above, the targeted confidence level and margin of error in this study was set at 95% and 5%, respectively, for the state-wide residential sector. This means that, if the Study were repeated multiple times, 95% of the studies would produce estimates to within ±5% of the true population value.

Given the different characteristics between single family (SF), multifamily, and manufactured homes, the SWE developed case weights to control for sample bias when presenting results by EDC.[465] Further, in an effort to provide a more inclusive study and to provide estimates for each of the EDC territories, a sample of 70 residential sites was selected for each EDC irrespective of the size of the EDC. Thus, when

[463] Penetration refers to the proportion of homes assigned a given equipment type or characteristic. For instance, if computers in an EDC's service area have a penetration of 84%, it means that 84% of all homes have at least one PC (though they could have more than one).

[464] At the statewide level, there were a significant number of observations to make statistically valid conclusions in excess of ±10% precision, with 90% confidence for single family-detached housing. For single family-attached and multifamily housing segments, however there were only enough observations to make assumptions at ±15% precision, with 90% confidence, and the number of manufactured housing observations was significantly small enough that the SWE did not recommend using for statistically reasonable conclusions.

[465] EDC case weights also controlled for sample bias related to the age of the head of household. The on-site sample had a higher proportion of older homeowners than the general population (according to 2010 US Census data).

aggregating the EDCs estimates to the statewide level, it was necessary to create a second set of case weights to control for differences in the number of residential accounts across the seven EDCs. This approach provides more weight to the data for larger EDCs when compared to smaller EDCs in the statewide findings.

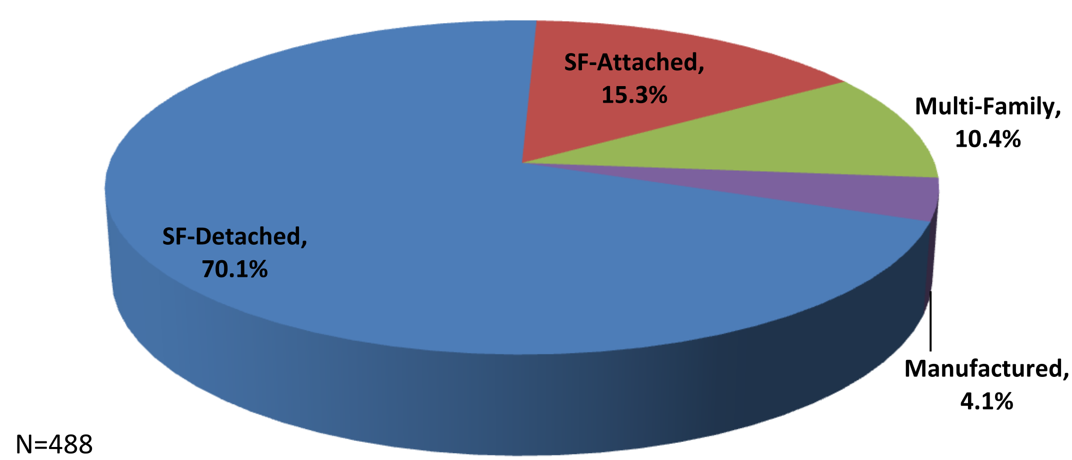
Statewide Results

Statewide level findings include data collected from both the 420 on-site surveys conducted by the SWE throughout six EDCs and, when possible, data from 68 on-site surveys conducted by Navigant, PECO's Program Evaluator, for the 2011 PECO Residential Baseline Study. The data presented below represents statewide results for all housing types combined.

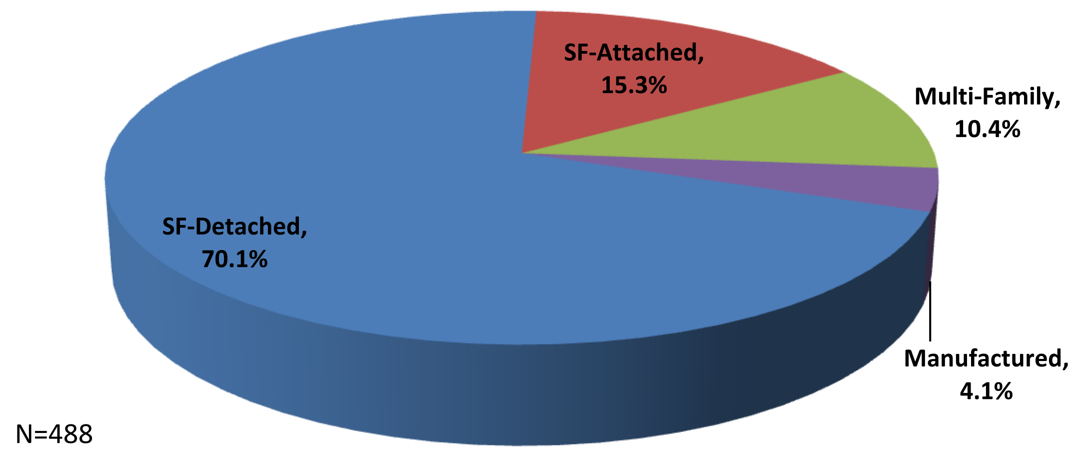
Basic Home Characteristics

Housing Type. After applying statewide weighting factors, SF-Detached housing represents 70% of the total surveyed housing units. SF-Attached (townhouses, row houses, duplexes) represents 15% of the statewide housing units, followed by multifamily housing (condos, apartments, etc.), and manufactured (or mobile) homes.[466]

Figure C-1: Statewide Residences by Housing Type



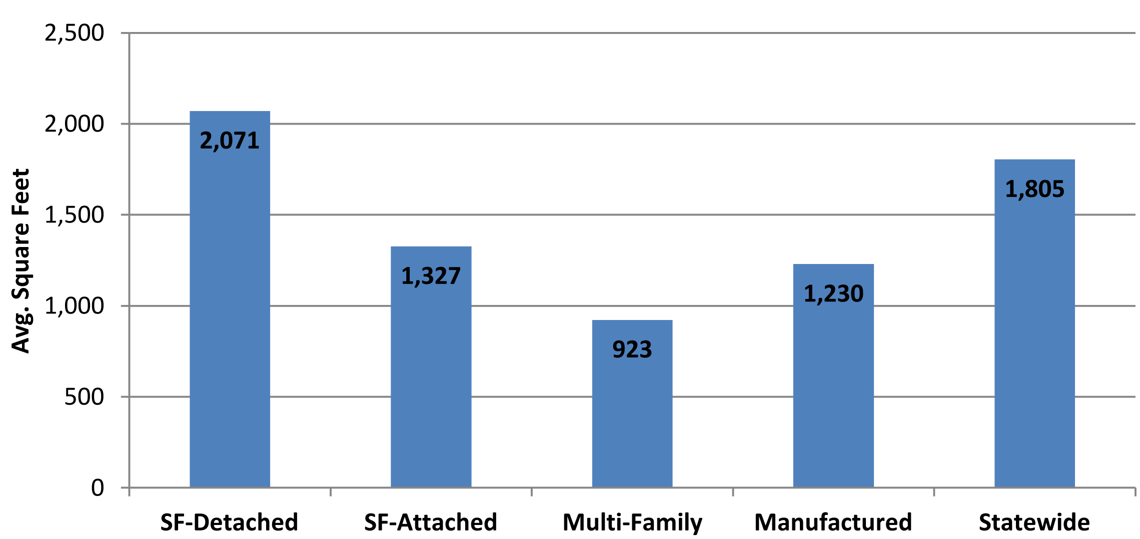
[466] Manufactured housing in this study refers to mobile homes and other housing on a fixed, steel chassis and towed to the home site. Modular homes are included as SF-detached housing.



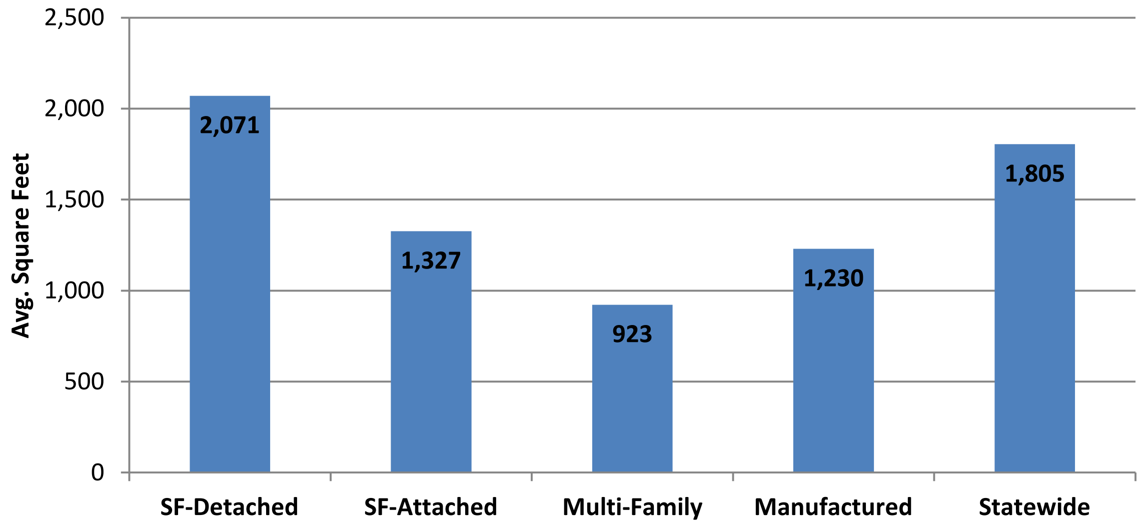
Average Age. The average age of housing units statewide was 50 years old. Approximately 42% of homes were built prior to 1960 while only 8% were built within the last 10 years.

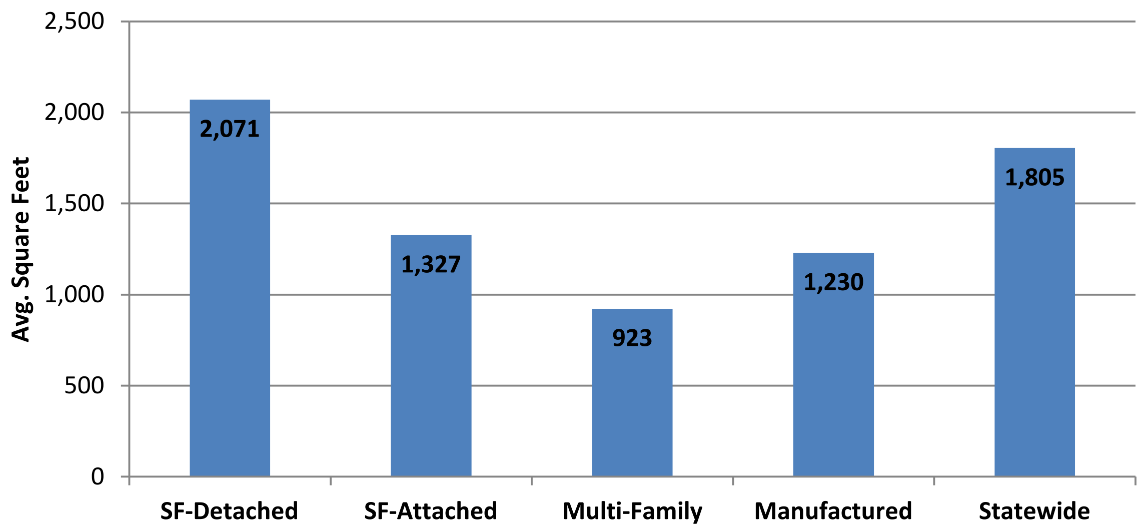
Average House Size. The average square footage of conditioned space, including finished basements, for all housing was approximately 1,805 square feet.[467] Single family detached housing square footage was approximately 2,070 square feet (N=350). SF-Attached, multifamily, and manufactured housing conditioned space square footage ranged from roughly 925 sq. ft. to 1,325 sq. ft.

Figure C-2: Average Square Feet of Conditioned Space by Housing Type[468]



[467] For purposes of the Study, conditioned space was generally classified as any area, room, or finished space being heated and/or cooled by equipment or appliance.
[468] "Statewide" refers to all housing types combined throughout the Study.



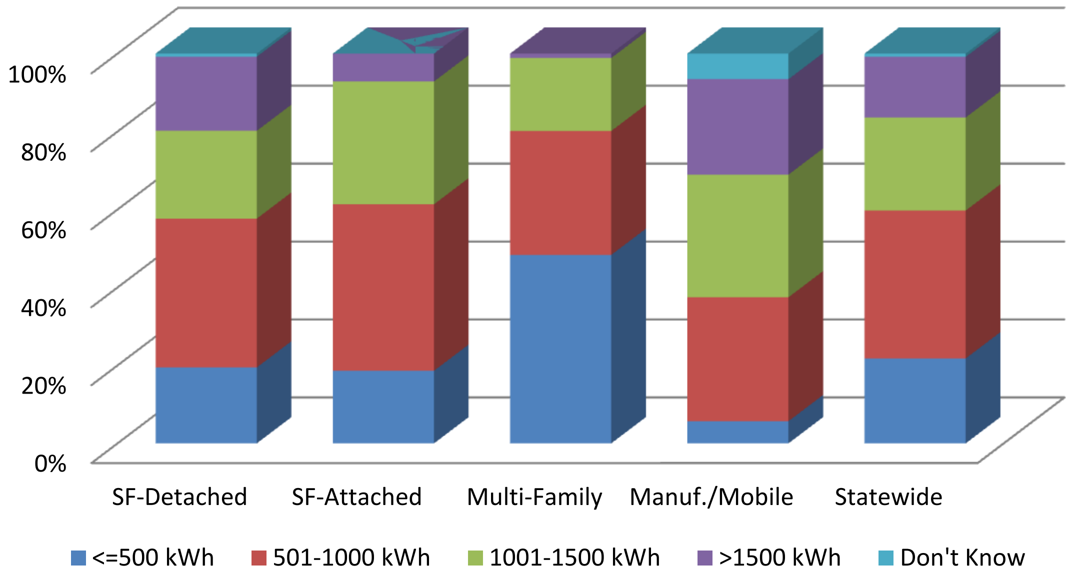


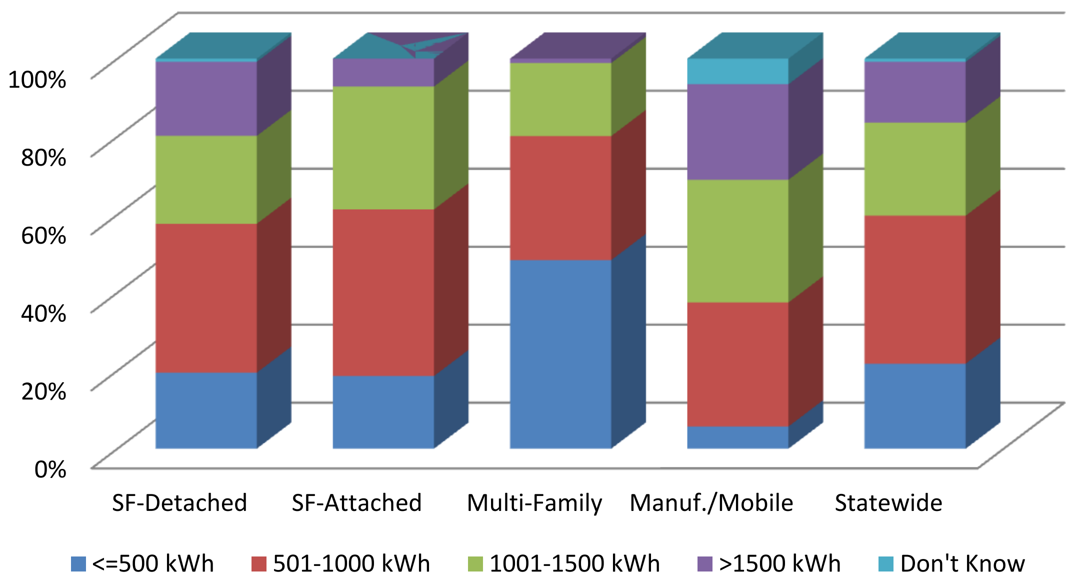
Monthly Energy (kWh) Use. Approximately 22% of surveyed homes statewide consumed less than 500 kWh per month based on historical billing data. 60% of homes consume less than 1,000 kWh per month. Only 16% consume more than 1,500 kWh monthly. In general, SF-Detached and manufactured housing had the highest proportion of 1,500 kWh and above residences. As expected, multifamily units were most likely to consume 500 kWh or less monthly.

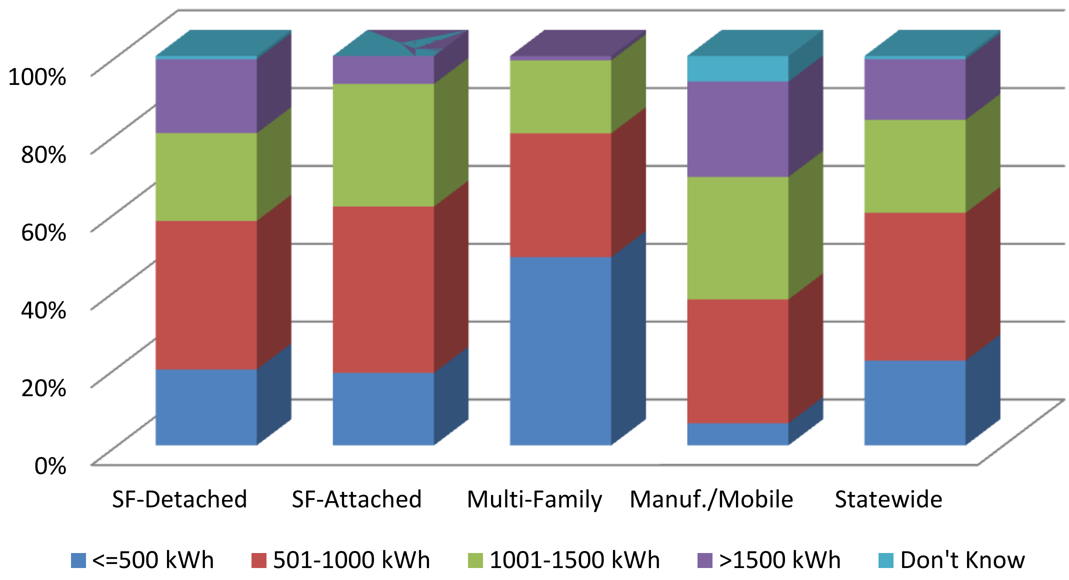
Foundation. Approximately 47% of surveyed homes statewide had unconditioned basements; an additional 35% had conditioned basements. Only 7% and 8% were slab on-grade or crawlspace foundations, respectively.

Other Demographics. Statewide, the average annual number of occupants was 2.6 people per household. Nearly all homes were used as year-round residences (97%) and the majority were owner-occupied (81%).

Figure C-3: Distribution of Average Monthly kWh Consumption (based on historical billing data)



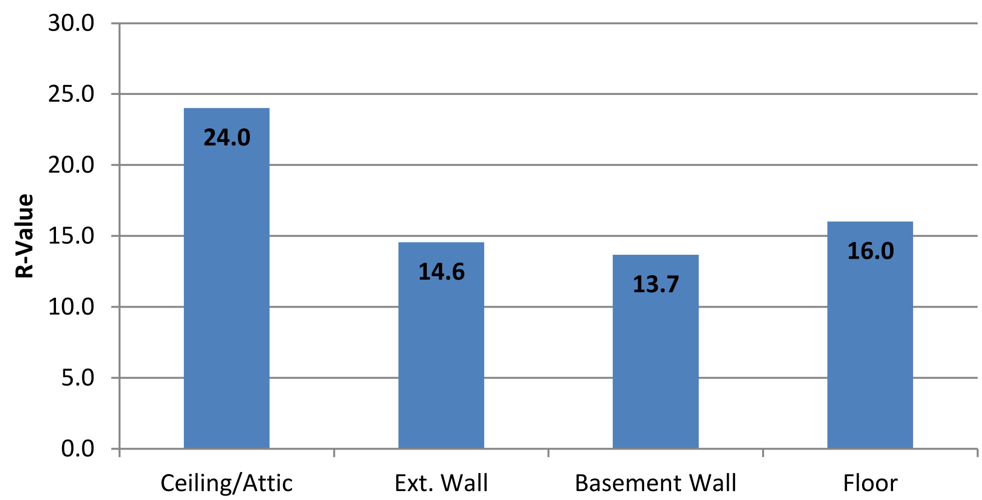


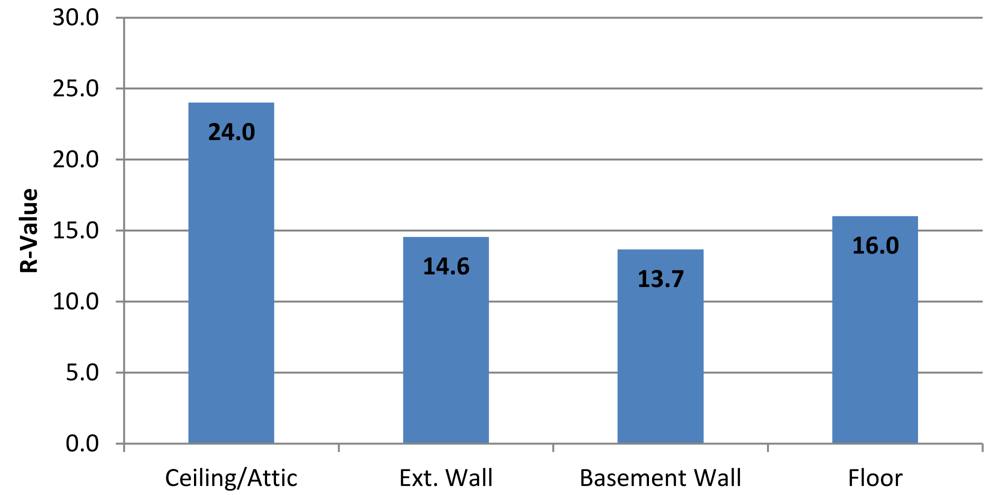


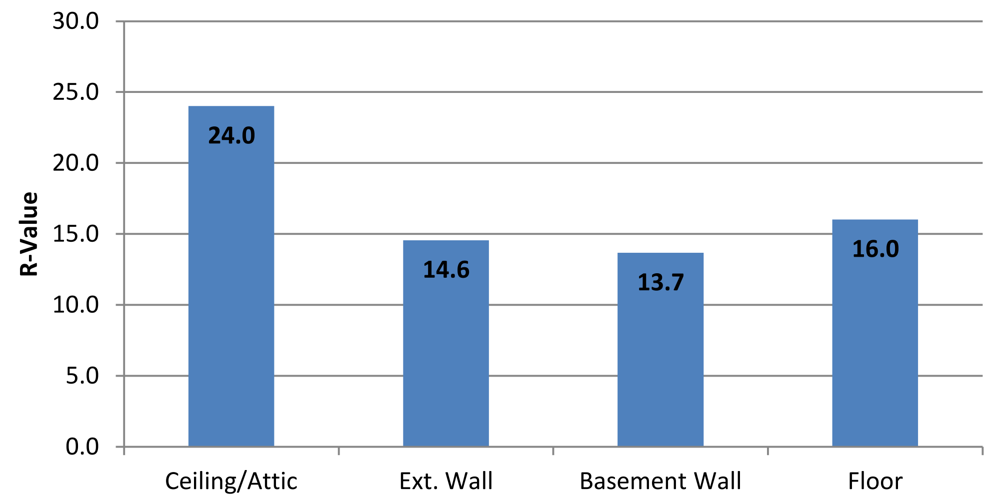
<u>Building Shell</u>

Insulation. Insulation was verified to be absent in 9% of attics/ceilings and 19% of exterior side walls. Insulation was less common in basement walls or floor space. The average R-value of insulation, when present, is depicted in the tables below for all houses statewide.

Figure C-4: Average Insulation R-Value by Location







Windows. On average, houses statewide have a total of 17 windows per residence. The average square footage of window area per home is 150 square feet. Twelve percent of all surveyed windows statewide were single-paned windows. Approximately 19% of surveyed windows were believed to be double-pane low-E or triple-paned windows. The majority of windows were standard double-paned.

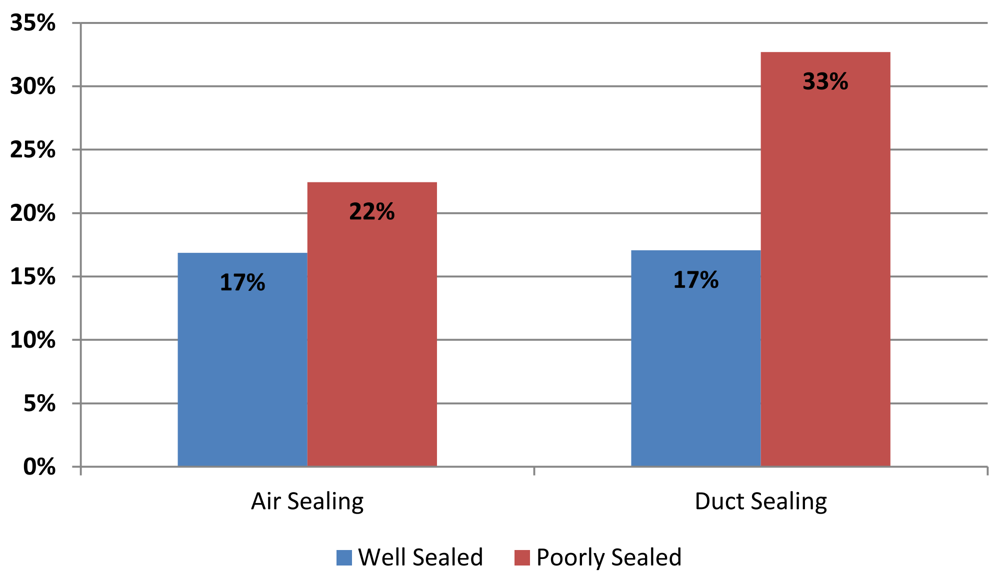
Table C-1: Average Number of Windows, Window Area, and Glazing Type

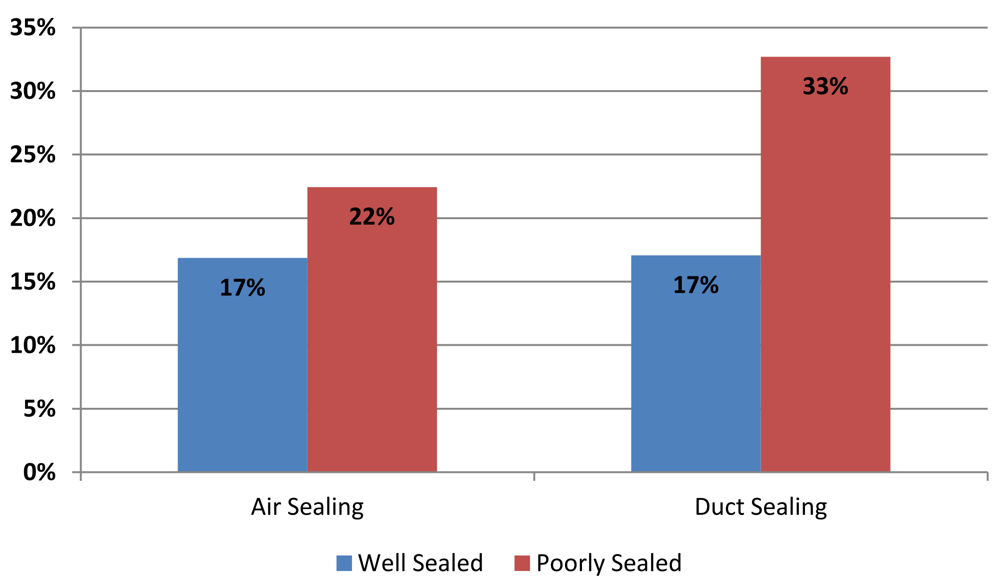
Average # per Home	Average Window Area per Home	% of All Windows Single-Pane	% of All Windows Double Pane	% of All Windows DP Low-E or Triple Pane
17	150	12%	69%	19%

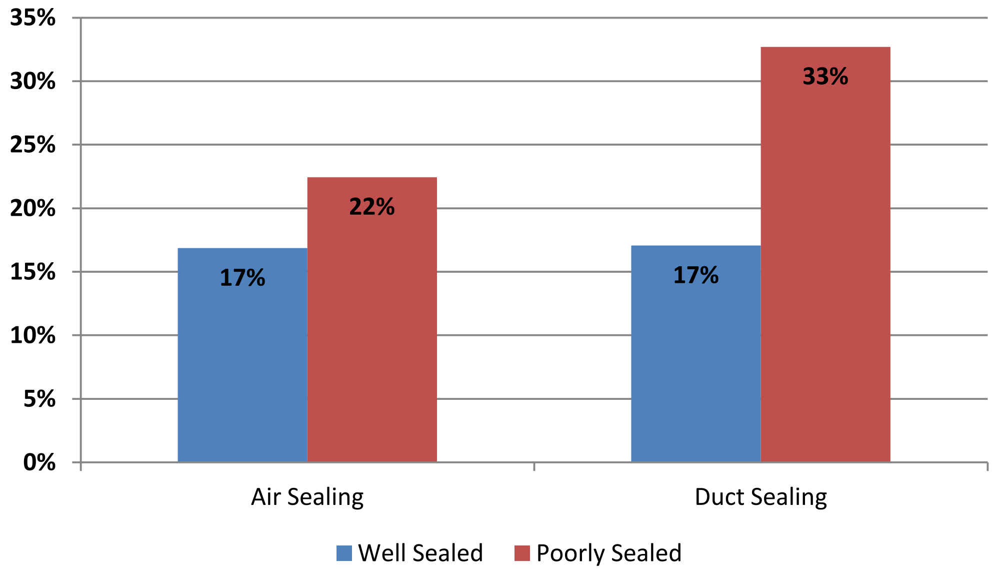
Air/Duct Sealing. Proper air sealing and duct sealing was qualitatively assessed during the on-site surveys. Surveyors were asked to examine residences for signs of air leakage at or around door and window sills, recessed can lighting, HVAC closets, or other points of entry. Ductwork was also examined for proper sealing techniques, including mastic or rated duct tape around a sampling of joints.

In general surveyors found that 17% of all surveyed homes statewide were well sealed in terms of air infiltration and duct-sealing quality. Air sealing was assessed as poor in 22% of surveyed homes, while duct sealing was assessed as poor in 33% of homes, suggesting a sizeable opportunity for proper duct sealing procedures.

Figure C-5: Air Sealing and Duct Sealing Quality





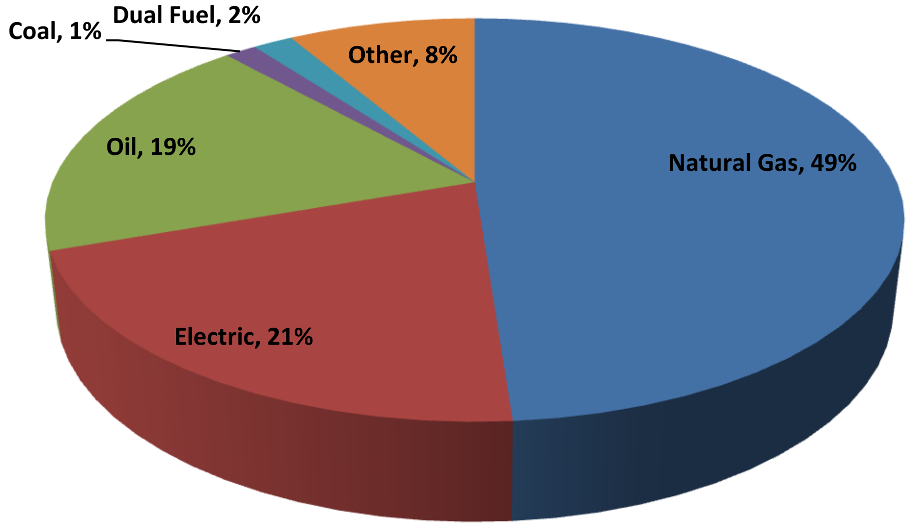


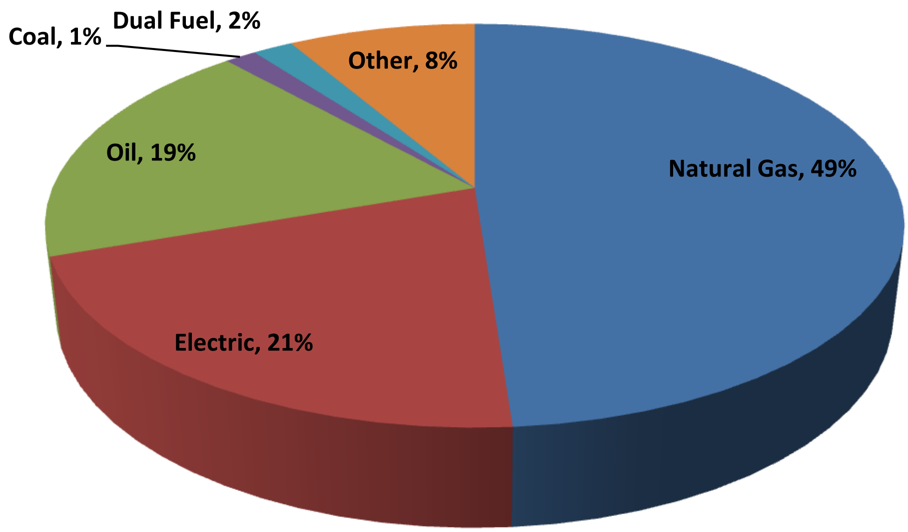
HVAC Equipment

Heating Fuel Type. Natural gas was the most common form of primary heating fuel-type statewide (49%). Electric heating was the primary fuel in 21% of households statewide. Oil heating systems were present in 19% of households. Other category includes propane, kerosene, and wood heating.

System Type (Primary Electric). The majority of all heating systems are central furnaces across all heating types; the majority of primary electric heating systems are air source heat pumps (43%). Baseboard heating is also common among primary electric systems (28% of all electric heated homes statewide), and electric furnaces are found in 16% of primarily electric-heated homes. The remaining 13% of primary electric systems include geothermal, wall-mounted space heating, and electric boilers.

Figure C-6: Primary Heat Fuel Type (All Fuels)

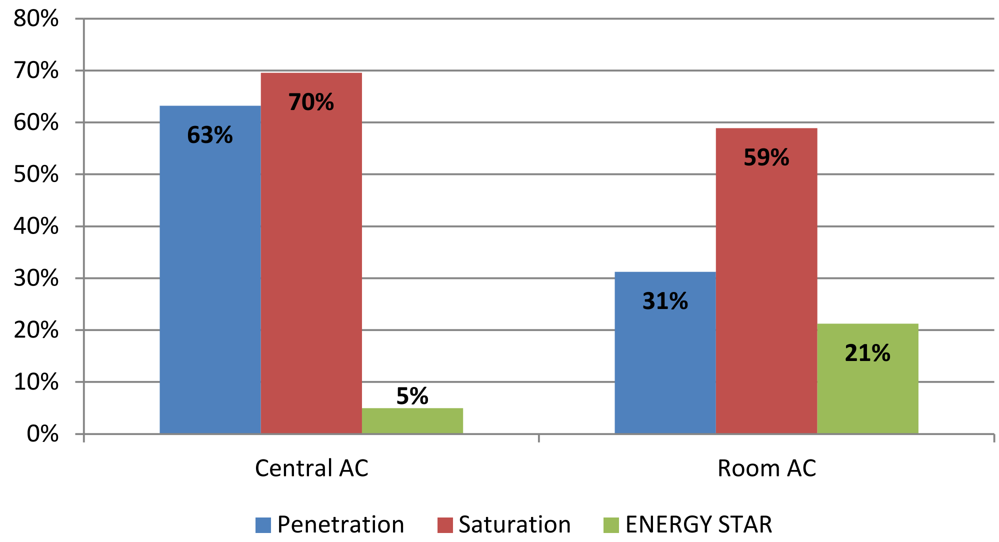


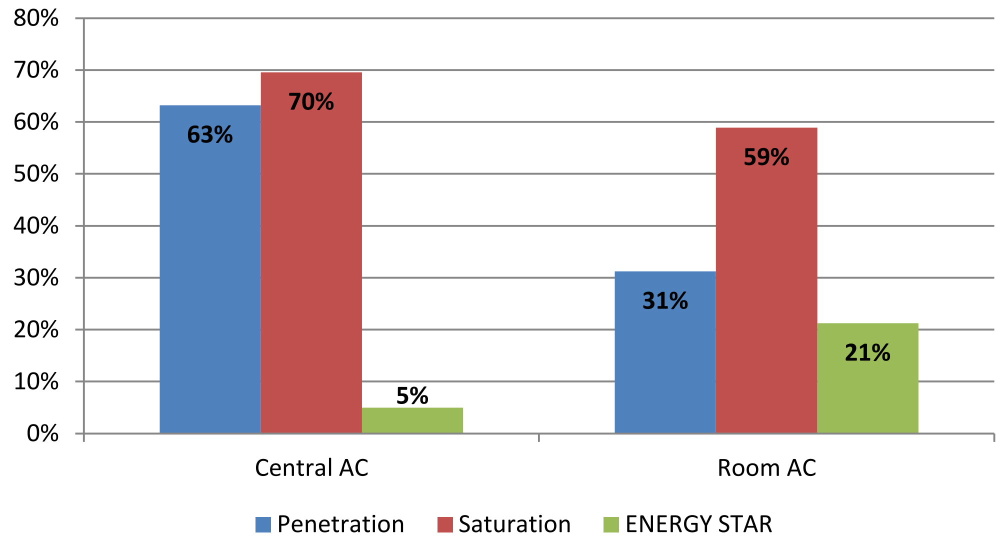


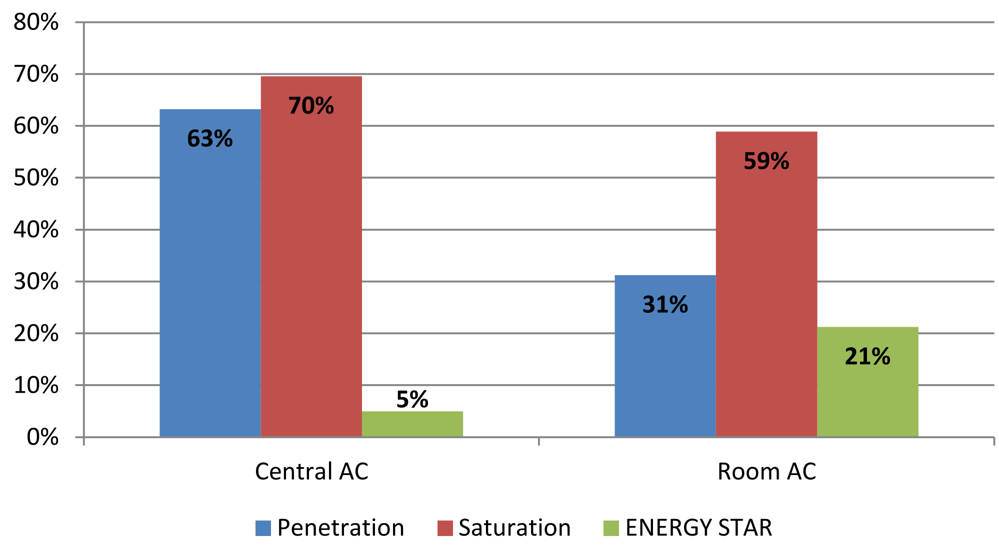
Cooling. Sixty-three percent of homes have at least one central air conditioner and 31% of homes have at least one room air conditioner. After accounting for residences with multiple central or room air conditioning units, the saturation of central air conditioning in Pennsylvania households is 70% and the saturation of room air conditioners is 59%.

Only 5% of all central air conditioning, including central air only, heat pumps and mini-split systems, were verified to have a SEER rating of 14.5 or better (currently meeting or exceeding ENERGY STAR standards). For comparison, 32% of central air conditioners in residences statewide are currently below the minimum federal efficiency standard of SEER 13. Room air conditioners fared better: 21% of room air conditioners were either verified to possess an ENERGY STAR rating or exceeded current ENERGY STAR compliancy standards.

Figure C-7: Penetration and Saturation of Cooling Systems







Lighting

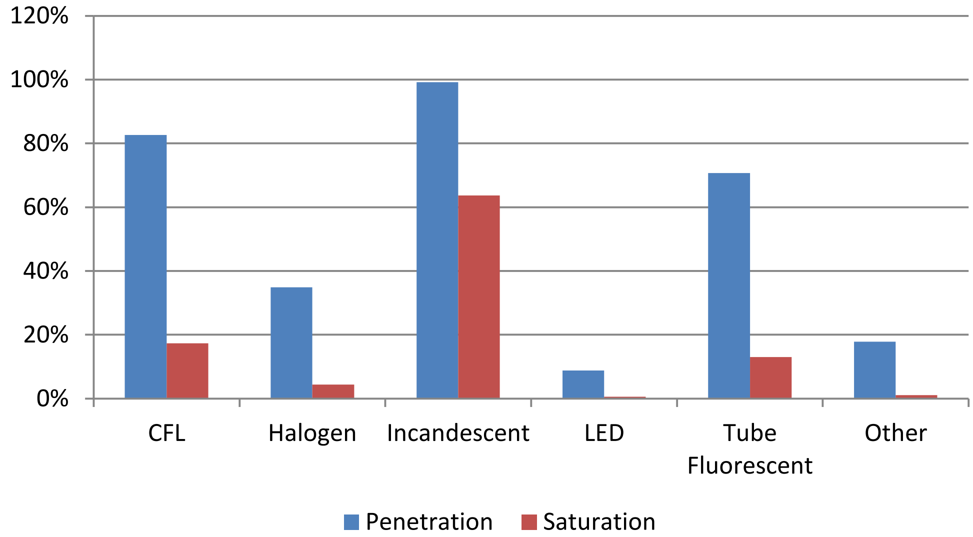
Sockets per Home. On average, there were a total of 54 interior lighting sockets per home across all housing types statewide. SF-Detached housing had an even greater number of average sockets (63), followed by SF-Attached housing (37) and multifamily housing (25).

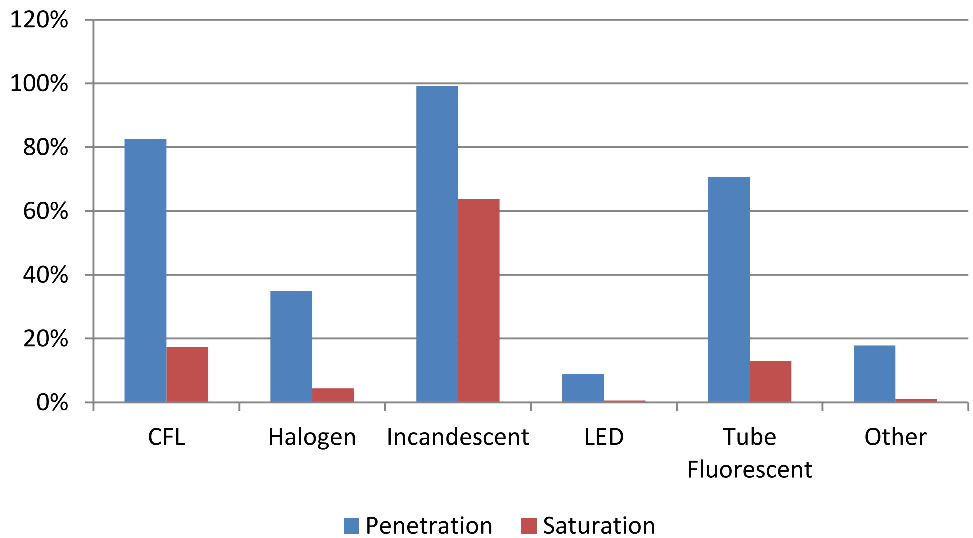
In addition to interior lighting, the average number of exterior lighting sockets was six. SF-Detached housing averaged 8 exterior bulbs per home, while other housing types typically had 2-4 exterior sockets per home.

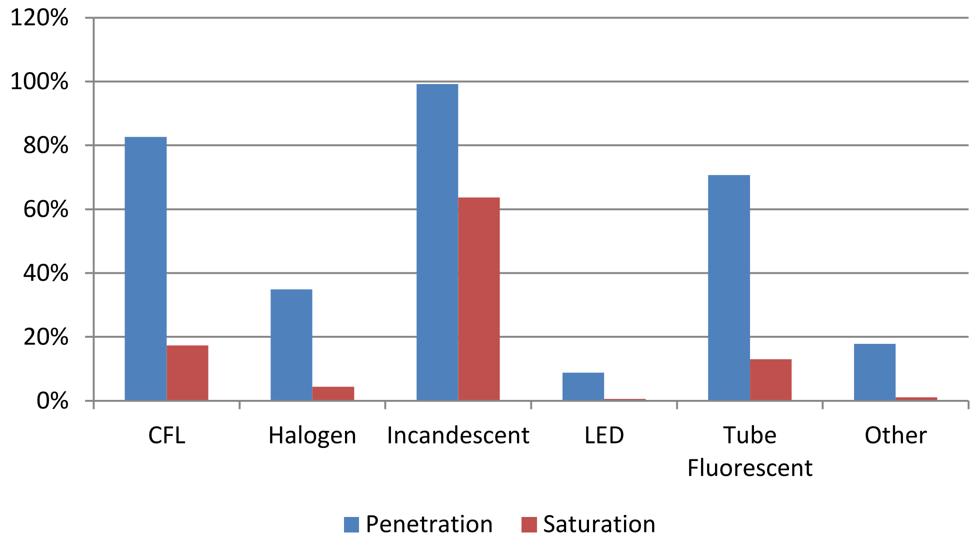
Bulb Type. The penetration and saturation of lighting by bulb type is present in Figure C-8 below. Lighting saturation refers to the proportion of lighting composed of the given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding penetration. Nearly 83% of all housing units statewide possess at least one compact fluorescent light (CFL) bulb. However, CFLs are only found in 17% of all sockets statewide. Incandescent lighting, by contrast, is found in 99% of all homes and 64% of all sockets.

Not all sockets can easily be retrofitted with efficient lighting options. After eliminating current tube fluorescent lighting, certain specialty lighting, and sockets that are currently empty the average number of sockets per home that could reasonably be expected to receive CFL bulbs is reduced to 45 interior sockets. Based on this reduced socket count, current CFL saturation increases to 21%.

Figure C-8: Penetration and Saturation of Lighting by Bulb Type



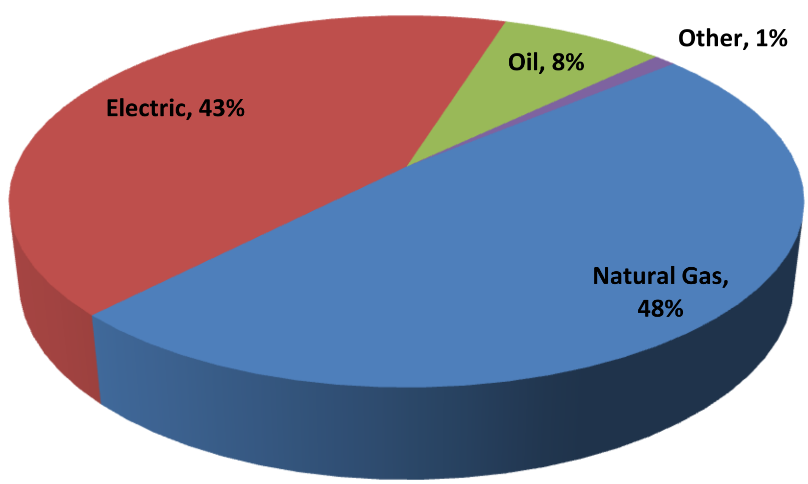


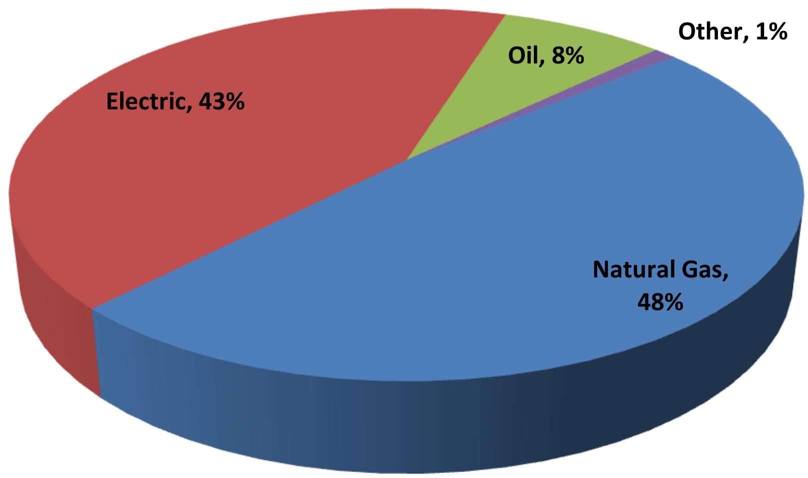


Water Heating

Fuel Type. The most common fuel type for domestic water heating is natural gas (48%), followed by electric (43%), and oil (8%). Other forms of domestic water heating, such as propane, solar, and wood are relatively uncommon.

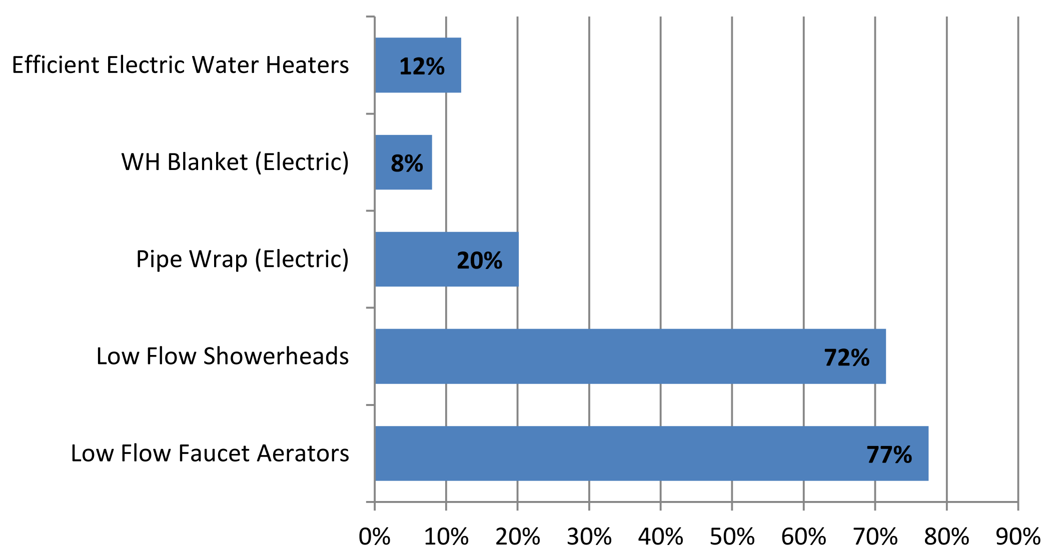
Figure C-9: Water Heating Fuel Type

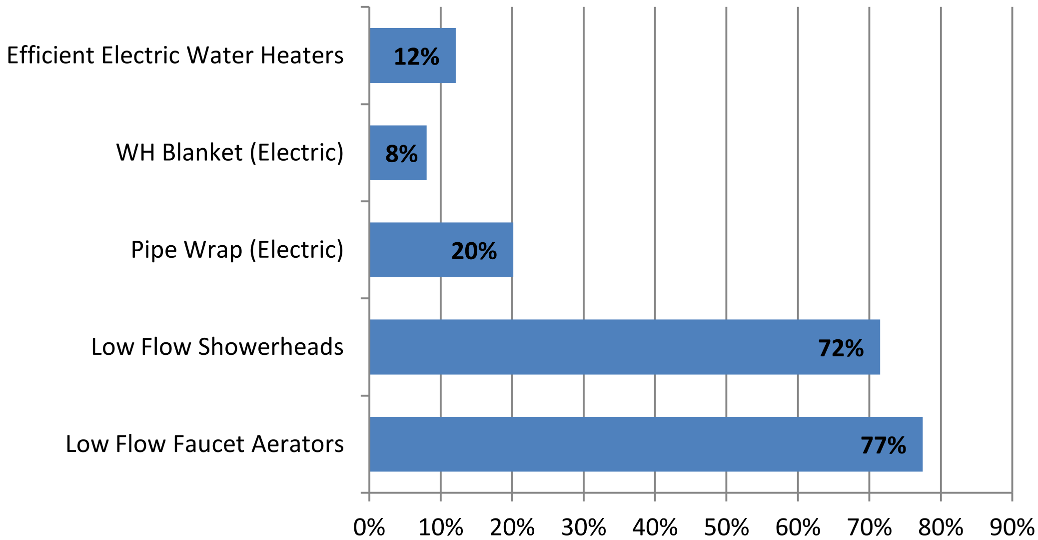


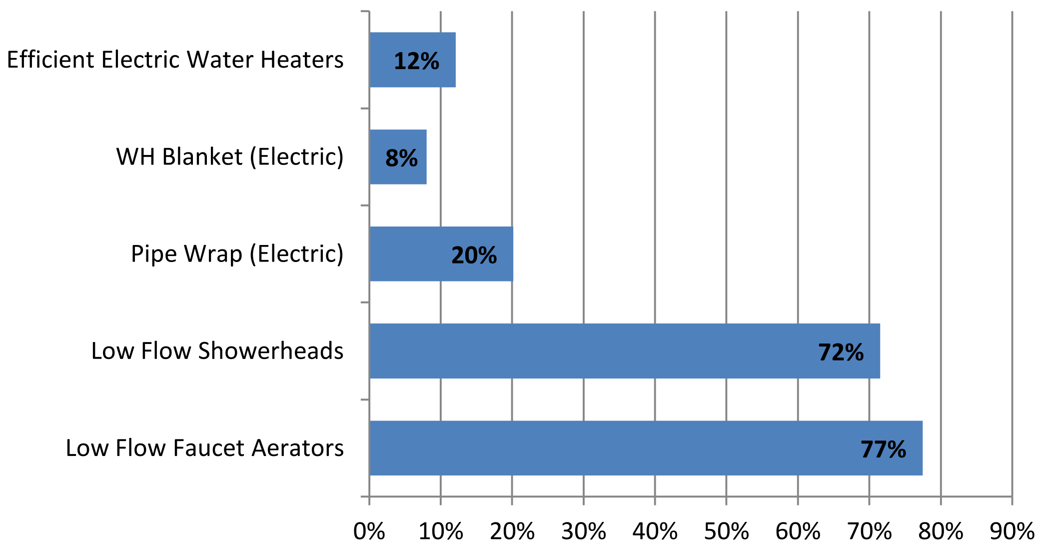


Efficient Water Heating Measures. The figure below describes the % of equipment related to water heating that is currently energy efficient. Twelve percent of electric water heaters currently have an energy factor (EF) =.93 or above. Additionally, 8% of electric water heaters are currently equipped with a water heater blanket (tank wrap) and 20% of pipes at or around the water heater are currently wrapped to reduce stand-by losses.

Figure C-10: Water Heating Efficiency Measures






Efficient Electric Water Heaters
12%
WH Blanket (Electric)
8%
Pipe Wrap (Electric)
20%
Low Flow Showerheads
72%
Low Flow Faucet Aerators
77%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%

Low flow showerheads and faucet aerators were fairly common among surveyed housing units. Nearly 72% of all showers were equipped with the low-flow showerheads and 77% of all sinks were equipped with faucet aerators.

<u>Appliances and Other</u>

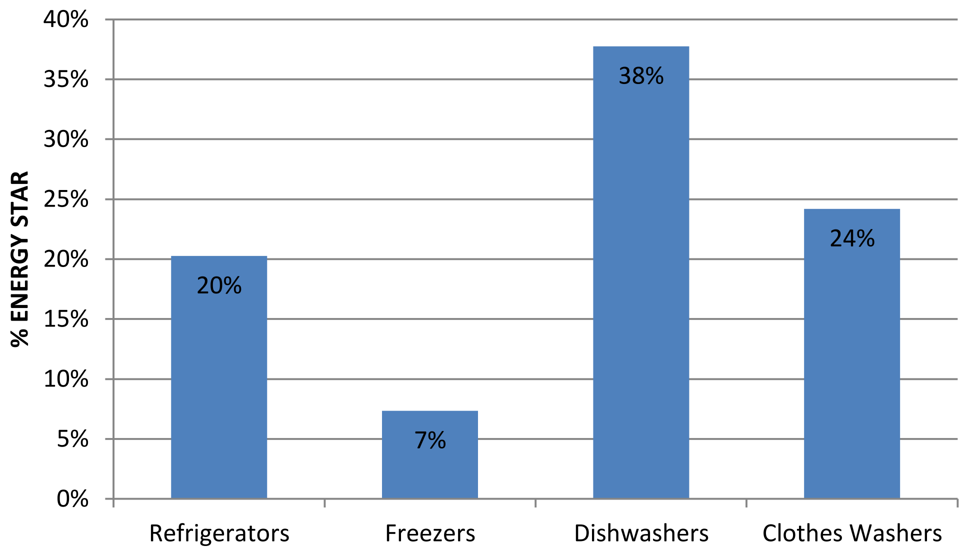
Appliance Penetration and Saturation. The table below outlines the penetration and saturation of all remaining major appliances, consumer electronics, and other common equipment for which we collected data. The saturation percentage is typically higher than the corresponding penetration because some households will have more than one of the appliance.

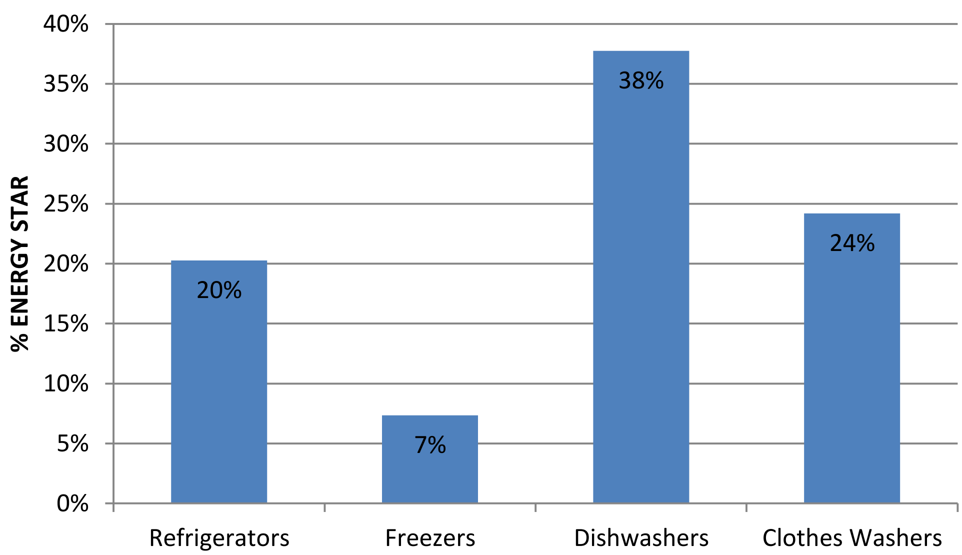
Table C-2: Penetration and Saturation of Major Appliances and Other Equipment

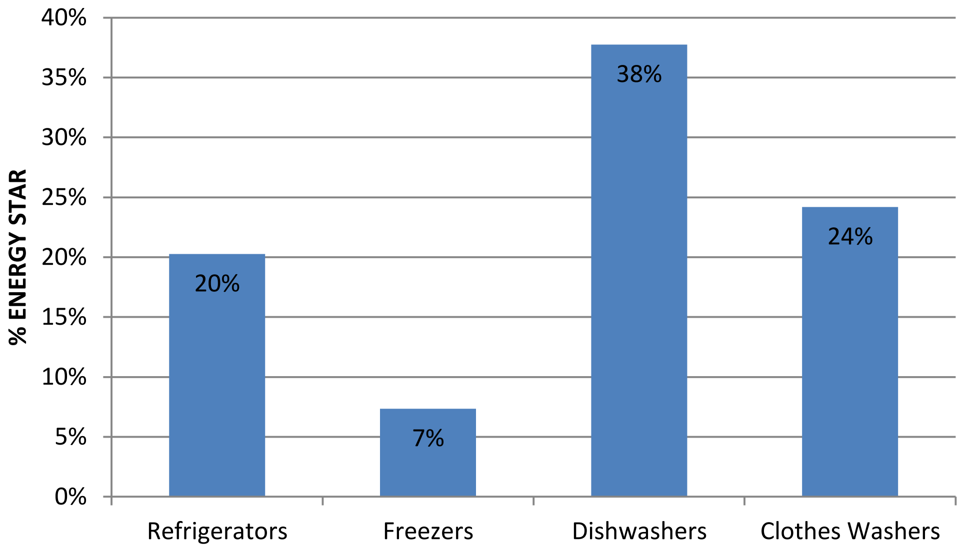
Equipment	Penetration	Saturation
Major Appliances		
Refrigerators	99%	140%
Freezers	39%	43%
Dishwashers	71%	71%
Clothes Washers	91%	92%
Electronics		
Televisions	98%	301%
PC (Desktop/Laptop)	89%	164%
Tablet PCs	11%	11%
DVD Players	87%	132%
VCR	44%	57%
Gaming Systems	41%	57%
Fax Machines	13%	15%
Stereo Systems	58%	73%
Home Theater	24%	26%
Mobile Phone Charger	89%	177%
Seasonal		
Dehumidifiers	42%	44%
Humidifiers	17%	19%
Ceiling Fans	79%	257%
Recreational		
Pools	10%	10%
Hot Tubs	6%	6%

Major Energy Star Appliances. Of the major appliances, dishwashers were the most common ENERGY STAR rated appliance. 36% of all dishwashers were verified to have been ENERGY STAR rated either by visual inspection or through manufacturer data. Similarly 24% of clothes washers, 20% of primary refrigerators, and 7% of freezers were verified to have been ENERGY STAR rated.

Figure C-11: ENERGY STAR Appliances







It should be noted that there are likely occasions where an appliance was ENERGY STAR compliant at one time, but may have since lost its rating due to increased efficiency standards. For purposes of this study, appliances that were once designated as ENERGY STAR (but would not meet current and updated standards) were included in the pool of efficient appliances.[469]

EDC Overview

In addition to presenting results at the statewide level, the Study also provided the results of the on-site surveys collected for each of the EDCs. EDC level results have been weighted based on housing type and age of head of household.

[469] This reporting is consistent with the SWE's method for estimated energy efficient technology saturations used in the SWE Efficiency Potential Study.

Electric Fuel Share by End Use

The percentage of homes that are primarily heated, with electricity, not including dual fuel systems, ranged from 8% in the Duquesne service area to 30% in the MetEd territory. Electric space cooling, either in the form of central cooling systems or room air conditioners, ranged from 69% in the Penelec area to 98% in the MetEd territory. Electric water heating ranged from 11% of surveyed homes (Duquesne) to 57% (MetEd). Other major electric end-uses (lighting, appliances, and electronics) were found in 100% of surveyed homes.

Table C-3: Electric Fuel Share by End Use

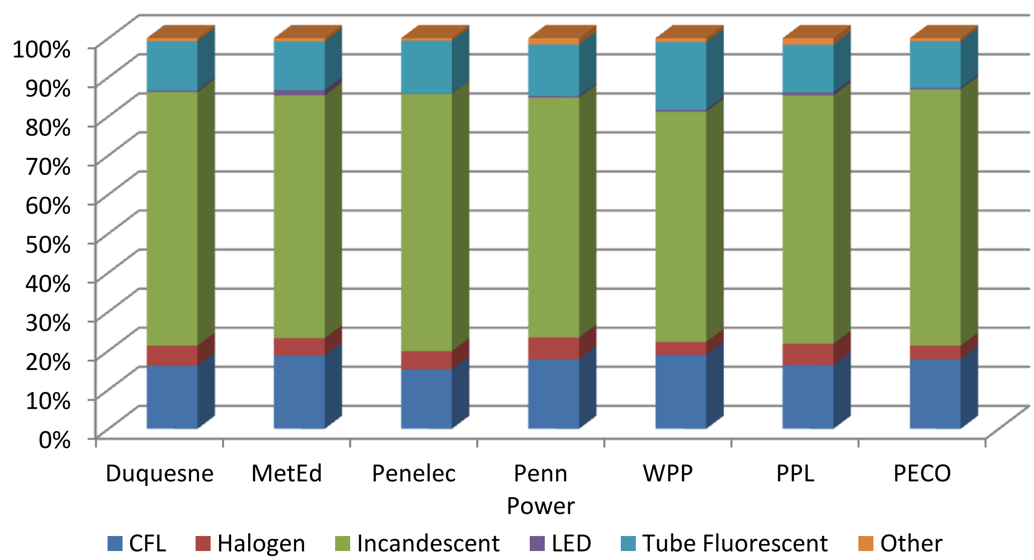
Electric End Use Share	Duquesne	MetEd	Penelec	Penn Power	WPP	PPL	PECO
Primary Space Heating	8%	30%	11%	23%	28%	29%	15%
Space Cooling	94%	99%	69%	93%	87%	88%	98%
Water Heating	11%	57%	38%	42%	54%	56%	32%
Lighting	100%	100%	100%	100%	100%	100%	100%
Appliances/Plug Load	100%	100%	100%	100%	100%	100%	100%

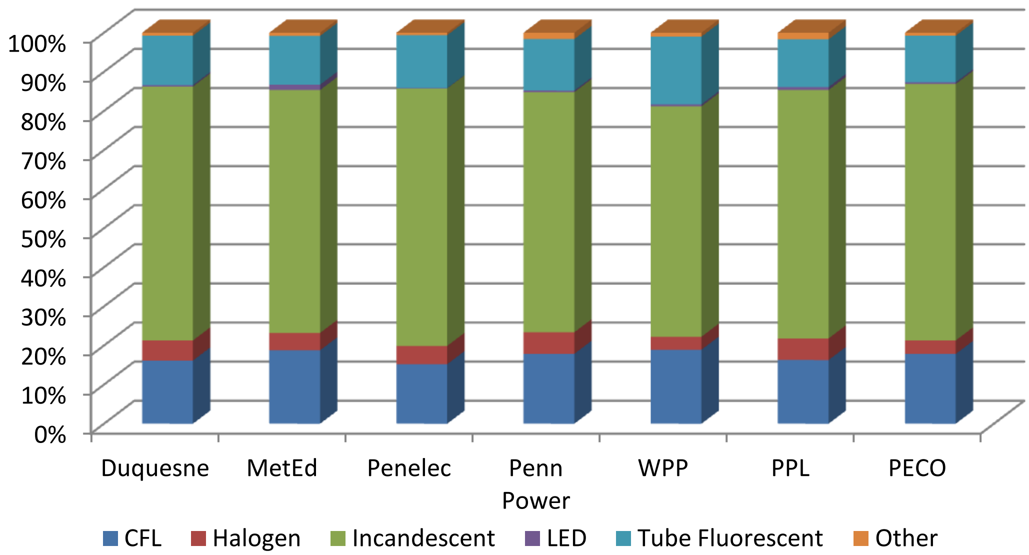
Lighting

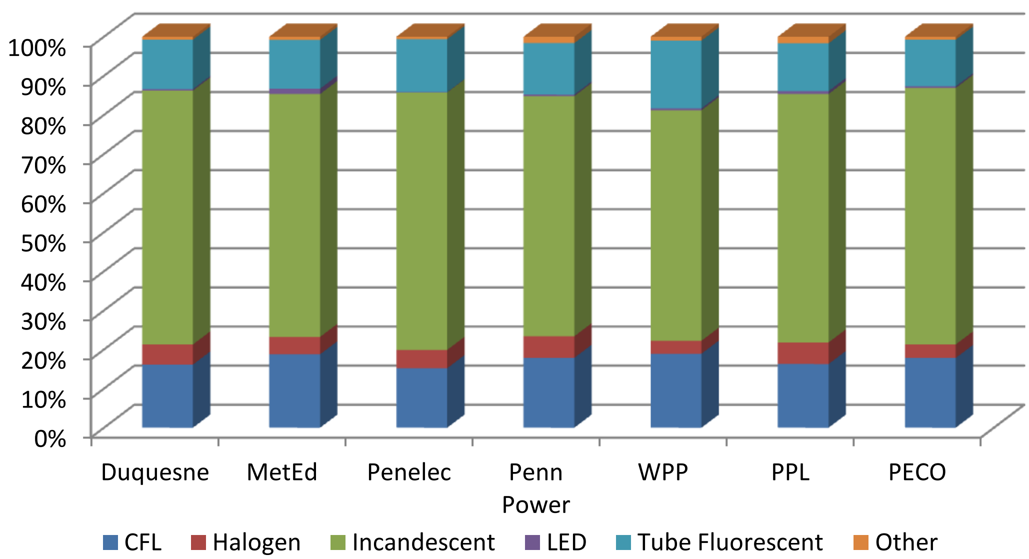
Figure C-12 demonstrates the saturation of all interior sockets by bulb type. In general, 15%-19% of all interior sockets were fitted with compact fluorescent light (CFL) bulb technology. By contrast, the saturation of incandescent lighting ranged from 59% to 66% of all interior sockets. The saturation of LED bulb technology is almost non-existent (1% or less) across the EDCs.

After accounting for interior lighting sockets where CFL bulbs are unlikely to be replaced due to incompatible socket and bulb types (i.e. current fluorescent tube fixtures, pin-based halogens, and other specialty bulbs), the saturation of CFL lighting increases to 18%-23% of all eligible bulb types.

Figure C-12: Interior Lighting Socket Saturation by Bulb Type



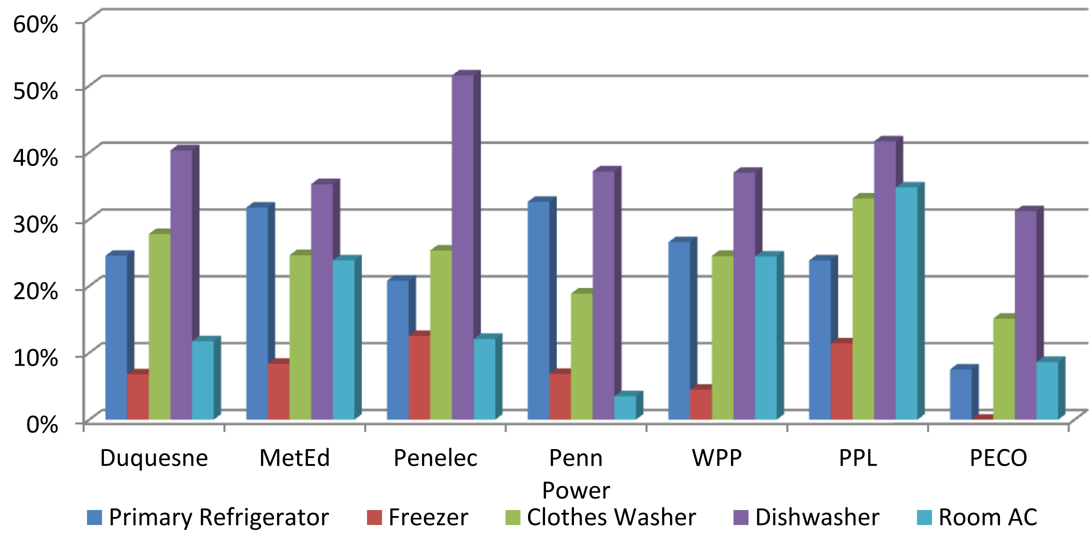

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Duquesne
MetEd
Penelec
Penn Power
WPP
PPL
PECO
CFL
Halogen
Incandescent
LED
Tube Fluorescent
Other

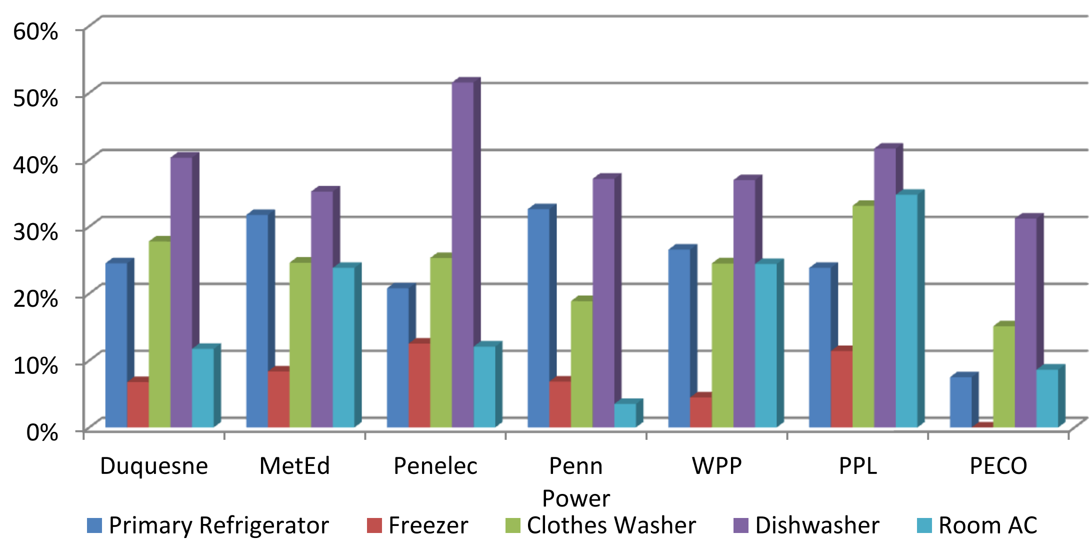

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Duquesne
MetEd
Penelec
Penn Power
WPP
PPL
PECO
CFL
Halogen
Incandescent
LED
Tube Fluorescent
Other

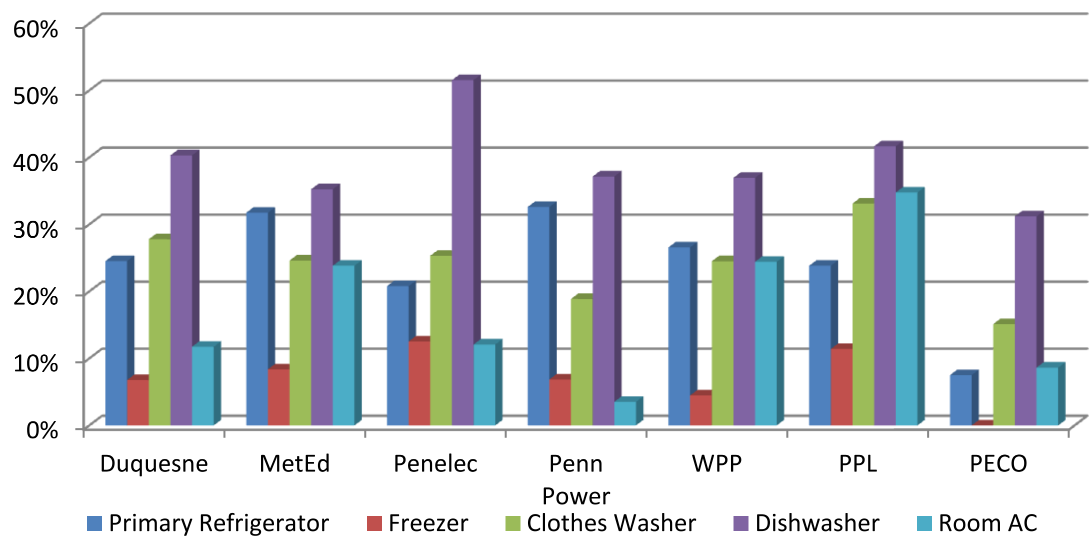
ENERGY STAR Saturation for Select Appliances

In general, dishwashers and refrigerators were the two appliances most likely to possess an ENERGY STAR rating in households across the seven EDCs, followed by clothes washers and room air conditioners. Stand-alone freezers were generally found to not have the ENERGY STAR rating.

Figure C-13: ENERGY STAR Saturation of Select Appliances by EDC







C.2.2 Commercial Baseline Study

Pennsylvania Commercial & Industrial Statewide End-Use and Saturation Study, April 18, 2012

The purpose of the SWE C&I Baseline Study[470] was to establish baseline energy usage characteristics for the commercial and industrial (C&I) sectors served by the seven EDCs subject to the consumption and demand reduction mandates of Act 129.[471] The study documented the findings of the C&I sectors' end-use energy usage and saturation,[472] and also provided baseline energy usage characteristics for the subsequent SWE Energy Efficiency Potential Study, which supported the Commission's establishment of energy consumption reduction targets for Phase II of Act 129.[473] Primary data were collected for the study from October 2011 to February 2012.[474]

The Study evaluated the characteristics of the energy using equipment and building stock present in Pennsylvania for the seven subject EDC service territories. SWE Team member Nexant used its experience working with the Pennsylvania EDCs in the evaluation of their current EE&C Plan programs,

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[470] PA PUC website, www.puc.pa.gov/electric/pdf/Act129/PA_CI_Baseline_Report2012.pdf.
[471] The SWE did not collect primary data as part of its on-site survey for PECO, but rather relied on data collected as part of the 2011 baseline report for PECO published by Navigant Consulting, prepared February 7, 2011.
[472] The term "saturation" refers to the percentage of buildings with a given end-use present. In some cases, saturation is also given for equipment types, in which case it refers to the percentage of buildings that have a specific equipment type present in buildings with the relevant end use.
[473] See Phase II Implementation Order, p. 11.
[474] Primary data were collected for the PECO study in Spring 2010.

and performing previous energy efficiency potential studies to identify output parameters integral to future resource planning and energy efficiency activities in Pennsylvania.

While a number of end use studies have been conducted on national and broad regional levels, at the time the Study was conducted there was a notable absence of data specific to Pennsylvania. To overcome this hurdle, Nexant conducted a survey of Pennsylvania C&I customers to gather accurate data specific to Pennsylvania and the six EDC service territories included for which the SWE collected primary on-site data (primary on-site data for PECO from Navigant's study was included where possible).

In order to maximize the reliability of the survey, Nexant gathered information through customer site visits. Therefore, the results of the Study relied mainly upon primary research conducted in the form of on-site customer surveys. A review of available secondary sources was also performed in an effort to streamline and compliment primary research efforts in addition to filling in gaps – either in the presence or quality of data.

Methodology

To accurately meet the objectives of the Study, Nexant designed an approach that successfully melded the results of both primary and secondary data sources. The Study began by analyzing the EDC customer billing data to provide a framework in which to gather additional primary and secondary data. The Study evaluated the characteristics of Pennsylvania's building stock by performing 418 C&I on-site customer surveys in six EDC territories (Nexant did not perform site surveys in the PECO territory, but rather incorporated results from a recent baseline study in its territory where possible). These surveys were designed to inventory the current energy using equipment with regards to type, fuel, efficiency, saturations and operating conditions, as well as document the characteristics of the buildings themselves.

In part serving as a primary data source for the energy efficiency potential assessment, Nexant designed the study parameters and survey instruments around the anticipated structure and content of the SWE Energy Efficiency Potential Study. On-site surveys were targeted at the customer segments which provide a representative sample of Pennsylvania businesses. Likewise, the energy end uses included in this study were selected to encompass typical building energy-using equipment. Moreover, the end uses encompass the typical energy efficiency measures in typical energy efficiency programs.

To provide statistically relevant results that can be reasonably applied to the C&I population of Pennsylvania, the SWE designed the study sample to produce findings with a 95% confidence level and a 5% margin of error (95/5) for the entire non-residential population (C&I combined) across the Commonwealth. Further levels of resolution were developed to characterize differences among EDCs, the C&I sectors and commercial segments. In developing its survey strategy, the SWE used a stratified sampling approach based on "highest potential impact" with the targeted minimum confidence/precision criteria as follows:

- 95/5 for the state-wide non-residential (C&I combined) sector
- 90/10 for the state-wide industrial sector
- 90/10 for major commercial segments at the state-wide level
- 90/10 for each EDC's non-residential sector

Statewide Findings

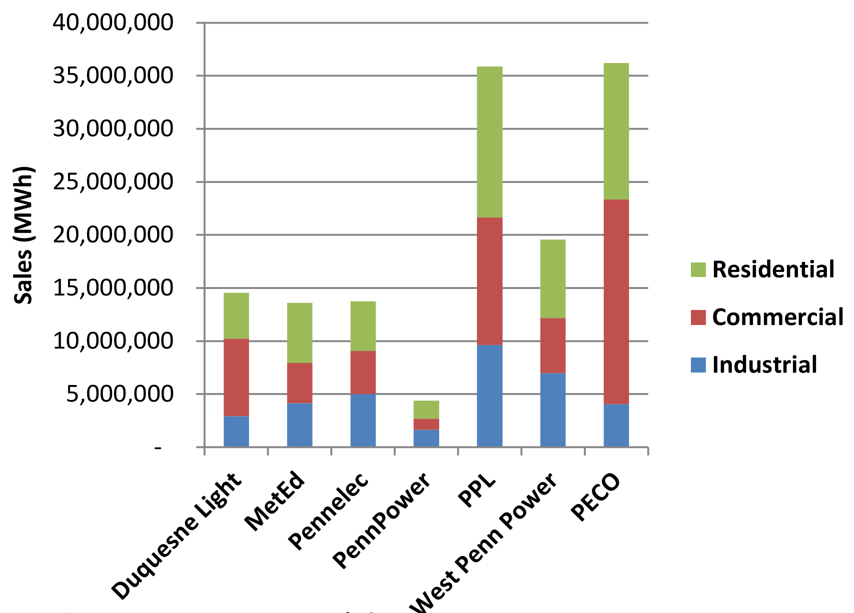
The Study evaluated customers associated with the non-residential electric supply loads of the seven largest EDC territories, totaling 99.1% of Pennsylvania's total residential and non-residential electrical load from EDCs[475]. Because the Study presented findings on building premises, energy findings, presented below, did not include transmission, substation, irrigation or lighting rate classes. Through analysis of EDC customer databases, on-site surveys, and secondary research, Nexant was able to break out the commercial energy usage by sector, commercial segment and end use. Results are presented below.

[475] Based on 2010 sales. *Electric Power Outlook for Pennsylvania Report,* 2010.

Electricity Consumption by Sector

The Figures and Table below show the overview of the electric sales by sector by EDC in Pennsylvania for calendar year 2010[476]. The commercial sector is the largest sector with 38.2% of electricity sales, followed by residential and industrial. As shown below, PECO is the largest EDC, in terms of both premises and sales.

Figure C-14: 2010 Statewide Electricity Sales by Sector, by EDC



Source: Customer Datasets, Nexant Analysis

[476] PECO figures are for June 2009 to May 2010.

Table C-4: 2010 Statewide Premise Counts and Sales by Sector, by EDC

EDC	2010 Premises			
	Industrial	Commercial	Residential	Total
Duquesne Light	1,224	40,348	524,406	565,978
MetEd	6,034	35,780	485,969	527,783
Pennelec	7,759	47,321	505,344	560,424
PennPower	1,964	12,527	140,101	154,592
PPL	10,905	92,112	1,224,602	1,327,619
West Penn Power	6,183	54,024	619,584	679,791
PECO[(1)]	7,688	93,873	1,400,000	1,501,561
Statewide	**41,756**	**375,986**	**4,900,006**	**5,317,748**

EDC	2010 Sales (MWh)			
	Industrial	Commercial	Residential	Total
Duquesne Light	2,908,498	7,314,744	4,326,339	14,549,581
MetEd	4,148,279	3,771,988	5,666,240	13,586,507
Pennelec	5,011,243	4,064,187	4,655,812	13,731,243
PennPower	1,623,329	1,068,515	1,696,442	4,388,286
PPL	9,618,254	12,041,062	14,205,788	35,865,104
West Penn Power	6,979,686	5,168,517	7,407,912	19,556,115
PECO[(1)]	4,059,704	19,271,928	12,880,403	36,212,035
Statewide	**34,348,993**	**52,700,941**	**50,838,937**	**137,888,871**

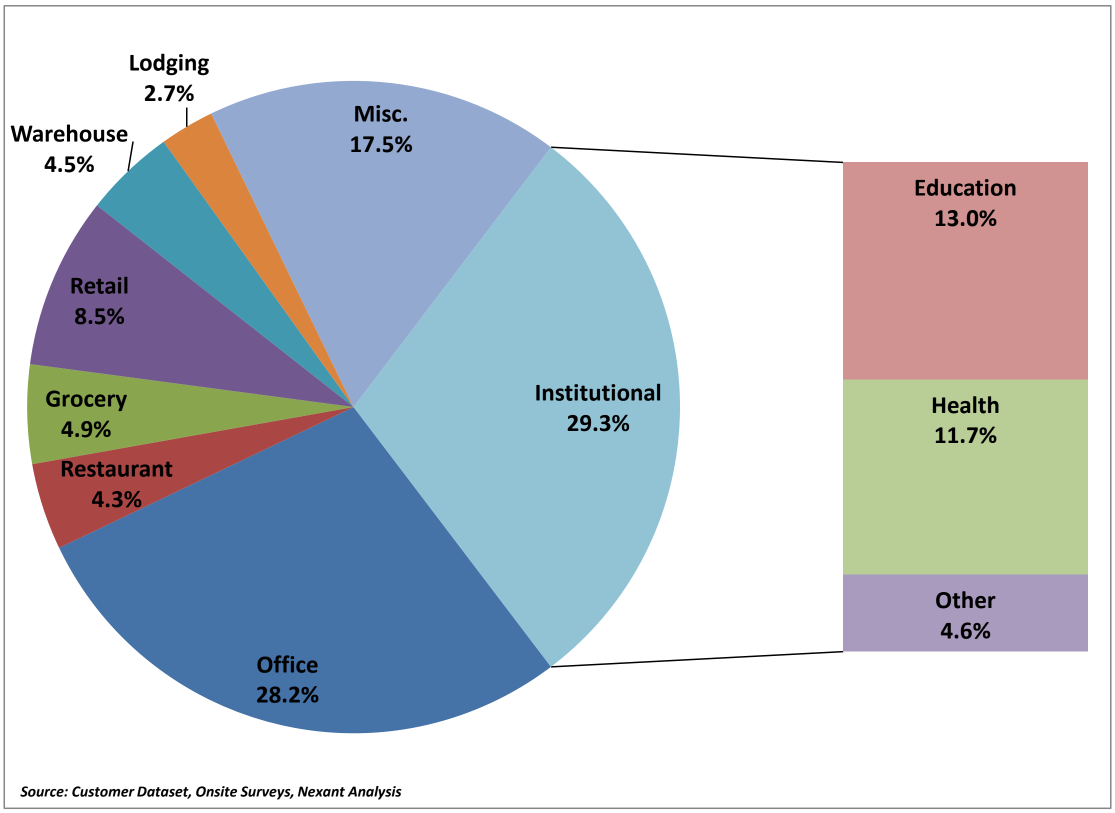
Source: Customer Datasets, Nexant Analysis

[(1)] PECO residential customer and sales figures are for June 2009 to May 2010

Electricity Consumption by Segment

Figure C-15 and Table C-5 show the breakdown of energy consumption and building stock by commercial segment. Table C-6 shows the same breakdown by industrial segment. The institutional segment consumes the largest share of electricity (29.3%) across the Commonwealth in the commercial sector, followed by the office segment (28.2%). The office segment also comprises more than one billion square feet of floor space. The manufacturing of metals consumes the largest share of electricity in the industrial sector (29.2%) with a number of steel manufacturers located throughout the Commonwealth followed by "other" manufacturing at 23.9%[477].

Figure C-15: 2010 Statewide Electricity Consumption by Commercial Segment



[477] Other manufacturing consists of a variety of manufacturing types such as apparel, furniture, leather, lumber, textile, tobacco, and misc.

Table C-5: 2010 Statewide Electricity Consumption by Commercial Segment

Segment	Building Stock (ft²)	Consumption (MWh)	Electricity Share
Institutional	**833,943,779**	**15,460,540**	29.3%
Education	Nx[(1)]	6,858,876	13.0%
Health	276,227,425	6,166,279	11.7%
Other	557,716,354	2,435,385	4.6%
Office	**1,054,798,396**	**14,859,623**	28.2%
Restaurant	**62,191,985**	**2,284,546**	4.3%
Retail	**272,203,100**	**7,050,787**	13.4%
Grocery	55,854,380	2,577,430	4.9%
Retail	216,348,720	4,473,357	8.5%
Warehouse	**355,597,286**	**2,390,718**	4.5%
Misc.	**1,163,797,719**	**10,654,727**	20.2%
Lodging	100,951,063	1,418,697	2.7%
Other	1,062,846,656	9,236,030	17.5%
Total Commercial	**3,742,532,265**	**52,700,941**	100.0%

Source: Customer Dataset, On-site Surveys, Nexant Analysis
[(1)] *Specific building stock data unavailable for education – therefore is rolled into the "Other" sub-segment for Institutional*

Table C-6: 2010 Statewide Electricity Consumption, by Industrial Segment

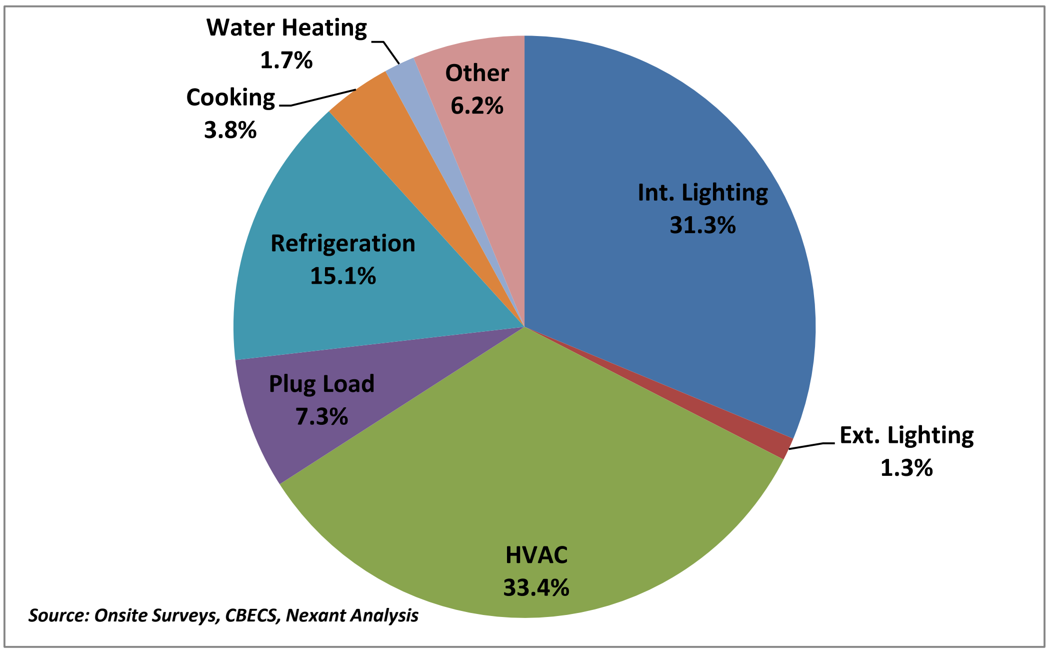
Segment	Consumption (MWh)	Electricity Share
Mfg: Chemicals	2,814,937	8.2%
Mfg: Computers	2,094,323	6.1%
Mfg: Food	3,185,786	9.3%
Mfg: Metals	10,030,211	29.2%
Mfg: Other	8,209,110	23.9%
Mfg: Paper	2,008,114	5.8%
Mfg: Plastics	2,242,259	6.5%
Mining	2,135,127	6.2%
Other Non-Mfg.	1,629,127	4.7%
Total Industrial	**34,348,993**	100.0%

Source: Customer Dataset, Nexant Analysis

Electricity Consumption by End Use

Figure C-16 and Figure C-17and show how energy is consumed by end use in the commercial and industrial segments, respectively.[478] HVAC systems consumed the largest share of electricity in buildings (33.4%), followed by interior lighting at over 31% and refrigeration (15.1%). The "Other" end use represents primarily pumps and other miscellaneous loads in buildings. In the industrial sector, motors consume almost half (43.6%) of all the electricity across the state. Process loads (heating, cooling and electro-chemical) make up another 30% of the electricity consumption.

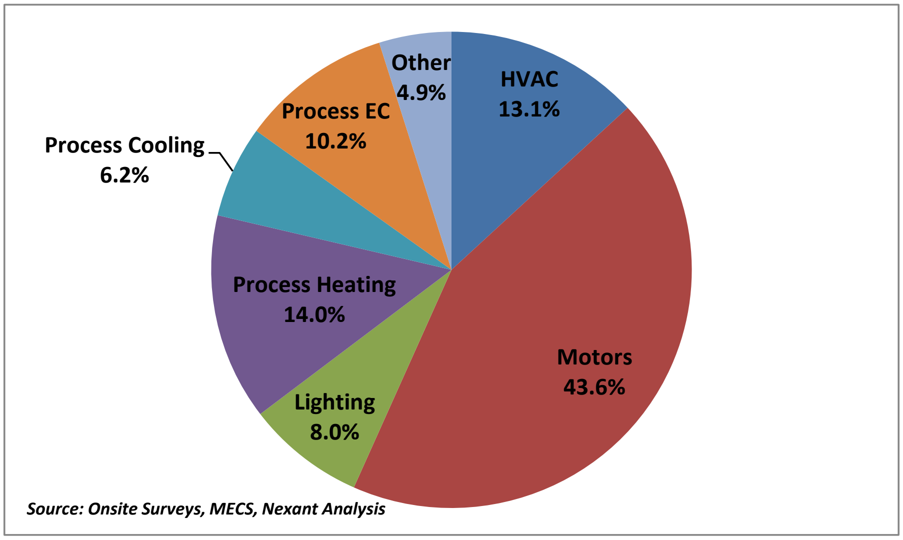
Figure C-16: 2010 Statewide Commercial System Electricity Usage by End Use[(1)]



(1) Excludes PECO

[478] Note: This data point does not include PECO.

Figure C-17: 2010 Statewide Industrial System Electricity Usage by End Use



Saturation & Fuel Share

The table below shows the saturations of different end uses in both the C&I sector along with fuel shares of those end uses. Saturation is defined as the percentage of buildings with a given end use present. In some cases saturation is also given for equipment types, in which case it refers to the percentage of buildings that have a specific equipment type present in buildings with the relevant end use. Space cooling is present in 80.4% of the buildings surveyed with cooking and refrigeration present in 40.6% and 26% of the buildings respectively. Fuel share is an important metric for energy efficiency program planning for the EDCs in Pennsylvania since they only provide electric service to their customers. Electricity provides only 27.7% of the fuel for space heating and 63.2% for water heating. Electricity fuels about two-thirds of cooking and water heating.

Table C-7: Non-Residential End use Saturations and Fuel Shares

End Use	Saturation	Fuel Share				
		Electric	Natural Gas	Fuel Oil	Other[(3)]	n-values
Lighting	100.0%	100.0%	0.0%	0.0%	0.0%	-
Space Heating	100.0%	27.7%	52.0%	13.0%	7.3%	646
Space Cooling	80.4%	100.0%	0.0%	0.0%	0.0%	-
Plug Load	100.0%	100.0%	0.0%	0.0%	0.0%	-
Refrigeration	26.0%	100.0%	0.0%	0.0%	0.0%	-
Cooking	40.6%	65.5%[(1)]	29.5%	5.1%	0.0%	498
Water Heating	84.5%	63.2%	32.4%	1.6%	2.7%	424
Other[(2)]	100.0%	100.0%	0.0%	0.0%	0.0%	-

Source: On-site Surveys
[(1)] Excludes PECO data
[(2)] "Other" End Use includes pumps and misc. equipment
[(3)] "Other" fuel share includes LPG, wood, and misc. fuels

Energy Use Intensity by End Use, by Commercial Segment

Energy use intensity (EUI) is a useful metric to measure how much electricity is consumed per square foot of building space and provides insight into how different building types and end uses consume electricity. SWE Team member Nexant calculated the EUI for each end use studied. These findings serve as crucial inputs into the Energy Efficiency Potential Study for the commercial sector and were calculated based on the findings from the on-site surveys and secondary data. Table C-8 shows the Energy Use Intensity by end use by commercial segment. The grocery segment, with a large refrigeration load, is the most energy-intensive at 50.1 kWh/ft². On the other end of the spectrum, warehouse is the least energy-intensive segment using only 7.1 kWh/ft².

Table C-8: Energy Use Intensity (kWh/ft²) by End use, Commercial Segment(1)

End Use	Grocery	Healthcare	Institutional	Lodging	Misc.	Office	Restaurant	Retail	Warehouse
Lighting	10.6	5.2	3.1	4.1	3.9	5.7	8.2	8.5	3.8
Ext. Lighting	0.4	0.2	0.1	0.2	0.2	0.2	0.3	0.4	0.0
HVAC	7.3	9.8	4.7	5.4	3.9	4.8	9.4	8.3	1.4
Plug Load	0.9	1.2	0.6	0.5	0.6	2.6	0.6	0.6	0.2
Refrigeration	28.6	0.7	0.7	1.0	0.9	0.6	9.9	1.5	1.0
Cooking	0.6	0.4	0.3	0.7	0.3	0.0	10.4	0.0	0.0
Water Heating	0.2	0.1	0.7	0.0	0.1	0.1	0.4	0.9	0.1
Other	1.4	2.2	2.0	0.8	0.9	0.1	1.2	1.2	0.6
Total	**50.1**	**19.9**	**12.2**	**12.7**	**10.7**	**14.1**	**40.4**	**21.3**	**7.1**

Source: On-site Surveys, CBECS, Nexant Analysis

(1) Values may not add up to presented total EUIs by segment due to rounding

C.3 Market Potential Studies

This section discusses the SWE Market Potential Study performed during Phase I of Act 129.

C.3.1 Electric Energy Efficiency Potential for Pennsylvania

Act 129 of 2008 states the following about determining cost-effectiveness for subsequent phases of Act 129 programs:

> "By November 30, 2013, and every five years thereafter, the Commission shall evaluate the costs and benefits of the program established under subsection (A) and of approved energy efficiency and conservation plans submitted to the program. The evaluation shall be consistent with a Total Resource Cost test or a cost-benefit analysis determined by the commission. If the Commission determines that the benefits of the program exceed the costs, the Commission shall adopt additional required incremental reductions in consumption."[479]

[479] 66 Pa. C.S §2806.1(c)(3).

In support of the Commission's evaluation and determinations, the SWE prepared an energy efficiency potential study[480] to determine the remaining opportunities for cost-effective electricity savings in the service areas of the seven Pennsylvania EDCs that are subject to the energy efficiency requirements of Act 129. The study examined the potential to reduce electric consumption and peak demand through the implementation of energy efficiency technologies and practices in residential, commercial, and industrial facilities in Pennsylvania. The study assessed electric energy efficiency potential throughout the Pennsylvania EDC service areas over 10 years, from 2013 through 2023.

The Study had the following main objectives:

- Evaluate the electric energy efficiency technical, economic, achievable and program potential savings in the overall Commonwealth of Pennsylvania, as well as in seven specific EDC service areas; and
- Calculate the Total Resource Cost Test ("TRC") benefit-cost ratio for the achievable potential savings for electric energy efficiency measures and programs and determine the electric energy efficiency economic potential savings for Pennsylvania homes and businesses.

The Study distinguished among four types of energy efficiency potential; (1) technical, (2) economic, (3) achievable, and (4) program potential. The definitions used in the Study for energy efficiency potential estimates were obtained directly from a National Action Plan for Energy Efficiency (NAPEE) report and are as follows:

- **Technical Potential** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a "snapshot" in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.[481]
- **Economic Potential** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration, etc.) that would be necessary to capture them.[482]
- **Achievable Potential** is the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to

[480] PA PUC website www.puc.pa.gov/electric/pdf/Act129/Act129-PA_Market_Potential_Study051012.pdf

[481] National Action Plan for Energy Efficiency, "Guide for Conducting Energy Efficiency Potential Studies" (November 2007), page 2-4. For purposes of the study, the SWE used the definitions exactly as listed in the 2007 NAPEE report without making any modifications.

[482] *Ibid.*

as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.[483] The Study considered two main scenarios of achievable potential for analysis:

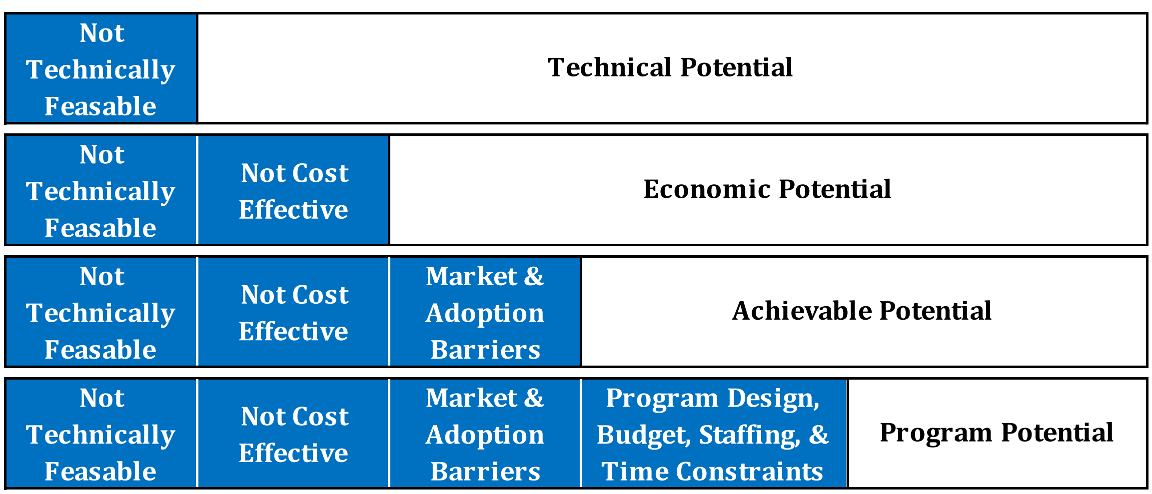
- Achievable Potential Scenario #1 was based on paying incentives equal to 100% of measure incremental costs
- Achievable Potential Scenario #2 was based on EDCs paying incentive levels comparable to those in effect during Program Year 2 of Phase I.

- **Program Potential** refers to the efficiency potential possible given specific program funding levels and designs. Often, program potential studies are referred to as "achievable" in contrast to "maximum achievable." In effect, they estimate the achievable potential from a given set of programs and funding. Program potential studies can consider scenarios ranging from a single program to a full portfolio of programs. A typical potential study may report a range of results based on different program funding levels. The Study considered two main scenarios of program potential for analysis:

    - Program Potential Scenario #1 was based on funding levels of 2% of 2006 utility electric revenues (this is the funding cap specified in Act 129 legislation).
    - Program Potential Scenario #2 was based on annual savings equal to 1% of aggregate 2011 actual retail kWh sales.

Figure C-18 below provides a graphical representation of the relationship of the various definitions of energy efficiency potential.

Figure C-18: Types of Energy Efficiency Potential[484]



483 *Ibid.*
484 Reproduced from US EPA, *Guide to Resource Planning with Energy Efficiency*, November 2007, Figure 2-1.

The Study presented results of the technical, economic, and achievable potential for electric energy efficiency programs in the service areas of Pennsylvania's seven EDCs for the three time periods:

- The three-year period from June 1, 2013 through May 31, 2016;
- The five-year period from June 1, 2013 through May 31, 2018; and
- The ten-year period from June 1, 2013 through May 31, 2023.

In addition, program potential for electric energy efficiency programs was calculated for the above-stated three and five-year time periods.

All Study results were developed using customized residential and commercial/industrial (C&I) sector-level potential assessment analytic models and Pennsylvania-specific cost effectiveness criteria including the most recent Pennsylvania EDC avoided cost projections for electricity and other fuels. To help inform these energy efficiency potential models, up-to-date energy efficiency measure data were primarily obtained from the following recent studies:

1) Pennsylvania Technical Reference Manual, June 2012.
2) Mid-Atlantic Technical Reference Manual 2.0, July 2011.
3) Pennsylvania Statewide Evaluator Residential and Commercial/Industrial Baseline Studies, April 2012.
4) PECO Baseline Study, February 2011.
5) Northeast Energy Efficiency Partnership (NEEP) Incremental Cost Study Report, 2011.
6) Appliance saturation studies conducted by the Pennsylvania EDCs.

The above data sources provided valuable information regarding the current saturation, costs, savings and useful lives of electrical efficiency measures considered in the Study.

The results of the Study provided detailed information on energy efficiency measures that are the most cost effective and have the greatest potential kWh and kW savings in the service areas of the Pennsylvania EDCs. The data used for were the best available at the time the analysis was developed. It is important to note that, as building and appliance codes and energy efficiency standards change, and as energy prices fluctuate, additional opportunities for energy efficiency may occur while current practices may become outdated.

As with any assessment of energy efficiency potential, the Study necessarily built upon a large number of assumptions and data sources; a significant change in any of them can affect the assessment. Such assumptions and data sources include the following:

- Energy efficiency measure lives, measure savings and measure costs;
- The discount rate for determining the net present value of future savings;
- Projected penetration rates for energy efficiency measures;
- Projections of electric generation avoided costs for electric capacity and energy as defined in the 2009 and 2011 Pennsylvania PUC Total Resource Cost Test (TRC) Orders;
- Future changes to current codes and standards; and
- Future changes in economic conditions.

Summary of Cost Effectiveness Findings

The Study concluded that continuing electric energy efficiency programs in a Phase II of Act 129 will continue to be very cost effective for Pennsylvania ratepayers. Table C-9 and Table C-10 show the Total Resource Cost (TRC) test benefit-cost ratios for the Achievable Potential Scenarios #1 and #2 for the three, five, and ten-year implementation periods starting on June 1, 2013. The TRC ratios statewide for Achievable Potential Scenario #1 are 1.75, 1.83 and 1.95 for the three-year, five-year and ten-year time periods respectively. The TRC ratios statewide for Achievable Potential Scenario #2 are 1.73, 1.85 and 1.97 for these three time periods.

Table C-9: Total Resource Cost Test Benefit-Cost Ratios for Achievable Potential Scenario #1 For 3-Year, 5-Year, and 10-Year Implementation Periods

	TRC Benefits	TRC Costs	TRC Ratio
3-Year Period	$ 4,236,649,800.37	$ 2,415,984,248.08	1.75
5-Year Period	$ 8,349,633,190.47	$ 4,571,820,105.28	1.83
10-Year Period	$ 21,026,641,589.24	$ 10,759,165,841.58	1.95

Table C-10: Total Resource Cost Test Benefit-Cost Ratios for Achievable Potential Scenario #2 For 3-Year, 5-Year, and 10-Year Implementation Periods

	TRC Benefits	TRC Costs	TRC Ratio
3-Year Period	$ 3,799,475,599.64	$ 2,202,502,753.00	1.73
5-Year Period	$ 4,540,392,369.13	$ 2,450,743,984.66	1.85
10-Year Period	$ 9,455,821,361.87	$ 4,808,941,993.06	1.97

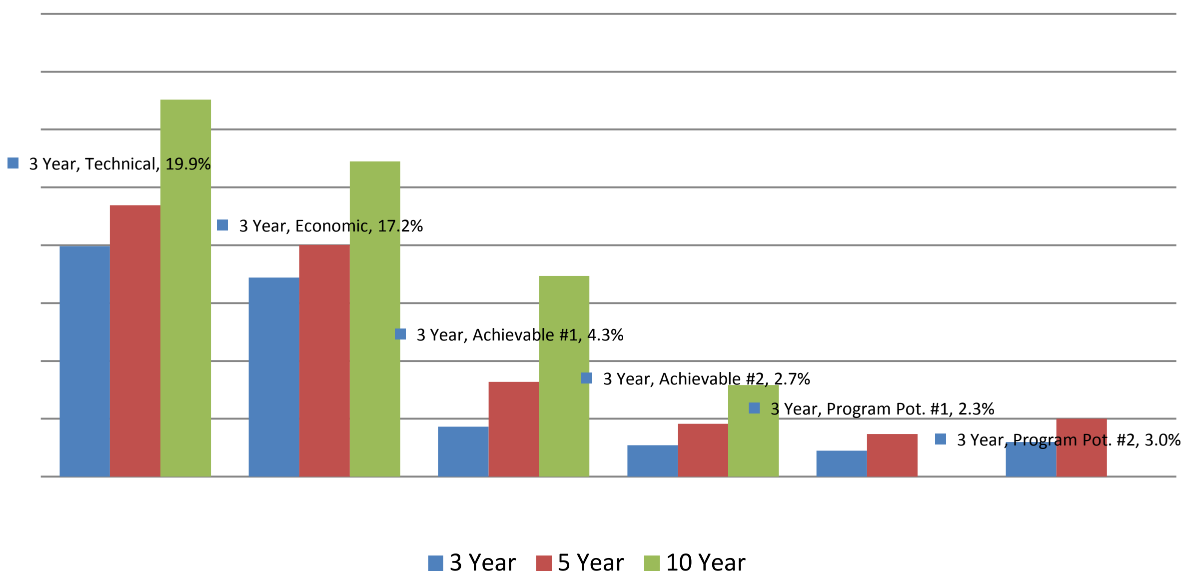
In addition, the SWE calculated a TRC ratio for each energy efficiency measure considered in the Study Only energy efficiency measures that had a TRC ratio greater than or equal to 1.0 were retained in the economic, achievable and program potential savings estimates.[485]

Summary of Energy Efficiency Potential Savings Results

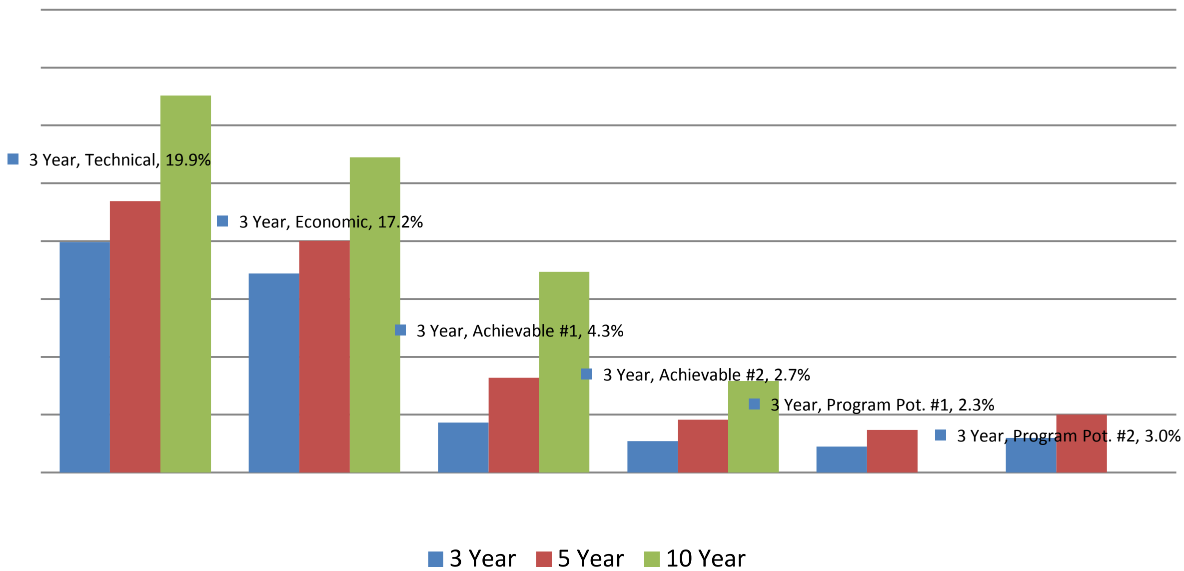
[485] The TRC Test does not consider, and there was no attempt to place a dollar value on some difficult to quantify benefits arising from installation of some measures, such as increased comfort or increased safety, which may in turn support some personal choices to implement particular measures that may otherwise not be cost-effective or only marginally so.

The Study examined over 579 energy efficiency measures in the residential, commercial and industrial sectors combined**.** Three hundred and seventeen measures were included in the residential sector energy efficiency potential analysis. For the non-residential sector, there were 262 total measures included in the potential energy savings analysis. Of these 262 measures, 95 were considered in the industrial model and 167 were included in the commercial model. The 262 is a count of the individual measures included; many measures had overlap between different segments and were counted as one measure.

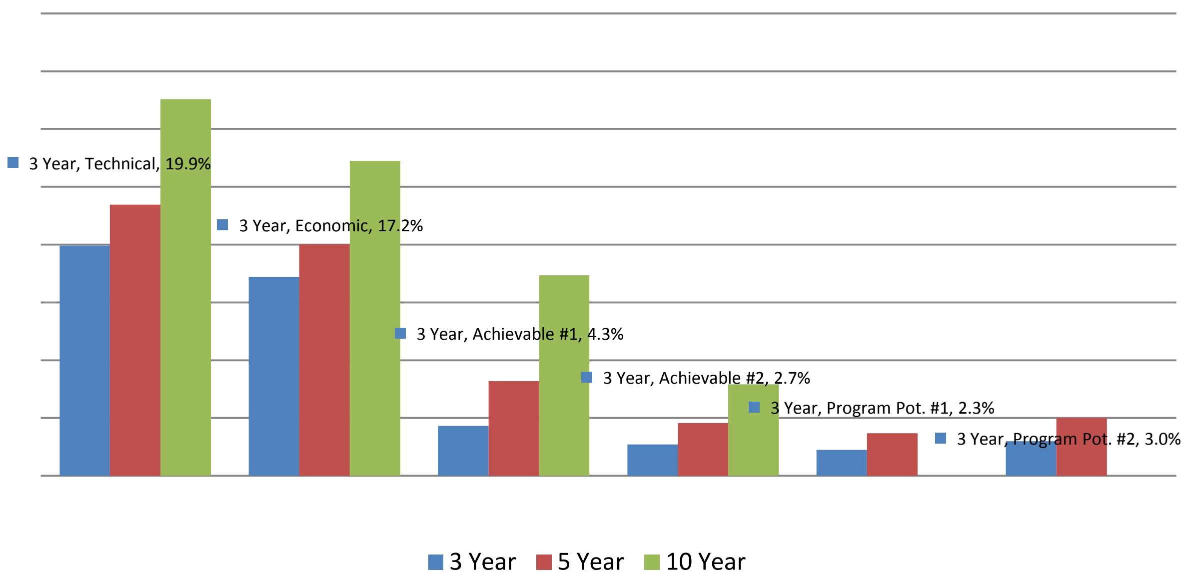
Figure C-19: Energy Efficiency Potential Savings Summary for Commonwealth of Pennsylvania



(Energy Efficiency Potential as a Percent of Forecasted Pennsylvania kWh Sales For the Baseline Period of June 2009 through May 2010)



(Energy Efficiency Potential as a Percent of Forecasted Pennsylvania kWh Sales For the Baseline Period of June 2009 through May 2010)



(Energy Efficiency Potential as a Percent of Forecasted Pennsylvania kWh Sales For the Baseline Period of June 2009 through May 2010)

Figure C-19, presented above, shows that cost effective electric energy efficiency resources can play a significantly expanded role in the Pennsylvania energy resource mix over the next 10 years. For the region of the Commonwealth of Pennsylvania served by the seven EDCs subject to the consumption reduction mandates of Act 129, the technical potential in 2016 and in 2018 for energy efficiency is 19.9%

and 23.4%, respectively, of forecasted kWh sales for the 2010 baseline period for this study.[486] The energy efficiency savings for economic potential and Achievable Potential Scenario #2 in 2016 are 17.2% and 2.7% of forecasted kWh sales for the 2010 baseline period. The energy efficiency savings for economic potential and Achievable Potential Scenario #2 in 2018 are 20% and 4.6% of forecasted kWh sales for the 2010 baseline period.

Estimation of program potential for Phase II of Act 129 utilized both residential and non-residential potential savings. Because Achievable Potential Scenario #2 is based on performance in Phase I of Act 129, this achievable scenario was utilized as the starting point for the determination of program potential.

The three-year and five-year Program Potential Scenario #1 energy savings and budget values are found in Table C-11and Table C-12 below for each EDC and statewide. Program Potential Scenario #1 considered an annual spending ceiling that limits the program spending to 2% of 2006 annual revenue as described within Act 129. Consequently, the SWE recommended that the savings targets for Phase II be based on the Program Potential Scenario #1. The SWE found that, so long as the Pennsylvania Technical Reference Manual continues to be updated annually during Phase II of the Act 129, there is no clear advantage of one of these scenarios over the other (all other things held constant).

Table C-11: Program Potential Scenario #1 2013-2016 Cumulative Savings and Budget

EDC	3 Year Spending Ceiling (total portfolio)	3 Year Program Potential Savings (MWh)	3 Year Program Acquisition Cost ($/MWh)	3 Year % of 2009/10 Forecast	Probable Range of 2009/10 Forecast
Duquesne	$58,637,855	276,722	$211.90	2.0%	1.7% - 2.5%
Met-Ed	$74,600,676	337,753	$220.87	2.3%	2.0% - 2.7%
Penelec	$68,924,232	318,813	$216.19	2.2%	1.9% - 2.7%
Penn Power	$19,979,352	95,502	$209.20	2.0%	1.7% - 2.5%
PPL	$184,504,128	821,072	$224.71	2.1%	1.9% - 2.7%
PECO	$256,185,476	1,125,851	$227.55	2.9%	2.6% - 3.1%
West Penn	$70,687,404	337,533	$209.42	1.6%	1.4% - 2.1%

[486] For purposes of the Study, the baseline period sales were forecasted kWh sales for each EDC for the period June 1, 2009 through May 31, 2010. Forecasted 2009/2010 kWh sales were used to allow the same baseline to establish compliance targets on a cumulative basis from Phase I to Phase II, which also allows adding kWh savings from Phase I to Phase II. All energy and demand savings presented in the Study are at the end-consumer (meter) level unless specifically noted otherwise.

EDC	3 Year Spending Ceiling (total portfolio)	3 Year Program Potential Savings (MWh)	3 Year Program Acquisition Cost ($/MWh)	3 Year % of 2009/10 Forecast	Probable Range of 2009/10 Forecast
Statewide	***$733,519,122***	***3,313,247***	***$221.39***	***2.3%***	***2.0% - 2.7%***

Table C-12: Program Potential Scenario #1 2013-2018 Cumulative Savings and Budget

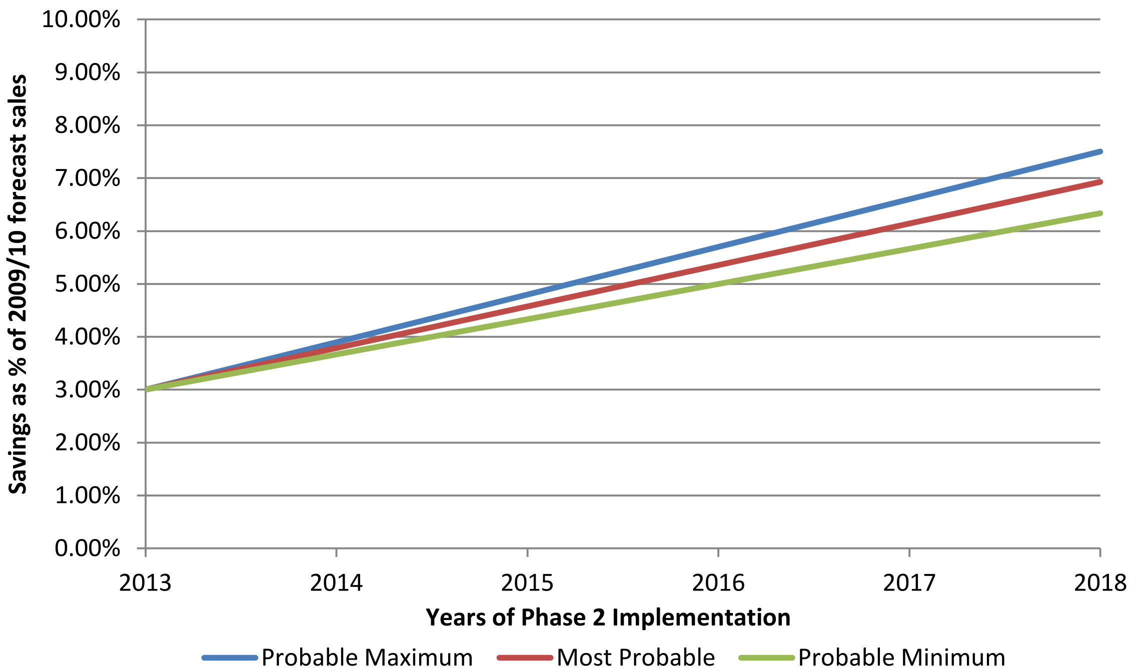
EDC	*5 Year Spending Ceiling (total portfolio)*	*5 Year Program Potential Savings (MWh)*	*5 Year Program Acquisition Cost ($/MWh)*	*5 Year % of 2009/10 Forecast*	*Probable Range of 2009/10 Forecast*
Duquesne	$97,729,758	442,451	$220.88	3.1%	2.8% - 4.2%
Met-Ed	$124,334,460	540,210	$230.16	3.6%	3.4% - 4.5%
Penelec	$114,873,720	513,332	$223.78	3.6%	3.2% - 4.4%
Penn Power	$33,298,920	154,500	$215.53	3.2%	2.8% - 4.1%
PPL	$307,506,880	1,332,001	$230.86	3.5%	3.2% - 4.5%
PECO	$426,975,793	1,884,517	$226.57	4.8%	4.3% - 5.2%
West Penn	$117,812,340	547,332	$215.25	2.6%	2.3% - 3.5%
Statewide	***$1,222,531,870***	***5,414,343***	***$225.80***	***3.7%***	***3.3% - 4.5%***

There are several key observations to be noted within these program potential savings and budgets:

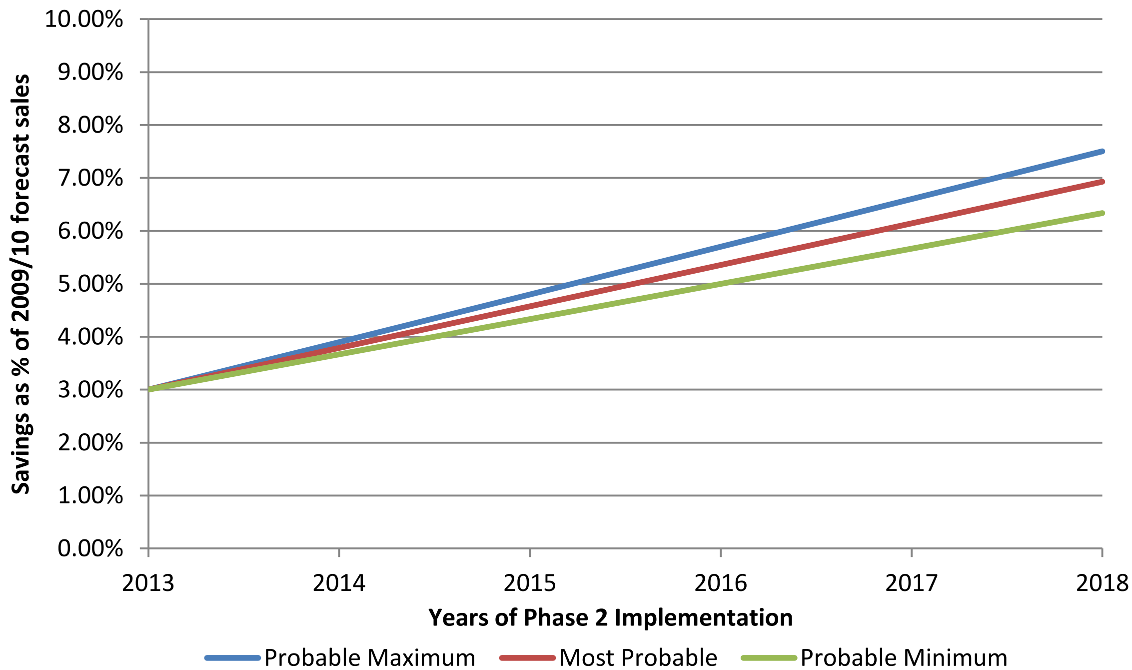
- For the three year period (2013-2016), Program Potential Scenario #1 estimated MWh savings are 2.3% of forecast sales. Over the five year period (2013-2018) program potential scenario #1 estimated MWh savings are 3.7% of forecast sales.
- Program potential savings were less than currently expected with Act 129's Phase I implementation. This is largely due to the impacts of federal legislation, changing baseline conditions and increasing saturation of energy efficient equipment.
- Expected program costs were considerably higher than for Act 129 Phase I implementation. Statewide estimated acquisition costs for 2013-2018 are 62% higher than current acquisition costs.

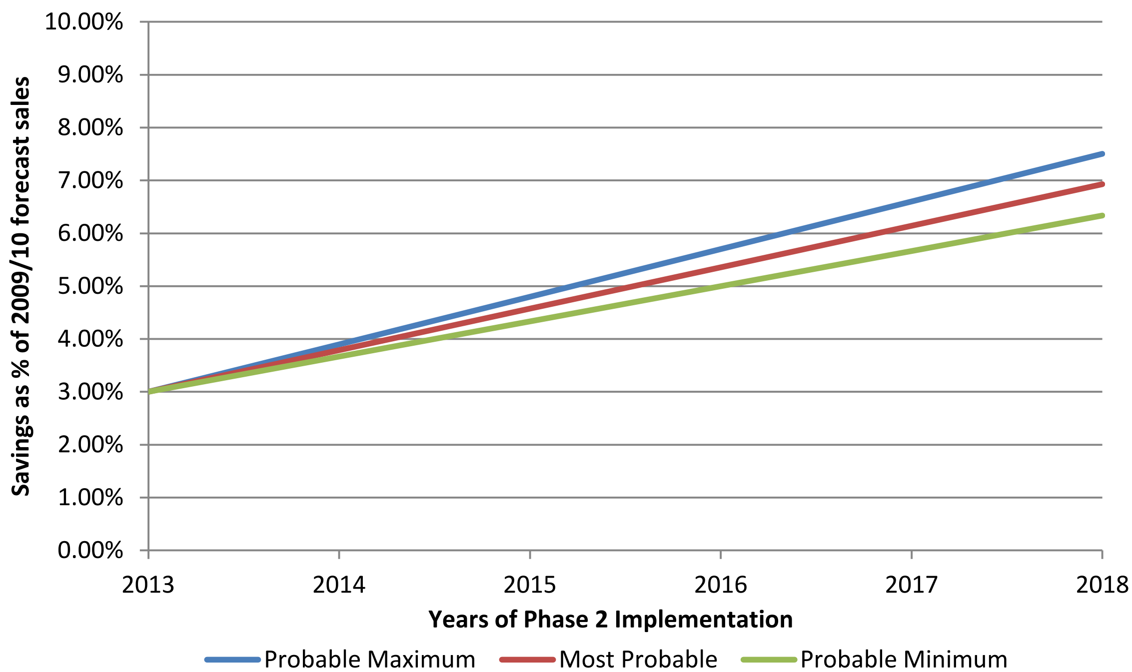
Due to the uncertainty in forecasting, marketplace technologies and costs, and expected program adoption, program potential may be best considered as a range of probable outcomes. Based largely on the Study analysis, the SWE's experience and research of other utilities, the most likely statewide program potential annual savings for years 2013-2018 ranges between 0.7% to 0.9% of 2009/2010 forecasted sales. Consequently, the expected probable acquisition cost may range from $170 to $250 per first year MWh savings. Figure C-20 illustrates this range from 2013-2018 along with the most probable outcomes summarized in Table C-12 above.

Figure C-20: Program Potential Range 2013-2018[487]



[487] Note: future savings potentials illustrated in this graph assume that the EDCs achieve exactly 3% of 2009/10 sales at the end of Phase I.





Estimation of Program Potential Scenario #2

Program Potential Scenario #2 considered a fixed annual savings target of 1% of 2009/2010 forecast energy sales and determined what the estimated costs would be to achieve these savings. This scenario provides an understanding of what the acquisition costs would be to acquire the current Phase I savings goals for Phase II of Act 129.

Based on the findings for Program Potential Scenario #1, no EDC achieves the goal of 1% annual incremental savings, and thus all expenditures must be scaled upward to achieve that level of savings. The results for Program Potential Scenario #2 are shown in Table C-13 and Table C-14.

Table C-13: Program Potential Scenario #2 2013-2016 Estimated Program Costs

EDC	3 Year Spending Ceiling (total portfolio)	3 Year Program Potential Savings (MWh)	3 Year Program Acquisition Cost ($/MWh)	3 Year % of 2009/10 Forecast
Duquesne	$94,543,076	422,565	$223.74	3.00%
Met-Ed	$131,640,852	445,951	$295.19	3.00%
Penelec	$123,114,709	431,979	$285.00	3.00%
Penn Power	$45,409,402	143,188	$317.13	3.00%
PPL	$259,331,715	1,146,431	$226.21	3.00%
PECO	$294,681,687	1,181,580	$249.40	3.00%
West Penn	$189,508,954	628,160	$301.69	3.00%
Statewide	***$1,138,230,395***	***4,399,854***	***$258.70***	***3.00%***

Table C-14: Program Potential Scenario #2 2013-2018 Estimated Program Costs

EDC	5 Year Spending Ceiling (total portfolio)	5 Year Program Potential Savings (MWh)	5 Year Program Acquisition Cost ($/MWh)	5 Year % of 2009/10 Forecast
Duquesne	$161,993,612	704,275	$230.01	5.00%
Met-Ed	$215,195,164	743,252	$289.53	5.00%
Penelec	$201,619,549	719,965	$280.04	5.00%
Penn Power	$73,270,746	238,647	$307.03	5.00%
PPL	$442,854,308	1,910,718	$231.77	5.00%
PECO	$479,423,225	1,969,300	$243.45	5.00%

EDC	5 Year Spending Ceiling (total portfolio)	5 Year Program Potential Savings (MWh)	5 Year Program Acquisition Cost ($/MWh)	5 Year % of 2009/10 Forecast
West Penn	$307,017,920	1,046,933	$293.25	5.00%
Statewide	***$1,881,374,524***	***7,333,090***	***$256.56***	***5.00%***

This analysis demonstrates that considerable increase in program spending would be required to achieve savings similar to Phase I goals during the Phase II period. Spending across the five-year horizon (2013-2018) would need to increase by over $650,000,000 to achieve these goals.

Study Conclusions

In summary, the remaining potential for electric energy efficiency in the service areas of the seven EDCs subject to the Act 129 consumption reduction mandates is significant. The statewide estimated electricity savings under Achievable Potential Scenario #1 amounts to 6,339,540 MWh on a cumulative annual basis by 2013 (a 4.3% reduction in projected 2010 baseline MWh sales) and 11,996,092 MWh on a cumulative annual basis by 2018 (an 8.2% reduction in projected 2010 baseline MWh sales).

The TRC ratios statewide for Achievable Potential Scenario #1 are 1.75 (3-year timeframe), 1.83 (5-year timeframe) and 1.95 (10-year timeframe). The TRC ratios statewide for Achievable Potential Scenario #2 are 1.73 (three-year), 1.85 (five-year) and 1.97 (10-year).

After taking into account the Act 129 program spending limits, the SWE recommended that the savings targets for Phase II be based on the Program Potential Scenario #1 presented in Table C-11 andTable C-12. The three-year program potential savings is 3,313,247 MWh with a corresponding three-year statewide reduction target of 2.3%. The five-year program potential savings is 5,414,343 MWh with a five-year statewide reduction target of 3.7%.

The results of the Study demonstrate that cost effective electric energy efficiency resources can play an important role in Pennsylvania's energy resource mix during the three-year or five-year period after the conclusion of Phase I of Act 129.

It should be noted that the Study analysis and results did not consider the impacts of program "carve-outs" or "set-asides" for specific sectors or target markets. Phase I of Act 129 has two such set-asides for residential low-income and governmental/non-profit sectors. Addition of set-asides could change the analysis for Phase II savings, likely with the effect of reducing program potential. For instance, residential low-income programs often utilize 100% incremental measure cost incentives. Higher budgets for set-aside programs would have the consequence of reducing the overall budget for the broader portfolio, leading to reduced program potential savings.

C.4 Demand Response Study[488]

Act 129 required the subject EDCs to reduce, by May 31, 2013, total annual weather-normalized energy consumption by at least 3% and peak demand by 4.5% over the 100 hours of highest demand. By enacting a demand reduction target greater than the required reduction for energy consumption, the Commission encouraged EDCs to implement peak shaving programs. The Commission approved, through the EE&C Plan proceedings, the EDCs' implementation of Demand Response (DR) programs during the summer 2012 performance period to achieve the Act 129 peak demand reduction target.[489] The Commission also directed the SWE to conduct a Demand Response Study to evaluate the effectiveness of Act 129 DR programs in Phase I and inform decisions about whether peak load reduction targets can be justified in future phases of Act 129.[490] Demand reduction goals, like the 4.5% peak demand reduction target in Pennsylvania, can be achieved by demand response programs or energy efficiency programs because most energy efficiency measures permanently reduce equipment power consumption during periods of peak demand over the life of the measure. A demand response (DR) goal is achieved solely by reducing peak demand temporarily through dispatched peak shaving resources or pricing signals and does not include the permanent reduction in demand resulting from energy efficiency programs. Phase I of Act 129 did not have a specific demand response goal.

In brief, Demand Response ("DR") generally refers to an end-user, or retail utility customer, forgoing, shifting, or self-generating electricity:[491]

- In response to a per-event signal from the applicable ISO or EDC on a **dispatchable** (or callable) basis; or
- In response to high electricity prices on a **non-dispatchable** basis, with pricing incentives offered typically through an EDC's retail service tariffs.

As indicated below, DR is broadly grouped into two main categories: **dispatchable** and **non-dispatchable**. Table C-15 below summarizes the common types of dispatchable and non-dispatchable DR programs.

488 PA PUC Website: http://www.puc.pa.gov/pcdocs/1256728.docx
489 In support thereof, the Commission approved protocols in the 2012 TRM Order for determining demand reductions from DR programs. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Docket No. M-00051865, December 16, 2011, at 61-65.
490 Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program Secretarial Letter*, served March 4, 2011, at Docket No. M-2008-2069887.
491 National Action Plan for Energy Efficiency (2010). *Coordination of Energy Efficiency and Demand Response*. Prepared by Charles Goldman (Lawrence Berkeley National Laboratory), Michael Reid (E Source), Roger Levy, and Alison Silverstein. www.epa.gov/eeactionplan.

Table C-15: Common Types of Demand Response Programs[492]

Non-Dispatchable	Dispatchable
Time-of-Use Rates: Rates with fixed price Blocks that differ by time of day	**Direct Load Control**: Customers receive incentive payments for allowing the utility a degree of control over equipment, such as air-conditioners
Critical Peak Pricing: Rates that include a pre-specified, extra-high rate that is triggered by the utility and is in effect for a limited number of hours	**Demand Bidding/ Buyback**: Customers offer bids to curtail load when wholesale prices are high
Real Time Pricing: Rates that vary at some regular interval (usually hourly) in response to wholesale market prices	**Emergency:** Customers receive payments for load reductions when needed for reliability purposes
	Capacity Market Programs: Customers receive payments for providing load reductions as substitutes for system capacity
	Interruptible/ Curtailable: Customers receive a discounted rate for agreeing to reduce load reduction upon request
	Ancillary Services Market: Customers receive payments from an ISO/RTO for committing to curtail load when needed to support operation of the grid

Dispatchable DR refers to load reductions that the end-user agrees to make in response to direction from someone other than the end-user itself. For example, direct load control (DLC)[493] programs and interruptible utility services fall into this category. The programs implemented by the Pennsylvania EDCs in 2012 consisted primarily of dispatchable DR. Non-dispatchable DR refers to programs in which end-users decide whether and when to reduce consumption in response to and based on a dynamic pricing structure that exposes the end-user to higher electricity prices during high, or peak, demand periods.[494]

Two distinct financial transaction markets need to be considered when examining DR: the Forward Capacity Markets (FCM) and the Energy Markets. Capacity is an annual commitment to provide energy when needed and assures that there will be sufficient resources when they are most needed. A FCM attempts to ensure that demand for electricity will be met in the future by providing pricing signals to encourage reliability investments such as generation, energy efficiency and demand response. Capacity revenues are paid whether energy is produced by the committed resource or not. Energy is the generation of electrical power over a fixed period of time and is commonly valued on an hourly basis.

[492] Ibid.
[493] Direct load control programs involve installation of a controllable thermostat or a control switch on an air conditioning unit. The utility can then either remotely change the temperature set point on the thermostat or cycle the air conditioner on and off during control periods.
[494] Federal Energy Regulatory Commission. *National Action Plan on Demand Response*, (June 2010), available at http://www.ferc.gov/legal/staff-reports/06-17-10-demand-response.pdf.

Several deregulated markets in the United States, including the PJM Interconnection (PJM), use Locational Marginal Pricing (LMP) to assign wholesale market prices for electricity in dollars per megawatt-hour ($/MWh).

The SWE DR Study presented the findings and recommendations of the SWE based on a benefit cost assessment of the Phase I DR programs, a review of DR goals and protocols in other jurisdictions, and a historical analysis of market conditions in the Commonwealth of Pennsylvania.[495] The SWE's findings and recommendations contained in the SWE DR Study are:

- Act 129 DR programs were not cost effective as offered in 2012. However, the SWE does not believe that this finding automatically means that DR should not be included in future phases of Act 129.
- Act 129 demand reduction targets in Pennsylvania are more aggressive than the other states examined in the Study.
- Most energy efficiency measures produce percent peak demand reductions that are comparable to the percent energy savings they achieve. Because the Act 129 peak demand reduction target was greater than the energy reduction target, each of the seven Pennsylvania EDCs elected to offer multiple dispatchable DR programs in 2012 in an effort to meet the mandated demand reduction goals. Approximately 2.5% of the 4.5% peak demand reduction goal established by Act 129 was achieved through the coincident peak demand reduction produced by energy efficiency measures, effectively presenting a 2.0% DR goal to be achieved in a single summer.
- Aggressive reduction targets appear to have contributed to the poor benefit/cost ratios observed across the state in 2012. The penalty aspect of Act 129 limited the discretion EDCs could afford to use and led to EDCs "overpaying" for DR resources to ensure the 4.5% peak demand reduction was met.
- Meeting Act 129's demand reduction target for the 100 hours of highest demand required EDCs to predict when the highest 100 hours would occur over the course of the summer season. These predictive difficulties are less common for DR programs in the other states and in the ISOs examined, where DR programs are used only when necessary based on reliability triggers or market pricing conditions. The SWE recommends the top 100 hour definition be discontinued.
- The treatment of DR incentive payments varies between the states examined in this report. California, New York, and Pennsylvania treat DR incentive payments by EDCs to DR program participants as proxies for participant costs in the TRC calculations. While Pennsylvania and New York include the entire incentive payment as the proxy for participant costs, California includes 75% of the incentive payment as a proxy for participant costs because it assumes that a

[495] This analysis was not meant to be a determination of EDC compliance with the summer of 2012 peak demand reduction mandates as prescribed at 66 Pa. C.S. § 2806.1(d)(1).

customer will only participate in DR if the benefit is greater than the costs to participate. Adoption of this protocol will increase the perceived cost effectiveness of a program by 5% to 30% depending on the proportion of program costs attributable to customer incentives. This protocol is shown to have a greater impact on load curtailment programs because customer incentives represent a dominant share of program costs.

- California and Illinois treat ISO payments to EDCs as a benefit in their respective TRC test calculations when the payments are direct revenue received for bidding retail DR into the wholesale market. The SWE believes that this is the most beneficial mechanism for the continuation of EDC direct load control (DLC) programs. Rather than calculating an avoided cost of capacity, an EDC which bids its DLC program into the PJM forward capacity auction can include direct revenue in its benefit/cost calculations. Bidding DLC into PJM can reduce the capacity needs of the region that must be secured through generation and can exert downward pressure on wholesale capacity prices.

- Residential customers are effectively unable to go to market in the PJM DR programs without aggregation by an EDC within a DLC program. The SWE believes there is value in EDCs acting in this role for the residential sector that does not exist for the C&I sector because those customers are able to participate in the PJM markets without EDC intervention.

- A historical analysis of Locational Marginal Prices[496] (LMPs) and capacity prices in Pennsylvania indicate that DR programs are less cost effective for EDCs in the western part of the Commonwealth than those in the eastern part of the Commonwealth. In New York, the NY Public Service Commission (NYPSC) determined that DR programs are most practical and economical in the New York City Metropolitan Area and only established DR goals in the Con Edison service territory. The SWE recommends that the decision to include DR targets in future phases of Act 129 be made at the EDC level rather than on a statewide basis.

- Capacity prices play a significant role in the cost effectiveness of DR and can vary from year to year. The decision whether or not to include DR targets in future phases of Act 129 should be dependent on the direction of capacity prices in the region. Based on the program expenditures and impacts observed during the 2012 performance period, the avoided cost of generation capacity will need to be in excess of $70-$80 per kW-year to justify continuation of Act 129 DR programs. The SWE recommends that the Commission pay careful attention to the results of the PJM Base Residual Auctions for the 2016/2017 and 2017/2018 delivery years when considering demand reduction goals for Phase III of Act 129.

- Avoided transmission and distribution (T&D) benefits are a major source of uncertainty in the benefit/cost analysis of DR. Additional research is needed by the Pennsylvania EDCs to quantify these benefits. The benefit/cost analysis presented in Study considers low, medium and high

[496] The Locational Marginal Price of electricity is the price of electricity that varies by time and location within PJM.

cases of $0, $25 and $50 per kW-year, respectively, for the monetization of transmission and distribution benefits. Without the inclusion of some T&D benefits, the SWE believes that Act 129 DR programs are unlikely to pass a total resource cost (TRC) test.

- Additional research is needed to estimate the possible benefits from wholesale price suppression.[497] These benefits were not considered for Phase I Act 129 energy efficiency programs and were not quantified in the benefit/cost analysis presented in the May 2013 release of the SWE DR Study. Estimates of price suppression benefits from peak-shaving will allow for a more accurate assessment and comparison of demand response and energy efficiency potential and should be included in a DR potential study.

- The value of DR is correlated with the cost of the generation resources it is competing against. The Energy Information Administration estimates the overnight construction cost of an advanced Combustion Turbine (CT) to be $666 per kW in its 2012 Annual Energy Outlook. The SWE recommends the Commission consider the costs of generation capacity that can be avoided through demand response. Given the relatively low upfront cost of construction of a new CT, its lengthy measure life, and the cost and availability of fuel, DR programs will have to be operated very efficiently to provide a cost effective alternative to generation.

- Act 129 commercial and industrial load curtailment programs face significant challenges because of the thriving PJM DR markets available to these customers. A significant portion of the participants in Act 129 commercial and industrial programs are also enrolled as capacity resources in the PJM Emergency Load Response Program. Engaging these participants in Act 129 DR programs does not offer additional capacity into the system. When EDCs secure DR resources that are not committed in the PJM program, the capacity needs of the region are not adjusted accordingly so the benefits to wholesale capacity prices are not realized. The SWE urges the Commission to be very cautious about establishing any goals for C&I DR programs. If goals are established, the SWE recommends carefully considering how Act 129 can offer incremental value to the competitive markets already in place.

- Although DLC programs did not prove to be cost effective in 2012, there is indication that the programs could offer value in future phases of Act 129. Equipment purchase, customer recruiting and installation costs result in high upfront costs for DLC programs. The SWE recommends the Commission view the Phase I infrastructure costs of these programs as “sunk” and consider continuing the programs if future benefits are expected to outweigh the future costs. If DLC programs are continued, the SWE believes that they should be bid into the PJM capacity market and the revenue received should count as a benefit in the TRC test.

[497] The dispatch of DR resources during high-priced hours for energy (i.e., hours with high locational marginal prices, or “LMP”) can have a positive effect on zonal energy prices. This “suppression” of wholesale energy prices creates a benefit for both the load being curtailed (avoiding high energy prices) and for non-curtailment loads (paying a reduced LMP because of DR).

- Precisely estimating the number of hours during which DR is likely to be cost-effective or needed for reliability is challenging because of the variation observed in Pennsylvania from year to year due to weather and economic conditions. Consequently, the SWE recommends that any future DR targets be crafted such that the compliance metric is the average load reduction observed over a subset of hours during which DR is likely to provide a cost-effective alternative to generation rather than a fixed number of hours.

- The optimal number of MW to acquire and dispatch in each EDC service territory should be determined through a DR potential study. Estimates of wholesale price suppression benefits, T&D benefits, and the amount of load reduction that can be achieved with less aggressive EDC spending will be important components of this assessment.

The SWE produced an addendum to the DR Study that was released for stakeholder comment on November 14, 2013. This addendum included preliminary estimates of wholesale capacity price suppression benefits and a prospective TRC analysis of Act 129 DR under an alternative structure to the top 100 hours performance definition. The November 2013 addendum to the SWE DR Study was accompanied by a Peak Demand Cost Effectiveness Determination Tentative Order from the Commission which proposed that the SWE conduct an in-depth wholesale price suppression analysis and DR Potential Study.

C.5 Guidance Memos

This section provides brief descriptions of each Guidance Memo written by the SWE during Phase I of Act 129.

GM-001 – Treatment of LED Lighting[498]

This Guidance Memo provides an explanation on the history of savings allowed for LED lighting, primarily that it will be allowed as of June 1, 2011.

GM-002 – Custom Measure Process[499]

This Guidance Memo covers a change in the way that custom project savings are calculated and verified, updating the guidelines to be applicable for the 2012 TRM.

GM-003 – Sampling Resolutions[500]

This Guidance Memo outlines expectations that were implemented following discussion on the proper population sampling and stratification methods for residential and non-residential energy savings, reinforced in the 2011 SWE Audit Plan.

[498] PA PUC Act 129 GM-001.
[499] PA PUC Act 129 GM-002.
[500] PA PUC Act 129 GM-003, dated March 10, 2011.

GM-004 – Calculating Coincident Demand for Non-Weather-Dependent Measures[501]

This Guidance Memo describes the protocol to use when calculating demand for measures when a coincidence factor is not provided, such as non-weather-dependent savings.

GM-005 – SWE Functional Roles[502]

This Guidance Memo lists the SWE Team members, their roles, and email addresses.

GM-006 – Reporting Timing Issues[503]

This Guidance Memo provides direction on how the EDCs should report savings for a project that is installed in the applicable program year but will not be able to verify savings in time for the November 15 annual report.

GM-007 – Savings Accrual[504]

This Guidance Memo describes the appropriate treatment of the annualized program savings for a project that is installed late in a program year.

GM-008 – Interim TRM Measure Approval Process[505]

This Guidance Memo describes the process for the SWE to approve a protocol for a measure that is not covered specifically in the active TRM, but which an EDC would like to submit as a savings measure.

GM-009 – Impact of EISA 2007 on CFL Programs[506]

This Guidance Memo describes the schedule and impact of the Energy Independence and Security Act that requires the phase out of certain incandescent and halogen bulbs and the effects to multiple utility incentive programs. A special focus exists on the treatment of savings baselines.

GM-010 – Appliance Recycling[507]

This Guidance Memo provides background and methodology for calculating energy savings for appliances that have been in use for both a full year and less than a full year prior to replacement.

GM-011 – IMP Procedural Memo[508]

[501] PA PUC Act 129 GM-004, dated March 4, 2011.
[502] PA PUC Act 129 GM-005, dated March 8, 2011.
[503] PA PUC Act 129 GM-006, dated July 26, 2011.
[504] PA PUC Act 129 GM-007, dated April 26, 2011.
[505] PA PUC Act 129 GM-008, dated July 15, 2011.
[506] PA PUC Act 129 GM-009, dated June 29, 2011.
[507] PA PUC Act 129 GM-010, dated July 15, 2011.
[508] PA PUC Act 129 GM-011, dated September 2, 2011.

This Guidance Memo provides the steps for the SWE and EDCs to follow with regards to submitting and handling interim measure protocols.

GM-012 – Peak Hour Wx Savings Custom Protocol[509]

This Guidance Memo provides direction on how to provide savings estimates for measures that do not specifically have a coincidence factor and are highly affected by the peak shift due to weather.

GM-013 – Clarification for Meter-Level and System-Level Savings[510]

This Guidance Memo describes the background for the decision to request energy savings at the meter level and demand savings at the system level.

GM-014 – Clarification of SWE Site Inspections[511]

This Guidance Memo describes the characteristics of both ride-along inspections where the SWE accompanies the EDC evaluators and independent site inspections that are performed only by the SWE.

GM-015 – DLC – C&I Site Inspection Process[512]

This Guidance Memo describes the protocol for C&I inspections for ride-along inspections and independent site inspections, as well as the pre-audit and post-audit activities.

GM-016 – Two-Tailed Sampling[513]

This Guidance Memo provides the justification for requiring a two-tailed rather than one-tailed sampling approach.

GM-017 – Low-Income Savings and Costs Reporting Phase I[514]

This Guidance Memo provides guidance for EDCs on how to estimate low-income participation in their residential programs and advises on how to account for the costs of low-income programs.

GM-018 – Statistical Reporting of Phase I Savings[515]

This Guidance Memo provides the confidence and precision targets, along with reporting guidance, that will be used to showcase the Phase I MW and MWh savings reported by the evaluators and EDCs in Phase I.

[509] PA PUC Act 129 GM-012.
[510] PA PUC Act 129 GM-013, dated December 9, 2011.
[511] PA PUC GM-014, dated December 6, 2011.
[512] PA PUC GM-015, dated February 14, 2012.
[513] PA PUC GM-016, dated March 28, 2012.
[514] PA PUC GM-017, dated September 6, 2012.
[515] PA PUC GM-018, dated December 3, 2012.

GM-019 – Application of 15-year Avoided Cost Streams[516]

This Guidance Memo summarizes the discussions between the SWE and the EDCs regarding the treatment of avoided cost calculations and which forecast to use for measures over the life of Phase I.

GM 020 – SWE Memorandum Regarding CFLs and Cross-Sector Sales[517]

This draft Guidance Memo provides guidance on how to calculate kWh savings for measures involving CFLs that are prone to cross-sector sales. The draft was not officially released to the EDCs.

GM-021 – Reporting of Unverified Energy and Demand Savings in Phase I[518]

This Guidance Memo provides guidance for the EDCs and evaluators to use when addressing savings-reporting lags and describes the treatment of any rollover savings from Phase I to Phase II.

C.6 Technical Reference Manuals

The TRMs are the basis of energy saving measure details and guidelines required for the SWE, EDCs, TUS, and other involved parties to successfully administer Act 129. Listed below are the relevant TRMs for Phase I:

- 2010 Technical Reference Manual[519]
- 2011 Technical Reference Manual[520]
- 2012 Technical Reference Manual[521]
- 2013 Technical Reference Manual[522]

C.7 SWE Quarterly Reports

The SWE quarterly reports summarize the SWE Team's findings for the given quarter. The reports consist mainly of updates on energy savings (MWh) and demand savings (MW), impact evaluations, cost-effectiveness, and process evaluations of Act 129 activities with regards to each participating EDC. The SWE quarterly reports begin with PY2 and are found on the PUC website:

- SWE Quarterly Reports for Program Year 1: June 1, 2009 – May 31, 2010
    - Quarter 1
- SWE Quarterly Reports for Program Year 2: June 1, 2010 – May 31, 2011
    - Quarters 1[523], 2[524], and 3[525]

[516] PA PUC GM-019, dated February 22, 2013.
[517] Unreleased.
[518] PA PUC GM-021, dated September 13, 2013.
[519] www.puc.pa.gov/electric/docs/Act129/Act129_TRM-2010.doc.
[520] www.puc.pa.gov/electric/docs/Act129/Act129_TRM-2011.doc.
[521] www.puc.pa.gov/pcdocs/1158402.docx. www.puc.pa.gov/pcdocs/1158402.docx.
[522] www.puc.pa.gov/pcdocs/1208574.docx. www.puc.pa.gov/pcdocs/1208574.docx.
[523] www.puc.pa.gov/electric/pdf/Act129/SWE_PY2-Q1_Report.pdf.

- SWE Quarterly Reports for Program Year 3: June 1, 2011 – May 31, 2012
    - Quarters 1[526], 2[527], and 3[528]
- SWE Quarterly Reports for Program Year 4: June 1, 2012 – May 31, 2013
    - Quarters 1[529], 2[530], and 3[531]

C.8 SWE Annual Reports

The SWE annual reports summarize the SWE Team's findings for the given program year, with a focus on the cost-effectiveness and viability of the current program standards. The report addresses the TRM standards and implementation success, as well as feedback from the seven EDCs involved in the program year. The SWE annual reports applicable to Phase I are:

- SWE Annual Report for Program Year 1: June 1, 2009 – May 31, 2010[532]
- SWE Annual Report for Program Year 2: June 1, 2010 – May 31, 2011[533]
- SWE Annual Report for Program Year 3: June 1, 2011 – May 31, 2012[534]

C.9 Monthly Progress Reports

The monthly progress reports are developed by the SWE Team and submitted to the PA PUC following the month to which they are applicable. Items typically covered in these reports are major protocol discussions with regard to the TRM, important audit activity for the program year, and communication of the schedule for reporting as required. Monthly progress reports are grouped by program years:

- SWE Monthly Progress Reports, Program Year 1: June 1, 2009 – May 31, 2010
- SWE Monthly Progress Reports, Program Year 2: June 1, 2010 – May 31, 2011
- SWE Monthly Progress Reports, Program Year 3: June 1, 2011 – May 31, 2012
- SWE Monthly Progress Reports, Program Year 4: June 1, 2012 – May 31, 2013

C.10 SWE Recommended Savings Target Memo

This memo to the PUC contains information summarizing the energy efficiency potential study performed in April 2012 by the SWE and resulting forward savings projections as referenced in the electric energy efficiency potential for Pennsylvania report.[535]

[524] www.puc.pa.gov/electric/pdf/Act129/SWE_PY2-Q2_Report.pdf.
[525] www.puc.pa.gov/electric/pdf/Act129/SWE_PY2-Q3_Report.pdf.
[526] www.puc.pa.gov/electric/pdf/Act129/SWE_PY3-Q1_Report.pdf.
[527] www.puc.pa.gov/electric/pdf/Act129/SWE_PY3-Q2_Report.pdf.
[528] www.puc.pa.gov/electric/pdf/Act129/SWE_PY3-Q3_Report.pdf
[529] www.puc.pa.gov/electric/pdf/Act129/SWE_PY4-Q1_Report.pdf.
[530] www.puc.pa.gov/electric/pdf/Act129/SWE_PY4-Q2_Report.pdf.
[531] www.puc.pa.gov/electric/pdf/Act129/SWE_PY4-Q3_Report.pdf.
[532] www.puc.pa.gov/electric/pdf/Act129/SWE_Annual_Report.pdf.
[533] www.puc.pa.gov/electric/pdf/Act129/SWE_PY2-Annual_Report.pdf.
[534] www.puc.pa.gov/electric/pdf/Act129/SWE_PY3-Annual_Report.pdf.
[535] www.puc.pa.gov/electric/pdf/Act129/Act129-PA_Market_Potential_Study051012.pdf.

Appendix D Process Evaluation Recommendations, and Actions

Below are tables containing all process evaluation recommendations and responses for each program year of Act 129.

D.1 Duquesne

Table D-1: Duquesne 2011-2012 Process Evaluation Recommendations and Responses

Duquesne 2011-2012			
Commercial			
	Recommendation	**2012 Update Findings**	**2012 Status**
1	**Manual interactions with CSPs.** Key interactions required with the CSPs occur through emails and phone calls, a time-consuming method to obtaining needed information and determining project status. While weekly discussions do occur with each CSP to expedite the project review process, better access to the tracking system on the part of CSPs could help reduce the level of such manual interaction.		1. **Interaction with CSPs on Project Submission:** DLC has taken a number of steps to improve communication in the submission and approval processes. In particular, DLC set up a Sharepoint site, in which CSPs can upload projects before they are formally submitted to PMRS, which continues as the system of record. Using the Sharepoint, with controlled access, CSPs and DLC can exchange information in a secure environment without disturbing the integrity of the PMRS system. In PMRS itself, DLC has given access to select program staff beyond the PMRS system administrator, which speeds the process of making corrections or changes to submitted projects.
2	**Segmentation.** Segmentation of program administration was done based on market sectors. There are several recommendations for segmentation:	**Segmentation -** Customers with multiple types and sizes of facilities. Navigant made several observations and recommendations concerning Commercial program segmentation in PY2 particularly regarding the coordination among CSPs for customers owning or managing portfolios of facilities that have multiple uses or sizes. The current approach of strictly adhering to the SED files allocated to each CSP reduces unnecessary competition among CSPs and reduces market confusion among customers, and allows the CSPs to	**Segmentation:** For Phase II, DLC created a single Office segment program, eliminating the prior Large Office - Small Office distinction. Additionally, in Phase II DLC created a single Retail segment program, eliminating the prior large Retail / Small Retail program distinctions. This organization will foster more customer-centered marketing and project development. Further, in Phase II, DLC will offer a small commercial direct install program, intended to simplify and limit the application and other processes that tend to discourage small

		focus on market channels, messaging and technical assistance that is most appropriate for the primary use. Interviews with CSPs suggest that there is some cooperation with mixed facilities, but that appears to happen on a case by case basis. Individual instances of cooperative efforts are laudable, but it's not clear what opportunities are being missed. Ensuring a process for coordination among CSPs in the case of multi-use facilities may improve the savings realized at a site or from a particular customer.	business participation.
2a	The Large and Small Office segmentation should be re-examined. Rather than dividing the office segment by maximum demand, it might make more sense to look at business type and ownership. Provision should be made for more customer-centered approaches. For example, Small and Large Office CSPs could develop coordinated customer-focused marketing and develop protocols for which CSP takes lead roles in varying situations. This is not a simple task. (See 2b)		**See Segmentation Above**
2b	The lines of separation between these segments are not always appropriate. Some Large Office customers have one or more facilities in the Small Office segment – it does not make sense for a customer to have to deal with multiple CSPs or DLC and CSPs. Similarly, many multi-use facilities are best approached through property owners/managers. Overall, a more customer-centered approach should produce more short term-projects and help develop relationships that lead to further efficiency projects over		**2. See Segmentation Above**

	the medium- to long- term.		
2c	DLC needs to clarify and rectify the limitation of Small Office projects to customers with a maximum of 200kW. Program design and CSP contract calls for projects with 300 kW and it impacts the project size and acquisition costs and, of course, affects the CSP's ability to attain savings goals. This may not continue to be relevant if the Office program segmentation is re-designed.	**Clarification of 200-300 kW customers.** On-going classification in SED files continues to blur lines between 200kW and 300kW customers and appropriate ways to serve them. One approach to small businesses that has been very successful in other jurisdictions is a street or neighborhood blitz, often in cooperation with the local government or business groups. This approach can increase the number of small projects while decreasing the high transaction costs typically associated with small projects. In this type of an approach, some customers may not be in the appropriate SED files, but without this approach they may not participate at all.	**2. See Segmentation Above**
2d	DLC should consider assigning the Commercial Umbrella segment to the Office segment and explore whether existing CSPs can integrate it into their operations. Navigant believes there is a need for combined and coordinated addressing of certain segments. For reasons noted above, there is a lot of coincidence among Office and Retail. Combining them may offer economies of effort and find better customer reception. DLC has a very small program staff and its time might be better spent administering the program and in oversight, especially ensuring quality control is maintained.		Filed and approved Phase II EE&C Plan maintains Duquesne Light direct implementation of the Commercial Sector Umbrella Program. The Umbrella program still is needed to address projects falling outside the scope of the other programs. Changes to the segmentation approach in Phase II should alleviate most concerns regarding the previously observed issues of blurred boundaries between market segments.

3	**Promotion.** DLC should consider cooperative advertising involving CSPs and trade allies. Currently, CSP markets to their own segments. Cooperative advertising can serve to build the Watt Choices' brand, especially if logos, signage, message reach down to the trade ally level. The program group's web pages are effective and easy to use.	**Promotion**. CSPs continue to be responsible for marketing the program to their respective segments. DLC reports that it has engaged in regular cooperative advertising with CSPs, trade allies and others, and continues to do so, as appropriate.	**3. Promotion:** DLC continues its cooperative advertising with CSPs, and trade allies providing equipment and installation services. DLC expects to increase those efforts as Phase II rolls out in June 2013.
4	**Satisfaction.** Participant satisfaction with the program and the equipment installed is high, with the appeal of energy savings and the program's incentives as the two most frequently reported drivers of participation. However, several participants offered suggestions for improving the program, including (1) notification of the specific measures or project for which an incentive check is being sent (customers with multiple applications can find it hard to know which project the incentive is for), (2) speeding up rebate turn-around time (while in the first year of a program one can expect processing times to improve over time, a third reported waiting more than eight weeks for their rebate checks), and (3) reducing the amount of paperwork required in the program. Program participant survey results indicated that acceptable efficiency measure payback times range from 1-9 years, with three years as the most frequently reported acceptable time frame.	**Satisfaction**. In the Program Year 2 evaluation we noted that several participants had offered suggestions for improving the program, including (1) notification of the specific measures or project for which an incentive check is being sent (customers with multiple applications can find it hard to know which project the incentive is for), (2) speeding up rebate turn-around time (while in the first year of a program one can expect processing times to improve over time, a third reported waiting more than eight weeks for their rebate checks), and (3) reducing the amount of paperwork required in the program. DLC and CSPs all report that rebate processing speed has greatly increased since 2011.	**4. Satisfaction:** The establishment and use of the Sharepoint site addresses a number of satisfaction concerns. DLC agrees that rebate processing time is a viable key performance indicator. DLC will strive to improve process efficiencies by further developing systems, processes and procedures to affect improved rebate processing time. DLC will work with its rebate check fulfillment services contractor in an attempt to identify rebate payment linkage with specific facility projects.
5	**Awareness.** Awareness of the program is most often stemming from interactions with Duquesne staff and with the customer's		**5. Awareness:** DLC continues to support awareness through the work of its Account Executives, program staff and interactions with trade allies. CSPs continue to be a major source of

	contractors.		program awareness.
6	**Account Executive Roles.** Account Executive (AE) participation in developing leads and projects should be strengthened. Adding an energy efficiency component to compensation packages is a very good motivator. AEs generally have the best knowledge of customers and their facilities and can advise on short term and long term efficiency improvement paths. A close relationship among AEs and CSPs also shows customers the depth of DLC's buy-in to energy efficiency and assures them these efforts will continue and can be integrated into capital planning over more than one cycle.	**Account Executive Roles.** Account Executives were initially considered as key contact points and promotion sources for the Commercial and Industrial programs. However, DLC found a frequent mismatch between the time scale CSPs needed to operate in and Account Executive availability. DLC is engaging an additional Account Executive as part of an internal reorganization of Customer Services and expects Account Executives to play a larger role in energy efficiency programs going forward.	6. **Account Executive Roles:** DLC is continuing to develop the most effective use of Account Executives' time in informing customers about the programs and potential projects, as the reorganization of Customer Services moves forward.
7	**Customer Listing Files Provided to CSPs**. Improvement is needed:		
7a	DLC has made considerable efforts to improve the existing files but it has been unable to provide all the customer listings expected in the Small Office segment		7a. For Phase II, DLC has created a single Office segment program, eliminating the prior Large Office - Small Office distinction.
7b	Owner information should be in place and up to date. It is often missing or inaccurate.		7b. DLC's CIS system is presently in the process of receiving a comprehensive upgrade that should improve treatment of customer information.
7c	NAIC codes should replace SIC codes (can be transitioned with new CIS activation). Customers are coded by SIC codes, which are often inaccurate. NAIC codes are current and better descriptors.	**Seed File Gaps.** CSPs have noted inaccurate or outdated seed file information, particularly with regard to ownership, business type, etc. Navigant recommended moving from SIC codes to NAIC codes. DLC expects that this change, along with a few other changes, will be accomplished in the coming CIS system changes in 2013.	7c. DLC agrees with the evaluator's observation. While customer specific SIC coding, updated to contemporary NAIC coding, is recognized as a valuable activity, such customer information system coding is outside the cognizance and resources of Duquesne's Act 129 implementation activities. Duquesne Light is in the process of updating its corporate-wide customer information systems and recommendations for NAIC coding

			have been advanced.
8	**"Retroactive" Projects.** DLC retroactive project reviews can be used to identify customers that have demonstrated receptivity to efficiency improvements. These customers can then be targeted for further efficiency improvements through later marketing efforts, to maximize savings and the potential for encouraging ongoing efficiency improvements.	"Retroactive" Projects. Retroactive projects are a declining factor in the program. CSPs and DLC are closely reviewing such projects and denying them when the documentation is not up to standards. The DLC program manager indicates retroactive projects will not be a feature of Phase II.	8. **Retroactive Projects.** This is a non-issue, beginning with the implementation of Phase II.
9	**PMRS.** As noted earlier in this report, there are several issues with how CSPs interact with the program tracking system which, if resolved, would facilitate better relationships with the CSPs and likely more efficient work activity.	**PMRS Tracking System Review.** The PMRS is the tracking database and project control system for DLC's programs. The PMRS was built from a data dictionary developed by DLC's planning contractor, MCR, and included in the July 2009 program filing. The data being collected forms a firm foundation for tracking program and project progress through the system. The PMRS was created by DLC in-house primarily by a DLC employee who is now an independent consultant who maintains the database. **IT Resources.** DLC continues to employ the services of a contract system administrator who is not local to the area but who also has a designated group of people in the Duquesne IT Department to provide backup support to the PMRS system administrator.	9. **PMRS Tracking System Review.** As noted, DLC has added in-house staff capabilities to ensure PMRS is well supported at all times. PMRS changes have been well received by CSPs, especially using the SharePoint environment, described above. DLC has increased the flexibility of PMRS, while maintaining its status as the system of record for the program.
10	**Project documentation.** Program staff interviews and on-site verification surveys uncovered two issues that need to be addressed:		

10a	Improve savings estimates by taking more care to review and document all savings variables. In the projects verified on site, CSPs and Duquesne estimates often tended to be quite conservative, so that this issue did not result in overstatement of savings but rather understatement. In this sense it contributed to a higher realization rate when savings were verified on site. However, the opposite could be true in the future. While such differences between claimed and verified energy savings are likely to be identified and addressed through the verification process, better savings estimates would provide a more accurate ongoing picture of program performance for program management.	In response to the PY2 evaluation report recommendations and on-going discussions with CSPs, DLC has made a number of changes to enhance the project, application, review and approval process by working both with and around the PMRS system. **Project Corrections**. Previously only the PMRS system administrator could unlock projects to make corrections or other necessary changes. The system is now set up in a way that allows DLC staff with administrative rights in PMRS to unlock the system to make changes, which shortens the correction process while still maintaining system integrity. This change has been well received by CSPs because projects are more accurately represented in PMRS and changes are made both quickly and efficiently. **Upload Capability**. MCR (consultant to Duquesne) is developing an "auto-upload" capability that will allow CSPs to upload projects in bulk. The upload protocols are still in a testing period, but once they are finalized they will reduce manual data entry, thereby reducing errors, and reducing CSP time commitment and associated cost of excessive data entry. CSPs are highly supportive of this development. DLC still has concerns about maintaining data quality with this protocol and is proceeding carefully in order to ensure PMRS' integrity. **Sharepoint Site.** DLC has established a Sharepoint site that performs a number of useful functions. Program-level documents and procedures are stored and readily available for all CSPs. At the project level, CSPs can upload project details for Duquesne review and response before projects are entered into PMRS. The SharePoint site provides a single point for CSP project submissions and consequent review and discussion by DLC and CSPs. Using this process, CSP submissions are refined until they are ready for formal	**10a. Improving Initial Savings estimates:** When DLC QA/QC finds project definition incomplete, in error or in other ways lacking, through no fault of the participating customer, projects are advanced applying the most conservative application of savings parameters. DLC continues to work with CSPs to accurately assess, review and document available savings, through training and rigorous review of applications. This is especially important both for not missing savings opportunities at the start of projects and for ensuring that all intended efficiency improvements are realized.
10b	Facilitate verification of savings claims by providing better documentation of measure locations, types and counts. This is important so that savings can be verified easily and so that savings from implemented measures will not be decreased simply because the measures could not be found on site (e.g., if the customer has staff turnover and no one can identify where measures were installed).		**10b.** DLC agrees that more accurate site descriptions of equipment and other measure installations are critical for properly identifying improvements installed by the program. Increased QA/QC reviews will address this issue. CSPs will be required to provide accurate locational representations of all measure installations as part of the submission process. DLC will randomly inspect CSP projects to ensure the documentation is accurate.

		PMRS submission. Previously, CSPs and DLC transmitted documents via email in individual actions and there was no single space where all parties could find reference documents for review and discussion. **Error Checking Routines**. In PY2 Navigant recommended that PMRS be enhanced with quality error checking that produces error messages when inappropriate or out of range data are entered into the project fields. MCR indicated that such programming requires considerable time and resources and is not being considered for PY4, but would be addressed in Phase II of the program. Navigant believes that the combination of SharePoint and instituting the auto-upload protocols may largely resolve the incorrect data problem. This should be watched as auto-upload comes online. **System Defined Reports**. There has been no action regarding this recommendation in PMRS. The Sharepoint site provides some capabilities in this area and CSPs can track the progress of their own projects.	Expanded PMRS reporting capabilities are in final stages of implementation.
11	PMRS Recommendations		
11a		**Auto Upload.** Continue moving forward with testing and implementing the auto-upload protocols, providing training and technical assistance to CSPs.	Automated uploading of TRM Appendix C lighting worksheets will be facilitated by the Phase II PMRS system currently in development.
11b		**IT Resources.** Continue this internal resource and ensure that all key existing PMRS programming and protocols are well documented, as well any future changes.	PMRS is supported by adequate levels on internal, as well as external/contract, system support personnel.
11c		**Error checking**. Once auto-upload is fully implemented, DLC should review the types of errors, if any, that continually occur and remedy them through training and internal error	Data input validation will be enhanced in Phase II PMRS, but processes will continue to rely on project review by cognizant DLC staff and contractors. PMRSs system definition and use has

		checking.	been documented in appropriate users' manuals.
11d		**Pre-Defined PMRS reports.** Navigant continues to believe that regular, system-generated reports that provide views of the program as a whole are desirable, particularly as the programs move into Phase II.	Expanded PMRS reporting capabilities are in final stages of implementation.
11e		There is logic in locking approved projects, but they should remain accessible to CSPs at least for checking project status throughout. Projects as implemented often have differences from planned measures. The quantities and types of measures may change or a specified piece of equipment may not be available and another efficient alternative, possibly with different cost or savings characteristics may legitimately be substituted. Rather than locking the system throughout, it may make more sense to allow CSPs to make changes with a secure log file recording every project change. A log file could also serve as an audit function.	DLC agrees with the recommendation and will incorporate in its continued and on-going system and procedural improvements.
12		**Program Recommendations**	
12a		**Staffing.** Continue to monitor staffing adequacy as Phase II is implemented and consider strategic staffing additions if gaps are identified. Navigant recommends an annual review, in concert with goal establishment, introduction of new and revised programs, and so on.	
12b		**Segmentation**. Continue to exam customer-centered offerings for customers who have facilities in multiple segments and for facilities with multiple uses occurring within the facility. Consider an analysis of the extent of these situations within the DLC service territory through customer interviews, reviews of commercial real estate records, and	Consistent with the approved Phase II EE&C Plan, DLC has advanced a market segment based portfolio of programs. Improvements have been made to remove and artificial separation of large and small facility participation in the Offices and Retail market segment programs, and a new direct install program will provide expanded services to small commercial

		market research.	customers.
12c		**Small Commercial Blitz Initiatives**. Undertake at least one pilot in coordination with local businesses or governmental entities to test the viability of this approach under the current segmentation scheme	In Phase II, pending selection of an implementation CSP, such "Blitz Initiatives" will be evaluated and, as indicated, incorporated into the small commercial direct install program implementation process.
12d		**Project Documentation**. Continue to closely document all projects, particularly noting locations of installed measures in facilities. While it may be difficult to establish a standard set of location protocols, DLC should press for consistency among the CSPs and monitor all reports of project completions for location information as well as other final measure types, counts, etc.	DLC continues to field aggressive QA/QC review of projects and processes; Commercial program realization rates exceeding 100% reflect this activity.
Industrial			
	Recommendation	**2012 Update Findings**	**2012 Status**
1	**Segmentation.** Segmentation in the industrial programs appears to work well and should be continued. Navigant recommends that DLC consider transitioning the umbrella industrial segment to CSPs. DLC has a very small program staff and its time might be better spent administering the program and in oversight, specially ensuring quality control is maintained.		At the Stakeholders' meeting prior to development of the Phase II filing, customers in attendance were asked for their input regarding segmentation. In all instances, segmentation in Phase I was deemed to be appropriate and suggested to have it continued. Filed and approved Phase II EE&C Plan maintains Duquesne Light direct implementation of the CSUP and ISPUP.

2	**Promotion.** DLC should consider cooperative advertising involving CSPs and trade allies. Currently CSPs market their own segments. Cooperative advertising can serve to build the Watt Choices' brand, especially if logos, signage, message reach own to the trade ally level. Participants indicated that the best way to reach potential industrial program participants is through contacts by Duquesne account representatives, and Duquesne should try to leverage the use of these representatives to the fullest extent it can. Acceptable measure payback times range from 1-2 years, with one year as the most frequently reported time frame. The program group's web pages are effective and easy to use.		The Industrial sector programs (Primary Metals, Chemical Products, and Mixed Industrials) target a limited number of large industrial process customers. These programs are implemented by specialized CSPs with a track record of success with customer counterparts in other regions of the country. Co-branding and other mass-market outreach approaches are not applicable or appropriate for these sectors. As annunciated in the Phase I program plan, specialized implementation contractors, in concert with Duquesne Light, participate in trade association meetings and events. Phase I Program participation and savings impacts reflect effective promotion.
3	**Satisfaction.** Participant satisfaction with the program and the equipment installed is high, with the appeal of improved equipment performance and the program's incentives as the two most frequently reported drivers of participation. However, several participants said that the program is too complicated, and more than half said they had to wait for their rebate longer than eight weeks (with some saying it took 3-6 months).		Industrial energy efficiency program projects are often large and complex, requiring pre- and post-metering and site-specific-measurement and verification plans and reports. Due to the size of the projects and customer incentives, these processes cannot be truncated in an attempt to emulate consumer rebate processing characteristics. For these segments, these requirements are becoming, by virtue of the adopted PA Statewide Evaluation Framework, more complex and onerous, not less.
4	**Awareness.** Awareness of the program is most often stemming from interactions with Duquesne staff and with the customer's contractors.		As referenced above, industrial market segment programs, are customer direct actions, not mass media applicable. Awareness of the programs will continue to be from specialized CSP and Duquesne Light direct interactions.

5	**Account Executive Roles.** Account Executive (AE) participation in developing leads and projects should be strengthened. Adding an energy efficiency component to compensation packages is a very good motivator. AEs generally have the best knowledge of customers and their facilities and can advise on short term and long term efficiency improvement paths. A close relationship among AEs and CSPs also shows customers the depth of DLC's buy-in to energy efficiency and assure them these efforts will continue and can be integrated into capital planning over more than one cycle.	**Account Executive Roles.** Account Executives (AEs) generally have the best knowledge of customers and their facilities and can advise on short term and long term efficiency improvement paths. A close relationship among AEs and CSPs also shows customers the depth of DLC's buy-in to energy efficiency and assure them these efforts will continue and can be integrated into capital planning over more than one cycle. Some CSPs report that in the current economy larger customers are still focused on immediate capabilities and concerns rather than longer term benefits that accompany installing efficiency measures. Account Executives can continue to play a very strong role in Industrial programs not only for entrée for CSPs but for putting CSP-proposed improvements in context with other needs.	AEs continue to play an introductory role and are kept informed of Act 129 EE activities at industrial customer sites. Duquesne Light is continuing to develop the most effective use of Account Executives' time in informing customers about the programs and potential projects as the reorganization of Customer Services moves forward. Industrial process improvements are outside the core competencies of typical utility customer service representatives and account executives. Duquesne will continue to rely the industry expertise, networks and relationships of specialized implementation CSPs to promko0te and implement industrial sector programs.
6	**Project documentation.** Program staff interviews and on-site verification surveys uncovered a number of issues that need to be addressed:		
6a	Improve savings estimates by (1) taking more care to review and document all savings variables, (2) making use of spot measurements, when appropriate, and (3) accounting for seasonal changes in consumption/hours of use. In the projects verified on site, CSPs and Duquesne estimates often tended to be quite conservative, so that this issue did not result in overstatement of savings but rather understatement. In this sense it contributed to a higher realization rate when savings were verified on site. However, the opposite could be true in the future. While such differences between claimed and verified		This recommendation is in conflict with item 3 (above) and assertion programs are too complicated and the rebate process lengthy. Industrial segment program projects are often complex and large based on engineering studies and site-specific measurement. Phase I EM&V realization rates are greater than 90%, reflecting more than adequate diligence in savings qualification and verification.

	energy savings are likely to be identified and addressed through the verification process, better savings estimates would provide a more accurate ongoing picture of program performance for program management.		
6b	Facilitate verification of savings claims by providing better documentation of measure locations, types and counts. This is important so that savings can be verified easily and so that savings from implemented measures will not be decreased simply because the measures could not be found on site (e.g., if the customer has staff turnover and no one can identify where measures were installed).		This recommendation is in conflict with item 3 (above) and assertion programs are too complicated and the rebate processes lengthy. Industrial segment program projects are often complex and large based on engineering studies and site-specific measurement. Phase I EM&V realization rates are greater than 90%, reflecting more than adequate diligence in savings qualification and verification.
	LIEEP		
	Recommendation	**2012 Update Findings**	**2012 Status**
1	Duquesne should be able to put more focus on the program by hiring a dedicated, experienced CSP that can design and administer a program in conjunction with Duquesne's unique parameters (i.e. the large amount of low income activity already performed outside of Act 129). A request for proposals that identified the current situation and asked for solutions might at least provide additional ideas that	The Residential Coordinator does community outreach speaking events to promote Duquesne EE programs, which are sometimes in low-income neighborhoods and senior citizen communities.	For Phase II, the whole house retrofit program and the multi-family retrofit program will focus on the low income target market and be run by specialized CSPs. The Residential Coordinator continues to speak at community outreach events to promote Watt Choices.

	could be tried.		
2	A further opportunity to increase program awareness in the low income target group may be to directly market it with low income account holders. While Duquesne does not currently have system functionality to send targeted bill stuffers, other direct mail opportunities could potentially be explored.	The Residential Coordinator is working with Lowe's and Home Depot to become retail partners with Duquesne, to add an additional incentive on top of the rebate (potentially $10-20 discount at the retailer to make the rebate more enticing to low-income customers).This is still in progress.	DLC attempted to have Lowes and Home Depot contribute to a rebate for the customer in addition to the existing rebates, however Lowes and Home Depot could not get corporate approval to implement dual rebates.
3	As mentioned above, refrigerator replacement is a measure only available to the LIEEP program. Under this measure, a service provider (historically, Lowe's) delivers a new refrigerator to the low-income account and hauls the old unit away. The old refrigerator is stored on the service provider's premises until JACO picks up the old unit for recycling. As of earlier this year, the process for the refrigerator recycling part of the transaction (from Lowe's storage to JACO's recycling location) was not formally defined. We recommend that Duquesne document the process that includes all participating service providers, JACO and Lowe's.		Process has been formalized. In Phase II, delivering retailer checks old refrigerator size and working status eligibility, affixes tracking number sticker, visually disfigures unit, does not render inoperable so as to allow unit operating condition verification. Delivering retailer collects and transports unit, segregates and temporarily stores harvested units. JACO picks up the units, scans barcode with collections on Mondays and Fridays.
4	Based on the limited survey results rates collected from Q3 and Q4 participants which indicate low installation rates for furnace whistles and LED nightlights, Duquesne should investigate the cost-effectiveness of including these measures in the efficiency kits.	A very high percentage (95 percent) of LI REEP kit participants reported they were very or extremely satisfied with the information and kit they received from Duquesne.	LED nightlights and furnace whistles are cost effective measures even given the low installation rates. Furnace whistles are no longer included in REEP kits. Feedback indicates that LED nightlights are valued and will continue to be a component of REEP kits.

RARP			
	Recommendation	**2012 Update Findings**	**2012 Status**
1	When Duquesne signed the contract with JACO, Duquesne had no internal marketing budget and welcomed that JACO would cover marketing as part of the "per application" fee. In light of the existing demands on the Residential Coordinator, this arrangement should be maintained. Coordination between JACO and Duquesne marketing and especially program cross-marketing efforts should be enhanced.	The program is marketed jointly between Duquesne and JACO. In PY3, JACO held an "oldest refrigerator contest" where several EDCs partnered with JACO to run this contest from April to August. Whenever a customer recycled a refrigerator, JACO tracked the age, and the oldest refrigerator in each EDC's territory received a prize, and the oldest statewide won an additional prize. The oldest refrigerator recycled was a 1937 Frigidaire, and was recycled in the Duquesne territory.	Coordination for cross-marketing events has occurred with the oldest refrigerator contest. A similar process will occur if warranted for other activities. The internal marketing budget has been included in the Phase II plan, additionally Phase I marketing allowance for per unit recycled has been maintained and that allowance has been increased for Phase II.
2	The JACO relationship is satisfactory, but could benefit from greater responsiveness on JACO's end. While Duquesne's Residential Coordinator interacts directly with a senior manager at JACO, her contact has many other responsibilities and responses have occasionally been slow. The program is largely running smoothly and is on target but issues that arose in the past were slow to get resolved. Navigant recommends that Duquesne consider requesting a dedicated account representative for the Duquesne account should a responsiveness issue arise in the future.		Improvement in responsiveness has occurred as program matures.
REEP			
	Recommendation	**2012 Update Findings**	**2012 Status**
1	Based on limited survey results rates collected from Q3 and Q4 participants which indicate low installation rates for furnace whistles and LED nightlights, Duquesne should investigate the cost-effectiveness of including	In PY2, Navigant recommended that Duquesne investigate the cost-effectiveness of including furnace whistles in the REEP efficiency kits going forward. In PY3, the furnace whistles were not distributed in the kits.	LED nightlights and furnace whistles are cost effective measures even given the low installation rates. Furnace whistles are no longer included in REEP kits. Feedback indicates that LED nightlights are valued and will continue to be a component of REEP kits.

	these measures in the efficiency kits.		
2	Duquesne does not currently work with retailers to promote residential rebates in their stores, for example by prominently displaying tear sheets next to appliances that qualify for rebates. In the past, Duquesne requested a quote for this type of promotion from ECOVA, but the cost was deemed to be unjustifiable. Some retailers promote REEP rebates based on their own initiative, but this is not a reliable source of promotion for Duquesne. Navigant recommends that Duquesne consider alternative options for closer retailer interaction, for example with direct mailing of 'tear sheets' to a limited number of high volume qualifying retailers combined with follow up telephone calls.	During PY3, Duquesne worked with the program's Upstream Lighting CSP and with retailers to promote residential rebates in their stores. These events occur at large retailers, such as Lowes and Sam's club, on a monthly basis. These events use lots of program signage and information sheets, along with special pricing. For PY4, Duquesne and ECOVA have targeted promotions in 58 major appliance stores in the Pittsburgh area to display program signage on or next to qualifying appliances.	The process as described by NCI during PY3 and PY4 continues.
3	Helgeson is Duquesne's rebate fulfillment house. All residential rebate applications are mailed to Helgeson for processing and payment, including the decision to approve or reject an application. When rejecting a rebate, customer satisfaction could be improved by including an explanation for the rejection.		Helgeson now provides a postcard to customers with reason for rejection. e.g. This account number has previously received a rebate. Helgeson includes an 800 number on the postcard for the customer to call should they have any questions.
4	Helgeson determines if a rebate is approved or rejected. To make this determination, Helgeson receives periodic updates of qualified Duquesne customer account numbers to verify that rebate applications are from active customers. Navigant recommends defining a process that ensures the provision of the customer account list on a		Helgeson has access to DLC customer information system that qualifies customer account status on a real time basis. This recommendation is unsupported.

	defined frequency, to avoid giving out rebates to customers who are no longer eligible.		
5	ECOVA, Duquesne's Upstream Lighting program administrator, provides detailed documentation along with its invoices, which allows the utility to report savings into PMRS. However, information on the "measure" purchased is based on manufacturer product names and most manufacturers identify their CFL products in terms of their incandescent equivalents. This means that the Residential Coordinator can only estimate the actual wattage of the CFLs sold. The utility should require that its program administrator provide the actual wattage of the CFLs sold in each product category (SKU), so that checks on the accuracy of reported savings can be made on an ongoing basis.	During PY3, Duquesne worked with the program's Upstream Lighting CSP and with retailers to promote residential rebates in their stores. These events occur at large retailers, such as Lowes and Sam's club, on a monthly basis. These events use lots of program signage and information sheets, along with special pricing. For PY4, Duquesne and ECOVA have targeted promotions in 58 major appliance stores in the Pittsburgh area to display program signage on or next to qualifying appliances.	ECOVA provides actual CFL wattage as a reporting data element. This issue was resolved in PY2.
		SEP	
	Recommendation	**2012 Update Findings**	**2012 Status**
1	The SEP program is exceeding its savings goals, though installation rates are lower than projected for kit items. Based on limited survey results collected from Q3 and Q4 participants which indicate low installation rates for furnace whistles, Duquesne should investigate the cost-effectiveness of including this measure in the SEP efficiency kits going forward.	In PY2, Navigant recommended that Duquesne investigate the cost-effectiveness of including furnace whistles in the SEP efficiency kits going forward. In PY3, the furnace whistles were still distributed in the kits, because the students received a presentation about the kit contents, and the benefit of using the furnace whistles.	Duquesne Light notes while furnace whistles are and have always been cost effective (they are a very inexpensive item) installation rates have been low. For the Phase II SEP program the kit contents have been reviewed and revisions have been made such that furnace whistles will not be included in the kits distributed through SEP.

2	In the past, in order to collect feedback and verify that SEP kits have been received by participants, Duquesne has run an auto dial outreach campaign in the past. The call outs were performed by Duquesne's call center personnel and results were fed back to Residential Coordinator. Duquesne may want to run the auto dial outreach program in the future to gain customer feedback and determine whether the participants have any questions about using any of the items in the kit.	In the past, in order to collect feedback and verify that SEP kits have been received by participants, Duquesne has run an auto dial outreach campaign in the past. The call outs were performed by Duquesne's call center personnel and results were fed back to Residential Coordinator. This auto-dial campaign did not happen in PY3. This is due to very limited resources in the IT department to run these campaigns.	SEP is included by NCI in the EM&V Plan therefore feedback via auto dial outreach campaign will be reviewed and utilized only as indicated necessary by the EM&V CSP. Historically during the last three years of EM&V, kit receipt by participant has not been an issue.
3	The completed pledge forms are sent back by the school to Duquesne in batches. Entering and tracking of the pledge forms is manual and time consuming. Each form is manually verified to be an active account. Then, the pledge information is manually entered into a list for processing by MCR. The manual and time consuming pledge form entry process could be improved, for example, by offering an online pledge entry option for parents.		SEP pledge form processing is performed by dedicated staff that have worked to improve process efficiencies since program inception. Some parts of the process continue to be performed manually, but have proven cost-effective and adequate. Program participation and savings impacts have exceeded EE&C Plan projections.
4	The program web pages are well-designed and easy to use. While it is easy to locate contact information for follow up questions or to enroll a school, it might be helpful to include more information on the impacts of the program so far and provide more information on participation and enrolment processes. Providing information on successes to date – perhaps in the form of a graphic showing progress toward goals – might be an effective approach to building enthusiasm for the program, especially if Duquesne decides to expand the program to		Enrollment is not an issue, there currently is and has been a waiting list since the first semester the program was implemented for schools to enroll. Use of SEP as a gateway to other programs is a design element of SEP. Spillover savings actions are cultivated via the pledge form which directs participants to the Watt Choices website for other programs. In addition at the assemblies Duquesne Light representatives encourage students, faculty and families to check out the other programs offered by the Company via their website.

	enable and encourage self-directed energy-saving activities on the part of participating schools (e.g., in the form of interschool competitions). Such feedback is a key element in programs that attempt to change behavior and encourage spillover savings actions.		

Table D-2: Duquesne 2013 Process Evaluation Recommendations and Responses

Duquesne 2013		
	Recommendation	**Response**
RESIDENTIAL ENERGY EFFICIENCY PROGRAM (REEP)		
1	Consider providing more information about kit products, specifically about the Smart Strips which have a low installation rate that is impacting the realization rate	Being Considered
2	Enhance efforts to cross-promote other Duquesne Light programs to REEP participants. Very few participants had heard of other programs. Cross promoting other programs could help Duquesne continue to reach its savings goals in the future.	Being Considered
3	Investigate CFL free ridership more thoroughly in future evaluations. The estimated CFL free ridership is high and, while any free ridership analysis is subject to question, the results suggest that a significant percentage of CFL purchases might have occurred even in the absence of the program. A more thorough free ridership and process evaluation assessment may be warranted in future years' program evaluation to better determine the extent of the problem and investigate ways in which the program might be modified to have a higher net impact on energy consumption.	Being Considered
RESIDENTIAL APPLIANCE RECYCLING PROGRAM (RARP)		
1	Consider cross-promoting other Duquesne Light programs to RARP participants. Very few participants had heard of other programs. Cross promoting other programs could help Duquesne continue to reach their goals in the future.	Being Considered
RESIDENTIAL LOW INCOME ENERGY EFFICIENCY PROGRAM (LIEEP)		

1	Consider cross-promoting other Duquesne Light programs to RARP participants. Very few participants had heard of other programs. Cross promoting other programs could help Duquesne continue to reach their goals in the future.	Being Considered
2	Investigate CFL free ridership more thoroughly in future evaluations. The estimated CFL free ridership is high and, while any free ridership analysis is subject to question, the results suggest that a significant percentage of CFL purchases might have occurred even in the absence of the program. A more thorough free ridership and process evaluation assessment may be warranted in future years' program evaluation to better determine the extent of the problem and investigate ways in which the program might be modified to have a higher net impact on energy consumption.	Being Considered
3	Consider conducting process-evaluation surveys early in Phase II of the program with more robust samples of participants. The very small sample sizes for the findings reported above indicate that these results are generally anecdotal rather than statistically significant.	Being Considered
	COMMERCIAL PROGRAM GROUP PROGRAMS	
1	While contractors are a good source of program marketing, Duquesne Light should consider other marketing options such as newsletters that provide energy efficiency case studies of Duquesne Light customers, to improve program awareness of nonparticipants.	Being Considered
2	Duquesne Light should consider emphasizing payback period in its promotion of the C/I programs. This is the most common decision criteria reported by participants. Providing this information may contribute to higher participation levels in the future.	Being Considered
3	Duquesne Light should make additional efforts to ensure that its CSPs have taken steps to ensure that the correct TRM is being used in estimating project savings, especially for motors and VFDs.	Being Considered
4	Duquesne Light should continue its efforts to work with CSPs, to ensure that CSPs are transparent about the various assumptions and data used in estimating savings.	Being Considered
5	Choosing the correct baseline has a significant impact on overall measure and project savings, due to the high fluctuation in the deemed savings values depending on which baseline is selected. Navigant recommends that the CSPs ask the customer about how the motors were controlled prior to the project and clearly	Being Considered

	document the findings in the project documentation.	
6	In light of the reported importance of trade ally contractors in informing participants about the program and in influencing their decisions to participate, Phase II program efforts should emphasize broader and more significant outreach to the contractor community. Bringing additional contractors into the program could extend the program to new participants and potentially help to drive down free ridership.	Being Considered
7	In light of the reported importance of trade ally contractors in informing participants about the program and in influencing their decisions to participate, PY5 evaluation efforts should include a substantive contractor survey effort to explore ways to increase contractor promotion of the programs.	Included in Phase II evaluation plan
8	In light of the participant reports that likely barriers to participation are the level of required paperwork and lack of awareness of the programs, the PY5 evaluation effort should include non-participant survey research.	Included in Phase II evaluation plan
	INDUSTRIAL PROGRAM GROUP PROGRAMS	
1	While contractors are a good source of program marketing, Duquesne Light should consider other marketing options such as newsletters that provide energy efficiency case studies of Duquesne Light customers, to improve program awareness of nonparticipants.	Being Considered
2	Duquesne Light should consider emphasizing payback period in its promotion of the C/I programs. This is the most common decision criteria reported by participants. Providing this information may contribute to higher participation levels in the future.	Being Considered
3	Duquesne Light should make additional efforts to ensure that its CSPs have taken steps to ensure that the correct TRM is being used in estimating project savings, especially for motors and VFDs.	Being Considered
4	Duquesne Light should continue its efforts to work with CSPs, to ensure that CSPs are transparent about the various assumptions and data used in estimating savings.	Being Considered

5	Choosing the correct baseline has a significant impact on overall measure and project savings, due to the high fluctuation in the deemed savings values depending on which baseline is selected. Navigant recommends that the CSPs ask the customer about how the motors were controlled prior to the project and clearly document the findings in the project documentation.	Being Considered
6	In light of the reported importance of trade ally contractors in informing participants about the program and in influencing their decisions to participate, PY5 evaluation efforts should include a substantive contractor survey effort to explore ways to increase contractor promotion of the programs.	Included in Phase II evaluation plan
7	In light of the participant reports that likely barriers to participation are the level of required paperwork and lack of awareness of the programs, the PY5 evaluation effort should include non-participant survey research.	Included in Phase II evaluation plan

D.2 PECO

Table D-3: PECO 2012 Process Evaluation Recommendations and Responses

PECO 2012		
	Recommendation	**Response**
Smart Lighting Program		
1	Focus education and marketing efforts on the wide variety of specialty CFLs that are available: Both the process evaluation and the market assessment indicate that a next generation of program marketing is warranted, moving from basic awareness of CFLs to a focus on the availability of specialty CFLs and their applicability. PECO customers are very familiar with standard CFLs, as indicated by the findings from the general population survey. Since the PECO program has switched to a "Stay in Market" strategy and is now providing discounts on specialty CFLs, PECO should now develop a marketing campaign around the uses of these specialty CFLs.	Implemented. PECO is developing a robust marketing outreach campaign to increase customer education and awareness via end-use application training. Marketing materials will be provided on the PECO website, through brochures and interactive displays at a variety of retail store locations.

2	Consider using the program to inform customers about the different light colors in which CFLs are available: Respondents who stated that they have not purchased CFLs to date were asked why they have not done so. The most common responses were that CFLs are too expensive and that customers did not like the light color or light quality emitted from CFLs. PECO has successfully used the Smart Lighting Discounts program to address the cost barrier over these past three years and now has continued to do so with discounts offered on specialty bulbs. Based on the survey findings, less than 17 percent of respondents are from households that have never purchased CFLs for their homes. PECO should consider using the program to inform customers about the different light colors in which CFLs are available. By doing so, PECO may be able to increase purchases of energy efficient lighting by increasing awareness about CFL varieties (color and types). Customers have indicated their preference for the color of light emitted by incandescent bulbs. PECO might consider developing a marketing campaign to let customers know that CFLs are now available in warmer colors that more closely resemble the light color of incandescent bulbs	Implemented. PECO is developing a robust marketing outreach campaign to increase customer education and awareness via end-use application training. Marketing materials will be provided on the PECO website, through brochures and interactive displays at a variety of retail store locations.
3	Anticipate a variety of reactions as EISA implementation progresses, and use this as an opportunity to emphasize growing diversity and excellent performance of energy efficient lighting options: Because general awareness of EISA 2007 implementation is low, it is likely that many customers will be surprised when they no longer see familiar traditional incandescent bulbs available on store shelves. This will be particularly true when 60W traditional incandescent bulbs are no longer manufactured or imported in the U.S. as of January 1, 2014. PECO should see this established change in available customer choices as an opportunity to raise customer awareness of the wide variety and high quality of energy efficient options available and to emphasize the fact that CFLs and LEDs will still represent by far the most energy efficient mass market lighting options following EISA implementation.	Implemented. PECO is crafting educational materials that address EISA standards and the changing market, which will be supplemented with the other learning materials prepared in conjunction with the CSP and geared to inform our customers of the most energy efficient lighting options.
4	Expect the education process around lumen awareness to take a long time, and sustain education efforts: PECO customers indicate that they most often use incandescent equivalent wattage when selecting bulbs to purchase. Lumen awareness remains low despite the prominence of lumens on energy efficient bulb packaging. PECO should regard the raising of lumen awareness as a long term process and persist in communicating and educating the community about thinking of lamp brightness in terms of lumens.	Implemented. PECO plans to build upon its continuous education process and further increase awareness through a variety of customer outreach programs that teach consumers about practical applications of CFLs with respect to lumens versus the incandescent equivalents.
5	Focus education and marketing efforts on the fact that savings outweigh costs very quickly if you replace functioning incandescent bulbs with CFLs: One area for increased potential socket saturation of CFLs is those sockets that currently have functioning incandescent bulbs in them where the customer is waiting for the bulb to burn out before replacing it with a CFL. It may be possible	Being Considered. PECO believes that the development of the aforementioned educational campaign will inspire all customers to make the right choice on CFL usage and cost.

	to increase the rate of customer switch out of functioning incandescent bulbs for CFLs by emphasizing the short period of time in which this choice pays for itself in increased energy savings.	
6	Raise people's confidence in the relatively long life of CFLs by citing independent research on this topic: Customers indicate that they value the lower frequency of needing to change longer life bulbs, but generally believe that a typical CFL lasts for only 6 months to 3 years before burning out. PECO should capitalize on customers' interest in long life bulbs by citing independent research on the relatively long bulb life of CFLs. Such an education and marketing campaign, in concert with efforts to raise awareness around specialty CFL and light color options, may collectively transition customers' perceptions of CFLs away from early generation models of CFL technology and toward the contemporary diversity of high quality options.	Implemented. All marketing and education efforts underway with PECO and the CSP contain an embedded aspect of quality improvement.
7	Use a Segmented Marketing Approach for PECO Customers Based on Socket Saturation: The broad range of CFL saturation levels may indicate that PECO customers could be characterized as belonging to several "types" with respect to their degree of CFL adoption. The differing levels of CFL saturation could be seen as one of multiple metrics for characterizing these customer types and could guide targeted efficient lighting marketing efforts accordingly. An example of the potential applicability of this from a marketing standpoint would be to use differentiated or pointed marketing approaches to try to move PECO customers from their existing level of CFL adoption to the "next" level. There would likely be crossover effects of this style of marketing on customers at different levels of CFL adoption, in that sending marketing messages that encourage people who have CFLs in 50%-75% of their sockets to move toward the 75%-100% range sends the broader message to all lighting customers that there is a significant proportion of customers with very high CFL adoption. This in turn carries its own marketing message to the whole customer base.	Being Considered. PECO customer base has an opportunity to provide the most cost effective application of CFL socket saturation. To that effect, we are collaborating with the SWE on performing a market saturation study and evaluating cost effectiveness.
8	Use Segmented Marketing for PECO Customers Based on Purchasing Behavior: Customers with different approaches to selecting lighting products may respond well to different types of marketing. Those customers who choose not to pay close attention to lighting options may respond best to a "grab-n-go" style of marketing that points them toward CFLs and the ease of buying multi-packs for most of their general service lighting needs. Customers who pay more attention to their lighting choices, either while in the store or while researching their options outside the store, may appreciate marketing materials that allow them to easily navigate their way to energy-efficient bulbs that meet the specific needs of the fixture or level of brightness they seek. Given the large and growing number of efficient lighting options, there is clearly demand for materials that allow customers to identify the broad types of lighting they	Being Considered. PECO is looking to engage the consumer at the point of impact, create trial, build awareness and increase overall shopping experience through in-store demos, interactive promotional and education materials.

	seek using images, followed by more technical information that allows them to narrow in on options that meet specifications either dictated by the fixture or specified by the informed shopper's preferences. It may be possible to meet all of these needs by targeting the most visible marketing materials to those shoppers who want to make their decisions quickly, while making the more detailed information available.	
	Smart Home Rebates	
1	SHR is a strong program but its weakest area is communication and coordination with trade allies. Going forward, PECO and Ecova should document its contacts with participating retailers and installation contractors to improve overall program operations as well as provide the documentation necessary to conduct process evaluation activities. This documentation would take the form of regularly updated contact information for the individuals responsible for the sale of Program rebated appliances and equipment for each trade ally	Being Considered. PECO recognizes this as an area for improvement and will engage the implementation team to work closely with EMV and the CSP to execute this recommendation.
	LEEP	
1	The program should focus on ways for LEEP to compliment rather than compete with the current LIURP program offerings. Specifically, the weatherization agency staff would like PECO's program to focus on providing measures to offset high cooling costs during the summer months rather than focus on electric heating.	Rejected. LEEP and LIURP are closely coordinated programs and are essentially the same. We've engaged the TUS to further collaborate on program development.
2	As a way to minimize program duplication and enhance overall cost-effectiveness, the LEEP could expand the current measure mix to include HVAC cooling equipment, power strips, and set-top boxes. If implemented, these recommendations will help to ensure that PECO's measures are a priority for weatherization agencies while also enhancing the overall program offerings for PECO's customers.	Rejected. PECO already offers HVAC measures and though LEEP and LIURP programs target the same audience, they are complementary in nature and are specifically designed for customers with low income and high usage.
3	The current program metric targeting households with monthly usage of 600 kWh per month may not be identifying the highest end users. The evaluation showed the program is reaching customers with average home sizes which could be an indication that this metric is just leading the program to larger homes, not necessarily highest users. Therefore LEEP may be missing opportunities to achieve greater savings. Going forward, PECO should consider targeting customers based on a normalized metric of kWh usage per square foot per month to help identify the highest energy users in all sized homes.	Being Considered. The LEEP program is modeled after LIURP with primary focus on high usage and income eligibility. PECO does not have the data on square footage of customer's home to identify highest users by size of the home.
	Smart Appliance Recycling	

1	Continue to reinforce the value of recycling older appliances. A small fraction (15% refrigerators and 5% freezers) of participants surveyed said that they would have continued to use the secondary appliance had it not been for the program. This highlights that there are still customers in PECO's service territory that need convincing that they do not need a second refrigerator or stand-alone freezer. Note that these percentages have increased since PY2, which may be an indication of the effect of the reduced incentive on appliance retention. PECO could help educate their customers on how much money they could save each month by taking different energy saving actions, including recycling an old appliance. Participants have not been able to discern much of a change in their bills due to the recycling as only 34% of participants said they noticed any reduction in their electric bills. Participants may have difficulty associating changes in their electric bill to their own energy saving behaviors. When customers do see the savings and are able to attribute them to their behaviors, they will be more likely to make additional changes in the future.	Implemented. PECO reviewed literature, collaborated with the CSP and established savings estimates using EPA website, educating customers about the program through outreach with selected participating retail providers via brochures, flyers and website materials.
2	Continue providing information about PECO's other residential programs when contractors come to pick up the appliance. For many participants, the Appliance Recycling program may be their first experience with PECO's energy efficiency programs. This can also be accomplished on PECO's website so that customers who sign up for the Appliance Recycling program online can learn about additional program opportunities if they choose.	Implemented. PECO is planning to cross market the program with the CSP on location at the time when the appliance is picked up.
	Smart Construction Incentives	
1	Marketing and Participation	
1a	Continue to use account managers and trade allies to reach participants. It is clear that these channels have been effective in reaching participants and participants have been satisfied with their interactions with both parties	We will continue to reach out to account managers and trade allies via regular update meetings, through trade talk newsletters, and sales training webinars to educate and keep customers engaged in the program.
1b	Increase outreach to the design and developer community as soon as possible. This will help distinguish the program from the SEI program and increase the influx of large whole-building projects. In addition, building these relationships with the design and developer communities will help to identify potential participant projects early in the design phase where program influence can be maximized. In PY3 the program benefitted from a large backlog of projects from PY2 and thus had high participation, but the program will not be able to sustain these participation levels in the future without additional outreach. Given the extended timeframe for many new construction projects, it is not too early to begin this outreach for Phase II.	PECO is engaging the Delaware Valley Green Building Council through event sponsorship and will be exhibiting at Green Build 2013.

2	Program Characteristics and Barriers	
2a	Increase communication with both participants and trade allies about the waitlist. Trade allies especially reported that customers were often misinformed about the waitlist, and that knowing more about what to expect in the future would help them sell the program to their customers.	Implemented. PECO released three separate campaigns to notify customers about project status and is now developing a trade ally portal to provide live, real time updates to all interested parties.
2b	Differentiate the SCI program from the SEI program. It seemed that trade allies did not delineate their feedback between the SCI and SEI programs, and do not see the programs as separate. The program should work to advertise the benefits of the SCI program in particular to increase participation.	Implemented has begun. PECO is committed to strong trade ally relationships and will engage the design community to increase participation and build awareness about the Smart Construction program through the Delaware Valley Green Building Council.
3	Administration and Delivery	
3a	Increase advertising of technical assistance offerings. As described in the net impact recommendations, this will help the program reduce free-ridership. The program can also market technical assistance as a low-cost way for design firms to incorporate higher levels of efficiency.	Being Considered. The Technical Assistance model is designed in parallel with the EE LEED points program. PECO is looking to increase education outreach in the design community to draw parallels between our SCI program and the LEED energy points.
3b	Communicate clearly with customers about savings and incentives. One participant complained that their incentive was not large enough. PECO should work to communicate more clearly with such customers so that they understand why their project did not achieve as much savings as anticipated.	Implemented. In effort to improve communication PECO is now requesting pre-existing condition documentation prior to reserving project funds in order to provide more accurate estimates. Additionally, we offer on-site meetings and face-to-face education to walk customers through the savings calculations.
	Smart Equipment Incentives	
1	PECO is strongly urged to decide what will happen to qualified projects on the wait list. The evaluation team recommends that program staff develop an action plan to manage the wait list. Once PECO has developed a wait list action plan, PECO should increase outreach efforts and reactivate the communication with both customers and contractors about the wait list and the process going forward. PECO needs to improve communication about the wait list, and the evaluation team recommends that PECO develop a portfolio of informational material that includes an explanation of how the wait list works, what is going to happen with the projects that are in the wait list and a timeline for program activity related to wait listed projects.	Implemented. PECO put together personalized letters to customers to address each wait list situation and bring projects to application completion by May 31, 2013.

2	PECO is strongly urged to continue to engage contractors and identify ways to work more closely with contractors going forward. The evaluation team recommends that PECO proactively notify contractors of pending program changes and also solicit contractor feedback about program marketing and collateral materials. PECO should assess this feedback and where it makes sense to do so incorporate the feedback into marketing materials when the program is reinstated.	Implemented. PECO has developed a robust, one of a kind trade ally portal to create a communication platform for materials, education, project status updates for its customers and trade allies.

Table D-4: PECO 2013 Process Evaluation Recommendations and Responses

PECO 2013		
	Recommendation	**Response**
Smart Lighting Program		
1	Prioritize in-store intercept surveys using field staff in the aisles of participating stores to collect information for key evaluation parameters	Implemented. EDC is working with program implementer to facilitate logistics and permission for these in PY5 participating stores.
2	Use a Segmented Marketing Approach for PECO customers based on socket saturation	Being Considered. PECO managers and the evaluation team are scheduling a call to discuss options
3	Focus education and marketing efforts on the wide variety of specialty CFLs that are available	Being Considered. PECO managers and the evaluation team are scheduling a call to discuss options
4	Use the phase-out under EISA of traditional incandescent 60W and 40W bulbs as of January 2014 as an opportunity to emphasize growing diversity and excellent performance of energy-efficient lighting options	Being Considered. PECO managers and the evaluation team are scheduling a call to discuss options
5	Expect the education process around lumen awareness to take a long time, and sustain education efforts	Being Considered. PECO managers and the evaluation team are scheduling a call to discuss options
6	Increase the coordination of community outreach and in-store tabling events across PECO's portfolio of energy efficiency programs	Being Considered. PECO managers and the evaluation team are scheduling a call to discuss options
Smart Appliance Recycling		
1	Synchronize marketing elements to throttle program participation up or down, as desired to meet goals.	Implemented. Current marketing strategy is expanded from PY4 due to significantly increased program goals in PY5.

2	Continue to reinforce the value of recycling older appliances, since there continues to be a large stock of secondary units out there.	Implemented. PECO's marketing messages include information on the annual cost of operating an old refrigerator or freezer.
3	Educate customers on how much money they could save each month by taking different energy-saving actions, including recycling an old appliance. When customers see the monetary savings and are able to attribute them to their behaviors, they will be more likely to make additional changes in the future.	Implemented. PECO's marketing messages include information on the annual cost of operating an old refrigerator or freezer.
4	Continue to provide information about PECO's other residential programs when the contractors come to pick up the appliance and on PECO's website.	Implemented. JACO crew members distribute energy efficiency program collateral when they visit homes to pick up appliances for recycling.
	Smart Home Rebates	
1	Develop agreements with HVAC contractors to assure promotional efforts identify PECO's contribution to the delivery of high-efficiency equipment to residential customers.	PECO is considering the most effective approach to achieve this recommendation.
2	Re-engage retailers and HVAC contractors to promote rebates and better coordinate PECO activities with trade ally marketing plans.	PECO plans to implement this recommendation in PY5.
3	PECO should continue to identify ways to link more closely its successful Smart Home Rebates program with other PECO efficiency activities to encourage broader participation across all programs.	PECO is considering this recommendation.
	LEEP	
1	Modify criteria for selection program participants to target customers with high energy density instead of customers with high usage. Add a series of questions about energy-efficient measures already installed to identify customers that have little opportunity for energy savings.	Under consideration
2	(For Pennsylvania Act 129 PEG) Include in future versions of the TRM CFL in-service rates that are specific to program delivery (i.e., direct install, mailings, and giveaways).	Under consideration
3	Develop additional educational materials for customers, especially focusing on consumer electronics.	Under consideration
4	Explain to PECO and IC staff how LEEP and LIURP interface and how they differ.	Under consideration
	SMART EQUIPMENT INCENTIVES: COMMERCIAL AND INDUSTRIAL PROGRAM	
1	PECO should increase communication with contractors and more closely manage relationships to improve the contractor and participant experience with the program. Contractors indicated that increased communication from PECO was desired. In addition, program participants expressed that contractors were a main	Implemented: • PECO has increased the frequency of the Trade Ally newsletter and already sent first edition for Phase II. • PECO has conducted 3 seminars in October

	source of information about the program. PECO should leverage contractor relationships to communicate program goals to customers and use contractor training and communication as a way to scale up or ratchet down program participation.	with attendance of 50-100 at each event. • PECO is holding trade ally certification seminars (First one Oct. 15). • PECO is holding a trade ally webinar series. • PECO launched an online trade ally portal for materials and live online project tracking.
2	PECO should consider a sliding scale for incentive payments, rather than reaching program targets and abruptly throttling the program with a waitlist. Incentive amounts could be reduced when certain program subgoals are met (e.g., 50% of program goal, 75% of program goal, 90% of program goal).	Being considered: Incentives were filed as a range, and thus PECO can adjust the rates without re-filing.
3	PECO should continue to review the program measure list to ensure that the latest proven technologies are being incented by the program. For example, PECO has expanded the prescriptive program LED offerings. This review of measures should be an ongoing process.	Implemented: KEMA is under contract to evaluate new technologies from potential suppliers; leverage KEMA's national technology group to keep us up to date.
4	PECO and/or the implementation team should develop a completed application example for both lighting and custom projects that can be utilized as a guide for prospective participants in the program.	Being Considered
	SMART EQUIPMENT INCENTIVES - GOV't, NONPROFIT, INST. Program	
1	PECO should increase communication with contractors and more closely manage relationships to improve the contractor and participant experience with the program. Contractors indicated that increased communication from PECO was desired. In addition, program participants expressed that contractors were a main source of information about the program. PECO should leverage contractor relationships to communicate program goals to customers and use contractor training and communication as a way to scale up or ratchet down program participation.	Implemented: • PECO has increased the frequency of the Trade Ally newsletter and already sent first edition for phase II. • PECO has conducted 3 seminars in October with attendance of 50-100 at each event. • PECO is holding trade ally certification seminars (First one Oct. 15). • PECO is holding a trade ally webinar series. PECO launched an online trade ally portal for materials and live online project tracking.
2	PECO should consider a sliding scale for incentive payments, rather than reaching program targets and abruptly throttling the program with a waitlist. Incentive amounts could be reduced when certain program subgoals are met (e.g., 50% of program goal, 75% of program goal, 90% of program goal).	Being considered: Incentives were filed as a range, and thus PECO can adjust the rates without re-filing.
3	PECO should continue to review the program measure list to ensure that the latest proven technologies are being incented by the program. For example, PECO has expanded the prescriptive program LED offerings. This review of measures should be an ongoing process.	Implemented: KEMA is under contract to evaluate new technologies from potential suppliers; leverage KEMA's national technology group to keep us up to date.

4	PECO and/or the implementation team should develop a completed application example for both lighting and custom projects that can be utilized as a guide for prospective participants in the program.	Being Considered
	SMART CONSTRUCTION INCENTIVES PROGRAM	
1	Try to reach participants earlier in the design phase.	Implementation in Progress
2	Increase advertisement of technical assistance to help participants incorporate more measures.	Being Considered
3	Prioritize shift to online applications if implementation of this tool has not yet been completed.	Implementation in Progress
4	Promote the SCI program more aggressively, especially the whole building track.	Implementation is a goal for Phase II.
5	Consider promoting highly active trade allies through the program website.	Being Considered
	RESIDENTIAL SMART A/C SAVER PROGRAM	
1	Only about one in seven survey respondents were aware of the control events and most survey respondents were satisfied with the comfort of their homes. Satisfaction with the program remained high during the PY4 load control season. The Navigant team concludes that PECO should not hesitate to call the A/C Saver program multiple days during a heat wave. There may be some limits, however, that customers will not accept that were outside of our research experience.	Under consideration
2	The largest change from last year was residential customers' evaluation of PECO. Satisfaction scores dropped from 82% in PY3 to 68% in PY4. The Navigant team felt this may be a result of uncertainty about the program in PY5 and recommends that changes to incentive levels, program cycling strategies, and pay by event strategies could all be utilized to regulate program activity and eliminate the need for canceling the program in future years.	Under consideration
3	The largest challenge in PY4 was determining how to communicate the status of the program without a clear plan for the direction of the program during the current program cycle. Navigant suggests that PECO develop strategies to communicate changes to the program ahead of Phase III, anticipating that the program may or may not be part of Act 129 at that time.	Under consideration
4	Bill inserts and direct mail flyers were still the most effective methods of marketing the program. However, residential customers were most likely to have	Under consideration

	remembered the bill insert. PECO should continue to utilize this channel as conduits of information during the maintenance phase of the program.	
5	The program was well run and well-liked by customers during PY4. At the time of the post-season survey, the PY5 program year was underway and many (but not all) customers realized the monthly rebate was reduced. Customer satisfaction was still very high for the program attributes – excluding the energy savings during events. Most residential and commercial customers participate in the program to reduce their energy usage. Navigant suggests that PECO downplay the idea that the program saves energy during program events. Previous Navigant research findings suggest that, for most customers, the snap back in energy usage after an event is 100% or more than the energy saved during an event. Participants are unlikely to see reductions in their bill other than the rebate.	Under consideration
6	The summer events have a strong and positive influence on satisfaction with the Smart A/C Saver Program. PECO may want to recommend the program to customers with high bill complaints.	Under consideration
	COMMERCIAL SMART A/C SAVER PROGRAM	
1	Only about one in seven survey respondents were aware of the control events and most survey respondents were satisfied with the comfort of their businesses. Satisfaction with the program remained high during the PY4 load control season. The Navigant team concludes that PECO should not hesitate to call the A/C Saver program multiple days during a heat wave. There may be some limits, however, that customers will not accept that were outside of our research experience.	Under consideration
2	The Navigant team recommends that changes to incentive levels, program cycling strategies, and pay by event strategies could all be utilized to regulate program activity and eliminate the need for canceling the program in future years.	Under consideration
3	The largest challenge in PY4 was determining how to communicate the status of the program without a clear plan for the direction of the program during the current program cycle. Navigant suggests that PECO develop strategies to communicate changes to the program ahead of Phase III, anticipating that the program may or may not be part of Act 129 at that time.	Under consideration
4	Bill inserts and direct mail flyers were still the most effective methods of marketing the program. However, commercial customers were most likely to have remembered a program flyer. PECO should continue to utilize this channel as conduits of information during the	Under consideration

	maintenance phase of the program.	
5	The program was well run and well-liked by customers during PY4. At the time of the post-season survey, the PY5 program year was underway and many (but not all) customers realized the monthly rebate was reduced. Customer satisfaction was still very high for the program attributes – excluding the energy savings during events. Most residential and commercial customers participate in the program to reduce their energy usage. Navigant suggests that PECO downplay the idea that the program saves energy during program events. Previous Navigant research findings suggest that, for most customers, the snapback in energy usage after an event is 100% or more than the energy saved during an event. Participants are unlikely to see reductions in their bill other than the rebate.	Under consideration
6	The summer events have a strong and positive influence on satisfaction with the Smart A/C Saver Program. PECO may want to recommend the program to customers with high bill complaints.	Under consideration

D.3 PPL

Table D-5: PPL 2010 Process Evaluation Recommendations and Responses

PPL 2010		
	Recommendations	**Status**
Efficient Equipment Program		
1	Ensure that the new change management protocol:	Please note that this is an internal PPL procedure.
1a	allows ample time and includes procedures to vet program changes with PPL Electric's program, major accounts, and customer communications staff, as well as with the marketing and EM&V CSPs, to ensure all ramifications of program changes are considered and documented.	Implemented.
1b	incorporates a checklist of internal and external communications procedures to inform all parties of program changes and protocols for updating Web sites and other program materials.	Implemented
1c	creates a centralized program information portal on the ePower Web site, linked to all Web pages, so that program information is updated consistently throughout. For example, if all pages containing equipment rebates were linked to a single chart, only that chart would need to be updated when changes occur.	Not implemented. There was no practical way to link the rebate amount in each PDF rebate forms to some type of "master rebate chart".

1d	is formalized in writing, communicated to all affected parties, and adopted and used by all.	Implemented
2	Integrate the KAMs into the process as decisions are made about adjustments to program processes and forms.	Implemented as part of the Change Management Process
3	Provide case studies to KAMs so they can better understand the programs and more effectively promote them to customers.	Implemented. In addition, PPL hired a C&I CSP who has the primary responsibility to understand/implement the C&I programs and more effectively promote them to customers.
4	Conduct hands-on, step-by-step training on the program's application forms for PPL Electric's KAMs. The training should incorporate examples based on actual projects, pointing out and correcting commonly made errors and missing data.	Not implemented. PPL hired a C&I CSP who has the primary responsibility to help customers and trade allies complete the application forms correctly.
5	Conduct periodic assessments of the KAMs' additional training needs in specific areas. Conduct KAM training sessions in response to these assessments.	Implemented. In addition, PPL hired a C&I CSP who has the primary responsibility to understand/implement the C&I programs and more effectively promote them to customers.
6	Conduct the hands-on, step-by-step training described above for customers and contractors. Such sessions would be held at a variety of geographic locations within PPL Electric's service area so all interested customers and trade allies have an opportunity to attend. Consider hiring a specialist specifically to organize and train lighting contractors on the program's procedures and forms.	Implemented
7	Continue improving and simplifying program forms to enhance participants' experience.	Implemented
7a	Consolidate lighting measures to the greatest extent possible.	PPL does not understand this recommendation. Does "consolidate" mean fewer lighting measures eligible for rebates? Fewer rebate forms? What is the intended benefit of consolidation? Lighting is the end use with the greatest percentage of portfolio savings (> ~70% of total savings), regardless of the recommendation, PPL does not believe consolidation is needed since lighting, as currently implemented, is so popular and successful.
7b	Reference lighting measures to a standard such as has been established by the Consortium for Energy Efficiency (CEE), enabling all rebates to be based on like metrics.	Implemented for LEDs. Other lighting types are covered by other, more common standards such as Energy Star ratings.
7c	Create a lighting program telephone hot line and/or online help desk to provide technical assistance for customers and vendors who need help filling out lighting measure spreadsheets.	Implemented with the C&I CSP.

7d	Follow up by phone or email with customers who initially fill out lighting applications incorrectly. Gather the information necessary to help them complete the forms correctly. This procedure can greatly increase customer satisfaction with the program.	Implemented with the C&I CSP.
8	Review all prescriptive measures that may be applicable to new construction to identify those that are required under current building codes.	Implemented as part of TRM revisions. The TRM establishes the "baseline" for new construction and retrofit measures.
8a	Establish review procedures to ensure customers are not incented to meet code.	Implemented as part of TRM revisions. The TRM establishes the "baseline" for new construction and retrofit measures. PPL's rebates apply only if customers exceed the baseline.
8b	For new construction applicants, provide an explanation in program materials and on the program application forms regarding the reasons for incentivizing only measures that go beyond efficiency levels required by building codes.	Not implemented. PPL determined its eligibility requirements are clear and an explanation of their rationale to customers is not necessary.
9	Assign a PPL Electric customer programs specialist to manage the residential portion of the Efficient Equipment Incentives Program. This individual’s responsibilities would include overall residential coordination, responding to residential participants’ questions and concerns that the administrative CSP cannot address, handling data tracking and reporting issues, and managing the day-to-day program operations and issues as they arise.	Implemented
10	Assign a PPL Electric customer programs specialist to manage the non-residential portion of the Efficient Equipment Incentives Program for small commercial customers. This individual’s responsibilities would include overall small commercial coordination, responding to small commercial participants’ questions and concerns—especially those related to lighting, coordinating customer and vendor trainings, and assisting in marketing the program to this sector, which is often underserved and difficult to reach.	Implemented. In addition, PPL hired a C&I CSP who has the primary responsibility to implement the C&I programs.
11	Assess the need and consider hiring a CSP to assist and support the non-residential customer programs specialist in day-to-day program operations including: KAM, trade ally, and customer training; one-on-one participant guidance to accurately complete program applications; and responding to technical questions posed by participants and trade allies.	Implemented.
12	Continue pursuing a two-step application process for long-term projects as a means of mitigating customer and trade ally risk.	Implemented for Custom Program and for programs/customer sectors that are approaching their funding limit (i.e. to reserve funding or to be placed on a waitlist). Implemented for prescriptive and custom for Large C&I. GNI and small C&I did not approach their funding limits.

13	Continue to monitor rebate processing time. Institute planned corrective measures (i.e., processing rebate applications in smaller batches) if needed to accomplish the processing time target.	Implemented
	Energy Assessment and Weatherization	
1	Consider increasing marketing to maintain current participation levels.	Implemented
2	Continue to keep contractors informed about the program and address trade allies' issues.	Implemented
3	Revisit the data entry screens in APOGEE and work with the software company to determine a data entry method that will meet the needs of both the contractors and the program.	Rejected. The increased cost would make the program much less cost-effective.
4	Work with APOGEE to modify the reports to allow for greater flexibility, such as the ability to more site-specific recommendations and photos.	Rejected. The increased cost would make the program much less cost-effective.
5	Reduce data entry errors in the implementation CSP's tracking database by having dropdown lists for the measure quantity fields and then conducting QA/QC checks on the values recorded in that field and in the recommended measures field.	Implemented
6	Assess the source of discrepancies between the bonus measure recommendations recorded in the implementation CSP's tracking database and EEMIS, and then revise data handling processes to prevent these errors.	Implemented
7	Clarify the data collection requirements for the bonus rebates and related measures and then provide these clarifications to the administration CSP to facilitate the accurate recording and uploading of data to EEMIS.	Implemented
	CFL Lighting Campaign	
1	Develop a mechanism for tracking the quantity and type of CFLs purchased through the ePower Web site.	Rejected. CFL sales through the website are not claimed for Act 129 EE&C savings.
2	Develop a mechanism for identifying customers who purchase CFLs through the ePower Web site. This will not only yield information about the purchase patterns of customers who buy CFLs through the Web site, but also enable PPL Electric to later contact known customer participants to answer survey questions about program satisfaction and other program process issues	Rejected. CFL sales through the website are not claimed for Act 129 EE&C savings.

3	Integrate a mechanism into the ePower CFL purchasing process (e.g., require purchasers to enter a PPL Electric account number) to ensure only PPL Electric customers are able to buy PPL-EU discounted CFLs from the Web site.	Rejected. To get a discount, purchasers must enter a delivery zip code that is in the PPL service territory. CFL sales through the website are not claimed for Act 129 EE&C savings.
4	Continue developing program mechanisms to enable bulk purchases of program discounted CFLs (through the CFL Campaign and through the Efficient Equipment Incentives program). Document the procurement and distribution processes for this mechanism—and develop clear rules and procedures for participants to follow—to prevent logistical issues, miscommunication, and delays.	Implemented for non-residential customers who purchase CFLs from an electric supply/wholesaler and get a rebate via the Efficient Equipment Program. Customers who buy in bulk through the CFL Campaign (Residential Lighting Program) get a discount at the point of purchase, regardless of quantity purchased.
5	Meet with staff from PPL Electric's Supply Chain, Office of General Council, and Customer Communication and Education departments to discuss each department's document review requirements and procedures, identify processes that might be streamlined and made more time-efficient, and confer about how communication between the departments could be made more effective.	Implemented.
6	Initiate bi-weekly meetings with the CFL CSP and the ePower team to facilitate better communication and giveaway event coordination.	Implemented. Bi-weekly meetings are scheduled with the Epower team and the lighting CSP to coordinate community events.
Appliance Recycling Program		
1	The program Web site may benefit from an independent assessment to determine if program information is presented clearly, thoroughly, and concisely. Based on this assessment, PPL Electric may opt to update the Web site's content.	Implemented (using a self-assessment instead of independent assessment). PPL and the CSP periodically reviewed the PPL website and the CSP's website to ensure that the information is clear and concise.
2	The program Web site may benefit from a review and thorough testing of its appliance pick-up scheduling form. The review may identify malfunctions that inhibit customers from signing up for the ARP online. Once identified, these malfunctions should be repaired to provide customers a reliable means of scheduling appliance pick-ups online.	Implemented. PPL and the CSP periodically reviewed PPL's website and the CSP's website to ensure customer had easy access to recycling information, including the program's telephone number and online recycling registration. In addition, customers have not reported problems with the online registration form.
3	PPL Electric has developed a strategy for minimizing the number of appliance pick-ups scheduled in specific locations, at specific times of the year, when driving conditions may be hazardous. To support this strategy, PPL Electric may want to prepare a formal "road conditions" policy that is disseminated to customers in the program's collateral materials.	Rejected. PPL and the CSP decided to handle weather-related issues on a case by case basis.

4	While improvements to interdepartmental communications at PPL Electric have been initiated, the program may benefit from regularly scheduled interdepartmental meetings to discuss any evolving ARP needs and processes as the program matures.	Implemented
	Behavior and Education Program	
1	Monitor customer feedback from the administrative CSP, PPL Electric's customer call center, and send directly to the program's customer programs specialist to assess whether:	Implemented. All escalated customer inquiries/problems are forwarded to the PPL Program Manager. Additionally, trends in customer inquiries are reviewed with CSP.
1a	Customers find the Home Energy Reports helpful and are contacting PPL Electric to inquire about other PPL Electric Act 129 programs;	Implemented. All escalated customer inquiries/problems are forwarded to the PPL Program Manager. Additionally, trends in customer inquiries are reviewed with CSP.
1b	Customers implement behavioral changes or install energy-efficient equipment based on tips provided in the Home Energy Reports;	Implemented. All escalated customer inquiries/problems are forwarded to the PPL Program Manager. Additionally, trends in customer inquiries are reviewed with CSP.
1c	Customers express any credibility concerns about the data presented in the reports (i.e., whether they believe the data accurately represents their energy usage); and/or	Implemented. All escalated customer inquiries/problems are forwarded to the PPL Program Manager. Additionally, trends in customer inquiries are reviewed with CSP.
1d	Customers are concerned about or dissatisfied with program's opt-out approach	Implemented. All escalated customer inquiries/problems are forwarded to the PPL Program Manager. Additionally, trends in customer inquiries are reviewed with CSP.
2	Conduct surveys with program participants to assess overall program satisfaction and specifically inquire about the issues listed above.	Implemented. Market Research group conducted a survey of program participants in September 2010.
3	As part of the PY2 program evaluation, conduct surveys with program participants and nonparticipant control group customers to verify that the two groups are comparable in terms of demographic characteristics, housing characteristics, and heating fuel types.	Implemented by Cadmus as part of their impact evaluation and verification of savings
	Renewable Energy	

1	Due to the disparities between planned and actual participation levels for PV and GSHP technologies and for the residential and institutional sectors, PPL Electric should determine how to reallocate the program’s remaining rebate budget. Such budget reallocations will need to take into consideration the cost-effectiveness of the Renewable Energy Program and the overall portfolio of programs. PPL Electric’s policy should state that, if program funding is still available, the company will consider additional rebate funding reallocations at the end of each program year.	Implemented. Program funding was committed very quickly and, therefore, program closed very soon after the program launched. PPL developed guidelines stating that if funding was still available, consideration would be given to fund further projects.
2	In conjunction with reallocating the program’s rebate funds, PPL Electric should develop a written policy describing how accepted applications within the residential PV pool, residential GSHP pool, institutional PV pool, and institutional GSHP pool are prioritized for rebate payment. The EM&V CSP recommends this policy state (for each of these three application pools):	Implemented.
2a	PPL Electric will use a twice-monthly application review cycle, examining program applications on specified days (for example, on the 1st and 15th day of each month).	Implemented.
2b	As long as funding is available, PPL Electric will rebate all customers who have submitted accepted applications.	Implemented.
2c	As long as funding is available, PPL Electric will contact customers who submit incomplete or seemingly faulty applications to explain the application’s deficiencies and give customers another 15 days to resubmit or correct their applications.	Implemented.
2d	Resubmitted applications will be given priority for the next application review cycle.	Implemented.
2e	If funding is available for only a portion of acceptable applications in a review cycle, PPL Electric will make rebate payments according to the projects’ installation completion dates (i.e., projects with earlier installation completion dates will be given priority over projects with later installation completion dates).	Implemented.
3	As stated on the program’s application forms, PPL should ensure all customers receive their rebates no more than 60 days after PPL Electric receives the customer’s rebate application.	Implemented.
4	Given the strong overall customer response to the Renewable Energy Program, PPL should proceed with its plan to close the residential GSHP component once the DEP’s GSHP program is launched.	Rejected. PPL's program is managed independently of the PADEP program.
	Low Income WRAP	
1	No changes in program design or delivery are recommended.	No action required.

2	A change from reporting savings using stipulated savings per measure was recommended and will be implemented. Savings will be stipulated by job type rather than at the measure level. In PY1, savings reported and approved for the 2008 program year will be applied to the three job types, i.e., baseload, low cost, and full cost jobs.	Implemented.
	Custom Incentive	
1	PPL Electric should continue to evaluate options to alleviate the burden imposed on customers by the Cx plan requirement. This is particularly important for smaller customers who lack project support from dedicated PPL Electric staff and typically do not employ their own in-house facility managers.	Implemented
1a	PPL Electric should continue to explore alternatives to requiring customers to develop and submit Cx plans and identify additional ways the M&V documentation requirements could be made less burdensome and more user-friendly for participants.	Implemented
1b	It will be important for PPL Electric to make a final determination in the near future regarding who will prepare large project Cx plans.	Implemented
2	It may be advantageous for PPL Electric to hire a customer support staff person specifically to support small customers interested in the custom program.	Implemented. PPL hired a C&I CSP
3	To support the customer application process and development of Cx plans, the EM&V CSP recommends PPL Electric pursue its plans to build a library of completed project information, approved commissioning plans, and case studies.	Implemented
3a	The library should be easy to access, searchable, include a robust index, and be available as a downloadable document.	Implemented
3b	For internal use among PPL Electric staff (i.e., not distributed to customers or vendors), documents in the library may include detailed information that would support internal decision making and help generate ideas to share with customers.	Implemented
3c	For external use, the library would offer a portfolio of case studies to share with customers, though client detail would be omitted.	Implemented. Maintained by the C&I CSP

4	PPL Electric may be missing an opportunity by not engaging with trade allies. PPL Electric should prioritize efforts to educate and leverage trade allies and get vendors' input on program delivery details. Although the program rules are not yet final, PPL Electric can make considerable information available to trade allies now and provide program updates as needed. This will help not only to promote the program but also to begin to create trust with these important program allies.	Implemented
4a	Although PPL Electric's corporate policy prohibits the program from providing specific trade ally recommendations to customers, PPL Electric should create a formal trade ally network that will give trade allies greater program buy-in and provide a simple platform to facilitate communications with vendors. For example, many utilities offer password- protected Web-pages for trade allies where they can easily make announcements about program changes, training and education opportunities, and vendor meetings or other events; offer access to marketing materials, customer applications, and best practices and quality standards; and facilitate peer-to-peer communications.	Implemented. The C&I CSP created trade ally networks and has workshops, meetings, and newsletters.
5	Calculations submitted in support of custom incentive applications have frequently been less well-supported than PPL hoped. Further outreach and training for trade allies should help to improve this.	Implemented
6	The defined protocol governing the flow of customer and vendor questions appears to be inefficient and should be revised. When customers call with questions, they should be answered in the most direct way possible within the shortest possible timeframe. If additional staff or other stakeholders must be informed of these customer interactions, the internal protocol should include mechanisms to notify all applicable parties.	Implemented
7	PPL Electric staff identified eligibility and process barriers regarding a few specific custom measures (e.g., combined heat and power, cogeneration and retrocommissioning). Over time, PPL Electric should evaluate whether expanding the program to include these measures is warranted.	Implemented
	E Power Wise	
1	PPL Electric should continue to test marketing and delivery strategies to boost participation from both CBOs and customers, and to maintain interest from CBOs.	Implemented. Direct mail is an example.

2	The customer programs specialist has established a regular, twice-weekly meeting schedule with the program CSP to discuss strategies to increase kit distribution. Even if participation increases, the program specialist should consider continuing this practice to maintain close coordination and communication with the CSP and to help identify any issues as they arise.	Implemented
3	The lower than expected participation rate may be partially due to a lack of reporting on the part of CBOs. PPL Electric should establish formal kit distribution and reporting requirements including weekly accounts from CBOs about kits distributed and projections for the following week.	Implemented
4	PPL Electric received some feedback that it is difficult to get low-income customers to classes. This may be due to customers' lack of time to dedicate to this activity, lack of trust in utility-sponsored programs, or lack of adequate marketing on the part of CBOs. PPL Electric may wish to conduct a formal investigation into the reasons for lack of interest in classes to help identify more appropriate strategies for promoting energy efficiency to this customer segment.	Rejected. Implemented a process to educate customers on a one-on-one basis while still maintaining classes for those customers who can attend.
5	PPL Electric should assess alternative kit measures used by other programs or innovative low-cost measures that may be added to the kits in program out-years. This will be particularly important as incandescent bulbs are phased out in 2012-2014 to identify new energy saving measures able to compensate for the loss of CFL energy savings.	Implemented
6	PPL Electric may wish to evaluate whether the difference in eligibility requirements between the E-PowerWise Program and the Low-Income WRAP results is confusing for CBOs or customers and track the number of potential participants who could enroll using the WRAP income requirements.	Rejected. The delineation between both programs is very clear. CBOs are aware of the program requirements and provide program services to the proper customer class. The program has achieved its goals.
	HVAC Tune-Up	
1	As the market for HVAC tune up services matures and a greater number of potential contractors enter this industry, PPL Electric may want to explore the services offered by other vendors and possibly re-bid its program implementation contract.	Implemented. PPL EU continued to work with the implementation CSP to develop alternative approaches to engage contractors and market the program to customers. Ultimately none of those efforts proved fruitful and the decision was made to keep the program open but to freeze payments to the CSP. Contractors continued to be eligible to receive rebates for tune-ups.

2	PPL Electric should continue to pursue strategies to help alleviate the cost barrier for contractors to participate in the program, but should also monitor contractor feedback and participation closely to determine whether the cost is really a significant barrier for most contractors.	Implemented. A $50 bonus, incremental to rebates for tune-ups, in order to help contractors off-set the initial cost of the equipment and to encourage contractors to seek more tune-up opportunities. The initiative did not generate significantly more projects.
3	Although it is too early in the program implementation phase to fully understand whether FSDI's alternative program delivery approach will produce the expected program results, PPL should carefully monitor the program to determine whether adjustments in the program structure may be needed to realize the savings required.	Implemented. Implementation CSP initiated a widespread marketing effort with chain stores, but was unable to generate sufficient commitment to meet the program's savings goal.
4	The customer programs specialist proactive approach to the program – including frequent communications and transparent delivery – is a good strategy for limiting internal and external structural problems with the program and should continue.	Implemented. Communicated weekly with CSP.

Table D-6: PPL 2011 Process Evaluation Recommendations and Responses

PPL 2011		
	Recommendation	**Response**
Efficient Equipment		
1	Continue to work with EPS to target small businesses and GNI customers directly.	Implemented
2	Continue improving and simplifying program forms to the extent possible. (This including the PA lighting form and the supporting tables in the TRM.)	Implemented where possible. PPL has no control over the statewide Lighting Form.
3	Implement a two-step application process for long-term projects to mitigate customer and trade ally risk and to improve trade ally relationships.	Implemented for Custom Program and for programs/customer sectors that are approaching their funding limit (i.e. to reserve funding or to be placed on a waitlist).
4	Develop a formal, streamlined application process for landlord-tenant projects. Ensure that related data collection and tracking are adequate for accurate reporting.	Implemented a third-party payment form for measures owned by the landlord (measure paid for and rebated to the landlord) but the metered account is with the tenant, and vice-versa.
5	Continue to examine the cost of processing rebates, the expected and actual participation, and the expected savings, as these efforts will help identify those high-cost, low-saving program measures. Eliminate those that do not significantly	Implemented

	contribute to portfolio savings.	
	Energy Assessment and Weatherization	
1	Consider increasing marketing to maintain current participation levels.	Implemented
2	Continue to keep contractors informed about the program and address trade allies' issues.	Implemented
3	Revisit the data entry screens in APOGEE and work with the software company to determine a data entry method that will meet the needs of both the contractors and the program.	Rejected. The increased cost would make the program much less cost-effective.
4	Work with APOGEE to modify the reports to allow for greater flexibility, such as the ability to more site-specific recommendations and photos.	Rejected. The increased cost would make the program much less cost-effective.
5	Reduce data entry errors in the implementation CSP's tracking database by having dropdown lists for the measure quantity fields and then conducting QA/QC checks on the values recorded in that field and in the recommended measures field.	Implemented
6	Assess the source of discrepancies between the bonus measure recommendations recorded in the implementation CSP's tracking database and EEMIS, and then revise data handling processes to prevent these errors.	Implemented
7	Clarify the data collection requirements for the bonus rebates and related measures and then provide these clarifications to the administration CSP to facilitate the accurate recording and uploading of data to EEMIS.	Implemented
	CFL Program	
1	Change the CFL Campaign name to the Residential Lighting program. With increasing numbers and types of efficient lighting technologies entering the market (and perhaps also the program), the "CFL Campaign" program name will soon be obsolete.	Implemented
2	Slow the program's pace so that it better tracks with the original plan; this will likely entail scaling back program marketing and decreasing the incentives on spiral CFLs (of which the general population is already widely aware). By slowing the program's pace, PPL Electric can avoid having to close the program's retail component midway through the current program cycle, which would likely result in customer confusion and frustration.	Rejected. Instead of closing the program too early, PPL decided to increase the projected CFL sales and savings in its EE&C Plan to maximize Phase I savings and improve portfolio cost-effectiveness. PPL did significantly slow the pace in Program Year 4.

3	Enhance customer service to help prepare customers for upcoming changes in the residential lighting market by providing updated program collateral materials, bill inserts, and feature articles in the Connect newsletter. The materials should explain the new EISA lighting standards, how these standards will affect customers' day-to-day lives, and the next generation lighting technologies that are becoming available. Additional EISA information could also be provided at participating retail locations that are willing to dedicate floor/shelf space to this messaging.	Implemented. A Next Generation of Lighting brochure was prepared and will be distributed to all PA PPL employees and to customers to educate them on the EISA standards, A Connect article (bill insert) is also being developed to discuss the new EISA standards.
4	Introduce customers to next-generation lighting technologies by providing incentives for select models of LEDs and other bulbs that exceed EISA efficiency standards. (However, offer incentives only for well-designed equipment that has been carefully evaluated.) This may reduce the occurrence of the early adoption problems that CFLs encountered.	Implemented. PPL added CREE LED light bulbs to the product mix.
5	Although PPL Electric's customers dispose of fewer CFLs in the trash than the customers of utilities in other states, PPL Electric could reduce that percentage further if it enhances program marketing and education efforts about both the mercury content in CFLs and the recycling options. This could be accomplished by providing more (or featured) information on the E-Power Website, bill inserts, and in the newsletter, Connect. Additional CFL recycling information could be provided at participating retail locations that are willing to dedicate floor/shelf space to this messaging.	Implemented
6	Continue bi-weekly meetings with the CFL CSP and PPL Electric's E-Power team to facilitate good communication and give-away event coordination. Continue the CSP's monthly retail store visits to: (1) Inspect the POP materials; (2) ensure retail staff members are properly educated about efficient lighting; and (3) address retailers' questions.	Implemented
7	Assign a PPL Electric customer service staff member who is very familiar with the Company's customer database, to work with the customer programs specialist to determine whether candidate lighting retailers are in PPL Electric's service territory.	Implemented
8	Correct the incandescent wattages reported in the CFL Type text field in EEMIS to avoid confusion and ensure EEMIS is internally consistent.	Implemented
	Appliance Recycling	
1	Consider revising the EE&C Plan to reduce the number of refrigerators and the total savings to reflect TRM changes and actual market conditions.	Implemented

2	To increase the likelihood of meeting revised targets, increase program marketing, especially through bill inserts. Timing marketing efforts with seasonal peaks during the spring and summer months could further stimulate participation.	Implemented
3	Earned media through news stories has been a very successful marketing tactic since program inception, and continues to be the number one way participants learn about the ARP. As such, PPL Electric should continue to use this outreach channel whenever possible.	Implemented
4	As supported by the PPL Electric panel study and by Cadmus' evaluation findings, education about the energy cost of an old unit compared to a more-efficient unit should be included in marketing messages to inform customers about the cost savings available by replacing their inefficient appliances. This message should be included in marketing materials, such as brochures, that are distributed by trade allies and retail partners.	Implemented
5	Given that customers mainly participate because they want to replace an old appliance, PPL Electric should expand the retail partner program component. This could be accomplished by reaching out to more big-box retail chains and creating strategies to reduce entry barriers for smaller, independent retailers.	Implemented. PPL is expanding the Buy New & Recycle component with their key independent retailers.
6	Increasing the ARP incentive could help boost participation, as supported by feedback from the ARP CSP and customer programs specialist, as well as participant survey results, findings from the PPL Electric panel study, and evidence from other appliance recycling programs around the country and in Pennsylvania. To increase participation, PPL Electric should consider increasing incentive levels from $35 to $50 per recycled refrigerator/freezer. Note that PPL Electric is maintaining the incentive levels because of budget constraints and inconclusive evidence that increased incentives will directly increase the participation rate.	Implemented for limited time periods
7	Implement an automated QA/QC system to check for data inconsistencies across EEMIS and the ARP CSP database. This could be a simple Microsoft Excel system that flags inconsistencies on a census of records.	Rejected. Low priority because there are very few inconsistencies and the impact is not significant.
	Direct Load Control	
1	PPL Electric's contract with the DLC CSP requires that the CSP recruit participants and that the CSP deliver savings. Thus, it is not PPL Electric's responsibility to retain participants. However, the DLC CSP may want to maintain records of the customers who exit the program, their reasons for leaving, and whether these customers had equipment that was actually cycled off. This information could be used to determine whether these customers may be experiencing actual discomfort, or if their discomfort is	Implemented

	predominantly perceived. If the issue appears to be perceived discomfort, consider discontinuing notifications to customers of planned DLC events.	
	Behavior and Education Program	
1	Educate participants more about the construction and interpretation of the neighbor comparisons. Many customers object to the comparisons for a variety of reasons, but additional education and explanation might alleviate some of their concerns.	Implemented. While PPL has not explicitly sent out additional information explaining the neighbor comparison, we have researched ways in which the neighbor comparison can be more precise. In an effort to create even more robust and accurate neighbor comparisons for the home energy reports, the CSP upgraded the information that is used to create neighbor comparisons. Out of the 100,000 customers receiving reports, approximately 16,000 customers' neighbor rank changed by more than 20 spots due to this upgrade (in 99.9% of those instances, the rank improved). Those 16,000 customers received a module on their April report letting them know about the data upgrade. The CSP was able to improve the accuracy of data utilizing several sources. For square footage data, they gained access to additional publicly available information (e.g. sourced from county assessors' offices) about home sizes. For heat type data, they were able to determine if homes are likely to use electric heat or not, based on homes' seasonal electricity usage patterns.
2	Study the report modules and consider revising those that generate high levels of dissatisfaction. For example, consider revising some of the language of neighbor comparisons to be less provocative, such as having ratings based on a more general comparison of similar homes in the area (e.g., by saying they have "room for improvement").	Being considered. The CSP has a dedicated User Experience team that continually conducts design studies and user interaction research, to evaluate customer attitudes, motivations, and perceptions towards the content and messaging of the Home Energy Reporting platform. These research initiatives, in addition to ongoing analyses of program energy savings and customer sentiment, have shown the effectiveness of current energy report modules (e.g. neighbor comparisons) in driving strong program performance and high levels of customer engagement. The CSP continues to run extensive test-and-control experiments within home energy report programs to determine and apply lessons learned about which content/messaging is optimal for maximizing energy savings and customer engagement.

3	Consider adopting a Web interface that allows customers to update their profiles. Many customers claimed the neighbor comparisons were inaccurate because they did not take into account special characteristics of their homes. A Web interface would be a convenient way for customers to update their information.	Being considered. When program started, the decision was made to only offer hard copy reports. The CSP does offer an online Web interface with this functionality. Further, because PPL offers the Energy Analyzer online to all customers, it was determined not to directly offer another web interface/usage profile as an option. This recommendation will continue to be evaluated to determine whether this should be an option for Act 129 Phase II.
4	Work with the CSP to develop a monthly reporting format that could be shared directly with PPL Electric management. Currently, PPL Electric's staff must clean up the report to make it presentable to managers.	Implemented. The CSP provides the monthly MWH savings in a spreadsheet to the Program Manager in the month after the reports are sent (there is no "report" to speak of, and nothing needs to be cleaned up). This method of communication provides the Program Manager with the information needed for monthly reporting to PPL EU Management.
	Renewable Energy Program	
1	Update the institutional GSHP rebate application to collect additional information needed to determine savings per the new calculation methodology. The additional information to collect includes the project type (new construction or retrofit); the previous heating and cooling equipment types; EER; COP; and the horsepower of the ground loop pump.	Rejected. Program closed around the same time this recommendation was issued. PPL will consider this recommendation if this measure is offered in Phase II.
2	These recommendations are associated with recording and tracking data:	
2a	Enter the capacity of both PV and GSHP systems into the database to allow Cadmus to select a more representative sample of the population and to calculate accurate savings for the program.	Rejected. Program closed around the same time this recommendation was issued. PPL will consider this recommendation if this measure is offered in Phase II.
2b	For GSHPs, always enter the model number into EEMIS so that the capacity and efficiency can be found in the AHRI database.	Rejected. Program closed around the same time this recommendation was issued. PPL will consider this recommendation if this measure is offered in Phase II.
2c	Return GSHP rebate forms without an AHRI certificate to the applicant, with a request that they provide the certificate or other documentation on the system's EER and COP values.	Rejected. Program closed around the same time this recommendation was issued. PPL will consider this recommendation if this measure is offered in Phase II.
2d	For PV projects, transfer tilt and azimuth information to the database in all instances so that savings can be estimated in the absence of a record review or site visit.	Rejected. Program closed around the same time this recommendation was issued. PPL will consider this recommendation if this measure is

		offered in Phase II.
3	As planned, close the institutional GSHP portion of the program when rebate funds are exhausted.	Implemented.
4	If PPL Electric considers offering a renewable energy program in its next EE&C portfolio, the Company should carefully evaluate the program's overall cost-effectiveness and coordinate closely with the DEP to ensure the rebates complement, rather than compete, with programs offered by the DEP.	Implemented. PPL will not offer a Renewable Energy Program in Phase II EE&C.
5	If PPL Electric includes a renewable energy program in future EE&C plans, the Company should evaluate options for offering lower incentives in order to spread the benefits over a larger number of participants.	Implemented. PPL will not offer a Renewable Energy Program in Phase II EE&C.
6	Because GSHPs can be cost-effective and serve the small commercial and government/institutional sectors well, PPL Electric could allow non-residential GSHPs under the Custom Incentive program and consider including residential GSHP systems under the residential Efficient Equipment Incentive program. However, the eligibility requirements should include a minimum efficiency level greater than code so that energy savings are achieved.	Implemented
	Custom Incentive	
1	Consider shifting the projected savings from the small C&I to other sectors, as previously discussed, to achieve the overall portfolio compliance target, since this program contributes significant savings.	Implemented
2	Increase participation among its small C&I and GNI customers. Although PPL Electric has taken a major step in addressing the savings shortfalls in these two sectors by hiring a C&I-focused implementation CSP, the Company will need to continue to work to overcome barriers in these sectors, support the CSP's efforts to the greatest extent possible, carefully monitor progress, and implement creative solutions to reach its targets. Specific recommendations include:	Implemented
2a	To target GNI customers, PPL Electric should use identifying criteria based on SIC codes, cross-referenced with information in its customer database, to create targeted customer lists for the CSP's outreach efforts.	Implemented
2b	The CSP's planned outreach to ESCOs should be continued, as ESCOs are traditionally a primary delivery mechanism for energy services to GNI customers, particularly for the municipal, university, schools, and hospitals market sector.	Implemented

2c	The CSP should continue to expand its focus on outreach to trade allies who primarily serve the small commercial and GNI sectors.	Implemented
2d	EPS should identify a list of custom energy-efficiency measures that are appropriate for small C&I facilities. The implementation CSP should, with PPL Electric's support, research appropriate technologies for small commercial customers that may not be offered under the prescriptive program, and actively promote those technologies to targeted customers. These could include new, cutting edge technologies such as LEDs and smart lighting systems, marginally cost-effective measures such as windows and retro-commissioning, or measures targeted to specific customer segments such as agriculture/farms or data centers.	Implemented. Researched market sectors that might benefit from cutting edge technology include hospitals, data centers, and airports. These efforts will be expanded in Phase II (agriculture and farms, for example).
2e	PPL Electric should continue its market segmentation analysis and leverage this work to target potential customer segments that are most likely to benefit from the Custom Incentive program. Consider using the insights gained from the resulting knowledge platform to implement a social marketing campaign to supplement PPL Electric's targeted messaging and media optimization approaches.	Implemented. The C&I CSP worked with market research groups to get various lists and customer survey results.
3	Carefully monitor program progress and cost-effectiveness and adjust program operations to reduce costs if needed. Recommendations include:	Implemented
3a	Consider reevaluating the reimbursement policy for technical studies if a reasonable portion of those studies do not eventually result in custom incentives. Few technical studies to date have resulted in custom incentive projects. It may be too early to judge success, since the time between the audit and installation of the recommended measures can be substantial.	Implemented
4	Assess the effectiveness of TRC screening at the project level. PPL currently estimates the TRC for each project based on ex ante cost and savings estimates. To be eligible, projects are generally required to have a TRC of 1.0 or greater. This process provides a clear and defensible rule for rejecting projects that are not cost-effective. However, it is not a requirement of the PUC or the SWE and is not necessary. PPL Electric should consider the tradeoff between lower participation and lower program cost-effectiveness.	Implemented
5	Attempt to reduce turn-around time as much as possible through the entire Custom Incentive program process. Additionally, PPL Electric should make it clear to customers as projects begin that the process may span over multiple months from initial application to rebate check payment. EPS should proceed with its plans to develop an online program dashboard to allow customers to see the progress of their projects through the application process. Participants will be less likely to be dissatisfied over the turn-	Implemented

	around time if they enter the program with the knowledge that, in the words of one program participant, "[the Custom Incentive program process] is not instantaneous."	
6	Leverage the experience of working with relatively simple technologies (such as lighting retrofits and variable speed drive motor control projects) to develop a streamlined approach for these simpler projects. This would help small C&I and some GNI participants with smaller facilities to more easily navigate the program and complete projects.	Implemented. Limited time offer for compressed air is an example.
7	Standardize the M&V approach for simple projects to ease the M&V burden on participants.	Implemented
	HVAC Tune-Up	
1	If this program does not get back on track by PY3, PPL Electric should consider dropping it.	Implemented. The program continued to pay rebates to trained contractors for tune-ups they completed, but payments to the implementation CSP were stopped in June 2011.
2	The implementation CSP and PPL Electric should continue helping contractors market the program to their existing and prospective customers to increase participation.	Implemented. Implementation CSP continued marketing efforts to chain stores and to individual contractors with limited results. Initiatives included technical training, in-person information meetings with contractors, and webinars to promote the programs and answer contractor questions.
3	The implementation CSP should continue training contractors on-site to ensure they understand how to properly implement measures using the Service Assistant tool.	Implemented. FDSI conducted technical training sessions for HVAC contractors individually as requested and in group sessions through distributors.
4	Instead of charging contractors up front for the complete cost of the tool, PPL Electric should consider waiving or reimbursing the cost of the tool based on contractors conducting a certain number of measure installations (or units serviced); or consider leasing the tool to contractors, with an option for them to purchase it at the end of the program. So as not to alienate contractors who already purchased the tool, offer an additional/equivalent rebate per installed measure to reimburse the tool's cost over time.	Under consideration. PPL Electric Utilities would consider both of these alternatives if an HVAC tune-up program was found to be marketable in future phases of Act 129.
5	The implementation CSP should encourage contractors to consider keeping the program free to end users, that is, not pass the cost of the service to end users. If this is too expensive for contractors, PPL Electric could consider providing contractors additional incentives to cover their labor costs.	Under consideration. PPL Electric utilities would consider this approach if an HVAC tune-up program was found to be marketable in future phases of Act 129.

6	The implementation CSP could focus on attracting national accounts, which could provide multiple opportunities for program sites in PPL Electric's service territory.	Implemented. Implementation CSP marketed the program to 27 national accounts totaling 369 stores in PPL electric Utilities Service territory. Few contracts materialized for tune-ups.
7	Encourage contractors to focus on marketing to their larger customers with many locations.	Implemented. Limited results.
	Low Income E-Power Wise Program	
1	Follow up, as planned, with inactive CBOs that have undistributed kits to determine the reasons for their inactivity, how the CBOs intend to disseminate the kits, and how PPL Electric can help if necessary.	Implemented
2	Establish a process (if not already in place) whereby a specified number of kits are shipped to each CBO, and no additional kits are shipped until the CSP receives enrollment forms verifying that the first set of kits (or a large proportion of the kits—to avoid start-stop kit distribution) have been distributed to eligible customers. If the CSP does not receive confirmation that a CBO's kits were distributed within a specified timeframe, the CSP should follow up with the CBO to determine why kits were not disseminated and establish a plan and schedule for dissemination. CBOs that repeatedly fail to disseminate kits in a timely fashion should be required to return the kits and be dropped from the program.	Implemented
3	Develop an online database to allow CBOs to enter participant information while in the field. Electronic entry of participant information would streamline documentation procedures, reduce the distribution of multiple kits per account, and reduce transcription issues.	Implemented
4	If participation begins to lag in PY3 or PY4, consider including an additional CFL or a coupon for a CFL in the energy kits. Alternatively, consider raising the CBO incentive level to $15 per kit until participation increases again. These tools should be used only as needed to maintain target participation and savings levels in the program.	Rejected. Participation is on target.
5	Include information about other PPL Electric energy-efficiency offerings in the energy kits and educational sessions.	Implemented
6	Prepare and provide CBOs with copies of the program materials in a larger font for CBOs to disseminate on an as-needed basis.	Being considered for Phase II.
7	Ensure that train-the-trainer sessions cover all measures included in the energy kits (e.g., plumbing tape).	Implemented
	Low Income Winter Relief Assistance	

1	For multifamily projects, consider determining the owner's intent to keep or sell the property before having the field representatives obtain tenant signatures.	Rejected. PPL does not intend to implement for the following reasons. 1. Only homeowners and tenants (not landlords or property owners) can apply for WRAP in accordance with LIURP guidelines. 2. Based on previous experience, it is unlikely that a property owner would disclose this information and WRAP staff cannot legally enforce. 3. At least 50% of the tenants must meet income guidelines for the building to receive WRAP. Therefore, it is probable that low-income tenants would continue to occupy the building, if sold.
2	Capitalize on the expanded resource of BPI-certified contractors by revisiting previous WRAP participants to identify potentially overlooked or ineligible inefficiencies and implement deeper savings measures.	Rejected. PPL EU has used BPI-certified contractors since 2011 for USP and Act 129 WRAP audits and third-party field inspections. In accordance with WRAP standards (2004-present), Inspectors are required to identify major missed opportunities.
3	Add HPWHs as a WRAP measure to capture the additional savings. Because savings from this measure far exceed those from standard high-efficiency water heaters, savings from HPWHs could be added to the savings deemed by job type, i.e., baseload, low-cost, and full-cost jobs.	Implemented.

Table D-7: PPL 2012 Process Evaluation Recommendations and Responses

PPL 2012		
	Recommendation	**Response**
Efficient Equipment		
1	PPL Electric should improve data collection for measures that are being continued in PY4: chillers, HE compressors, and insulation measures. These have high savings that are hard to verify without the needed variables. A system that checks for missing values should be put into place, and rebate applications should not be accepted if this information is missing.	Implemented where possible/practical in EEMIS. Where not possible/practical, deemed savings or simplified assumptions were used for ex-ante savings and the evaluator adjusted those savings as-needed for ex-post. These measures did not contribute a significant portion of the portfolio's savings.
2	PPL Electric should continue the Direct Discount delivery channel in PY4 to improve participation rates in the small C&I sector and meet the planned savings. PPL successfully increased lighting projects through this method, but refrigeration projects did not increase (only eight were installed through Direct Discount.) PPL Electric should consider replicating the marketing approach used	Implemented. Direct Discount was very successful for small C&I lighting. PPL plans to recruit more trade allies for refrigeration in Phase II. Refrigeration was not that popular for customers in Phase I.

	for lighting for measures other than lighting. PPL could also consider increasing recruitment efforts for trade allies that install refrigeration and other non-lighting measures.	
3	Continue and expand efforts to leverage trade ally engagement for Direct Discount program promotion, particularly through:	
3a	One-on-one outreach to contractors that have completed low numbers of projects	Not implemented. Customers are free to choose their own Direct Discount contractor. Some Direct Discount contractors have large businesses (a lot of customers/jobs) and others do not. PPL does not think it is appropriate to dictate the volume level for Direct Discount contractors. PPL tracks jobs by Direct Discount contractor and works with contractors that have a low take rate in order to improve their business and ensure customers get the benefit of rebates.
3b	Advertising the improvements that PPL Electric has made to the rebate processing times	Not implemented. PPL does not think it needs to advertise or "toot its own horn". PPL improved its rebate processing time and customers show their appreciation through increased participation and higher customer satisfaction levels.
3c	Showcasing successful testimonials from other contractors	Implemented
3d	Improving inspection processes.	Status unknown. Recommendation is too vague. Does this apply to CSP site inspections, communication of site visits (customers, PPL, etc.) or Cadmus' site inspections?
4	PPL Electric should continue LTOs in PY4 to improve participation rates in the small C&I sector to meet the planned savings; however, more marketing is needed to increase the number of participants that apply for the LTO rebates.	Implemented.
	Energy Assessment and Weatherization	
1	To increase the conversion rate for the Home Energy Assessment and Weatherization Program, PPL Electric should considering the following changes to the program structure:	
1a	Pre-screen audit participants to reserve audits for those more likely to follow through on measure recommendations.	Implemented
1b	Because cost was most often cited as a reason for not following through with recommended measure installation, and because the market cost of the audit is high, consider creating a larger insulation rebate for survey/audit participants.	Implemented

1c	Consider reimbursing customers for the full cost of the audit if they follow through with measure installation.	Rejected due to increased cost and limited benefit
1d	Explore using a limited-time offer for a larger weatherization rebate to encourage past survey/audit participants to install recommended measures.	Implemented
1e	Provide dealer incentives to contractors who sell weatherization projects to audit customers.	Implemented
2	PPL Electric should work with the program's CSPs to process rebates and enter data into EEMIS on a timelier basis to improve the accuracy of the conversion rate calculation.	Implemented
	Appliance Recycling	
1	Increase intermittent marketing activities heading into winter holiday months. We encourage PPL Electric to further explore with JACO methods to increase participation and to evaluate costs and benefits of increasing marketing activities during historically slower months.	Implemented
2	Develop a routine QA/QC procedure to proactively identify data upload issues. In addition to including work package upload date in JACO's database, PPL Electric should formalize a QA/QC process to identify missing units after every data upload. The protocol should identify key fields to summarize within defined time periods, accounting for the lag between quarters and identify any discrepancies.	Implemented
	Behavior and Education Program	
1	The program CSP and PPL Electric should continue to educate participants about the neighbor comparisons in in the Home Energy Reports. The comparisons should be made as transparent as possible, explaining the criteria used for determining "neighbors" for this comparison.	Implemented. A brief description of the neighbor comparison is included on all reports and is explained to customers that contact the call center or Program Manager.
2	To allow for more accurate matching for the neighbor comparisons, the program CSP and PPL Electric should consider offering a way for participants to update details about their homes. A possible approach would be to allow participants to update their information over the Web.	Being considered. When program started, the decision was made to only offer hard copy reports. The CSP does offer an online Web interface with this functionality. Further, because PPL EU offers the Energy Analyzer online to all customers, it was determined not to directly offer this as an option. This recommendation will continue to be evaluated to determine whether this should be an option for Act 129 Phase II.
3	PPL Electric and the program CSP should continue to advertise other PPL Electric energy-efficiency program offerings in the Home Energy Reports.	Implemented. Including other Act 129 residential programs is a critical component of all reports.

	Renewable Energy Program	
1	Consider adding prescriptive incentives for residential and small commercial GSHP systems to the Efficient Equipment Program.	Rejected. Program funding was committed so quickly and the program closed.
2	Nonresidential systems containing chillers, roof top units, or other equipment that complicates the energy savings calculations should be handled under the Custom program.	Implemented. Any requests for non-residential systems will be handled through the Custom Program after the Renewable Program closed.
3	Collect cost data for residential and small commercial GSHPs to calculate a cost per ton for cost-effectiveness calculations. For PY3, an assumed cost per ton will be used.	Rejected. Program closed before this information could be added to the rebate form. Will include this information if program is re-opened or included in Phase II.
4	In rebate applications and EEMIS, distinguish between water source heat pumps (WSHP), groundwater source heat pumps (GWSHP), and ground source heat pumps (GSHP).	Rejected. Program closed before this information could be added to the rebate form. Will include this information if program is re-opened or included in Phase II.
5	Enter the values into the EEMIS database from the AHRI certification corresponding to the specified system type and use those values to calculate savings. For example, if the system is a GSHP, the EER, COP, heating capacity, and cooling capacity for a GSHP should be used.	Rejected. Program closed before this could be implemented. Will implement this if program is re-opened or included in Phase II.
6	Request the size of the ground loop pump(s) on rebate forms. The TRM methodology subtracts the electricity used by the ground loop pump. Currently this pump is not taken into account in the claimed energy savings but it is included in the verified energy savings (Cadmus collects this information during the site visit). This anomaly can result in significantly lower savings.	Rejected. Program closed before this information could be added to the rebate form. Will include this information if program is re-opened or included in Phase II.
	Custom Incentive	
1	PPL should consider modifying the program rules and applications for Phase II. Application forms currently do not disqualify retroactive projects. We do not recommend changing them for the remainder of Phase I; however, we suggest considering this modification for Phase II. The installation date for Phase II projects cannot be earlier than June 1, 2013 (the start of Phase II). However, PPL Electric should consider requiring a customer to submit an application for a custom project before that project is installed.	Implemented for Phase II by requiring pre-approval (application submittal) before measure is in-service.
2	In Phase II, program staff and KAM outreach should not attempt to identify projects that customers have already installed. Customers should be regularly asked about any upcoming renovations, upgrades, expansions, or other projects, so that opportunities to improve energy efficiency can be identified and integrated into the project.	Implemented for Phase II by requiring pre-approval (application submittal) before measure is in-service.

3	PPL Electric should implement a pre-screening process to ascertain whether the program impacts customer decisions to install a project. Alternatively, set limits on application submittals relative to project installation. This may help to reduce free-ridership but it will be very difficult to determine if customers committed to their project (i.e. budgeted the project, obtained internal approval to proceed, etc.) before their Act 129 EE&C rebate was approved or would have proceeded with their project in the absence of the Act 129 EE&C rebate. Over time, customers will likely be savvy enough to answer pre-screening questions in a way that ensures they will not be screened-out as "free riders."	Implemented for Phase II by requiring pre-approval (application submittal) before measure is in-service. PPL will consider additional free-ridership screening if the PY5 net-to-gross evaluation indicates free-ridership is too high.
4	Continue to work to mitigate the risks to program cost-effectiveness presented by large CHP projects by collaborating with the C&I CSP and the EM&V CSP. To date, the projects have been paid after several months of post-installation performance data has been obtained. This process leads to better alignment of verified to claimed savings than would payment of the incentives at the time that the project is completed.	Implemented
	HVAC Tune-Up	
1	Explore alternative HVAC tune-up diagnostic program models that do not require an expensive tool.	Considered. It is too late in Phase I to consider launching a new program, but alternate models will be considered should a tune-up program be included in future Phases of Act 129.
2	Consider an approach that qualifies contractor quality at the onset of their participation in the program, and then reduces the data reporting requirements after a number of successful tune-ups to reduce contractors' time to participate	Considered. It is too late in Phase I to consider launching a new program, but alternate models will be considered should a tune-up program be included in future Phases of Act 129.
3	Further research to assess freeridership should consider:	
3a	Customer intent. Only two of 11 respondents in the survey conducted by PPL Electric and FDSI found that contractors share incentives with the customer, meaning a standard practice tune-up probably would have occurred. Research should be conducted to determine whether the tune-up would have occurred without the program.	Considered. Due to poor performance, the relatively small impact of this program, and budget constraints (program funding was nearly committed) PPL decided not to pursue the recommendation. PPL will revisit this recommendation if a similar program is included in Phase II.
3b	Comparison of savings from a standard practice tune-up to savings the claimed from diagnostic tune-up.	Considered. Due to poor performance, the relatively small impact of this program, and budget constraints (program funding was nearly committed) PPL decided not to pursue the recommendation. PPL will revisit this recommendation if a similar program is included in Phase II.

Low Income E-Power Wise Program		
1	Provide additional instruction to agencies and participants to on how to install aerators and showerheads, including refinements to the showerhead and aerator instructions provided in the E-Power Wise Quick Start Guide.	Implemented
2	Consider increasing the number of CFLs included in the kits in all delivery channels.	Rejected. Other measures have been added to the kit to increase the energy efficiency value to the customer. Phase II kits will include a power strip, furnace whistle, and an LED night light.
3	Consider expanding the list of prequalified potential participants so that RAP can recruit a greater number of participants through the direct-mail program.	Being considered for Phase II.
4	Work with RAP to encourage agencies to collect participant phone numbers and ensure that phone numbers are uploaded to EEMIS for use with surveys.	Implemented
Appliance Replacement		
1	Use PY3 replacement rates to develop assumptions and inform program planning. PPL Electric should use data collected from customers through evaluation surveys to develop a more realistic replacement rate assumption for PY4 and to inform Phase II program planning.	Implemented for PY4 and Phase II planning assumptions. In Phase II, PPL's reported savings (ex ante) will be a single measure code (refrigerator and freezer) each with a savings estimate that is a blended average of not-replaced, replace with ES, replaced with non ES. Cadmus will determine actual, program-induced replacement rates in accordance with the Uniform Methods Protocol in the 2013 TRM.
Peak Saver Program		
1	Verify technology and system viability before calling for curtailment events.	Implemented.
2	For the initial event—or before making system changes—conduct a test event with a sample of the participant population. This will help to ensure that the program technology is set up correctly and internal processes are functioning appropriately. PPL Electric and the CSP conducted several test events during the summer of 2011 but none of those events had the same extremely hot weather, immediately preceded by cool weather, as the first two curtailment events in 2012	Will be implemented if this program is offered in the future.
3	Establish both a system monitoring protocol to monitor the signals being sent to the DLC devices and a plan to revert the control strategy to normal, in the event that problems occur with the cycling strategy or duration.	Implemented. Used different cycling strategies throughout the summer after the initial incident.

4	Consider the use of a temperature-dependent cycling strategy that limits temperature rise. For example, by limiting temperature rise to four degrees, PPL Electric may have been able to minimize the severity of the problems incurred with the first event.	Rejected. The DLC CSP has no way to determine the temperature rise in a participant's home. However, the CSP adjusted the cycling strategy to reduce the likelihood of significant temperature increases in a home.
5	Increase efforts to manage customer expectations regarding the Peak Saver Program participation and conservation events. PPL has already taken steps to manage expectations by sending outbound messages to customers to notify them of upcoming events.	Implemented. Outbound messaging plus an announcement on the website prior to events.
6	PPL Electric should consider revising program materials to reflect a more cautious description of the potential conservation event experience, with warnings about potential higher temperature levels. However, that should be weighed against the likelihood this type of communication may discourage customers from participating.	Will be implemented if this program is offered in the future.
7	In anticipation of increased customer calls during conservation events, consider increasing the number of Peak Saver representatives who are on call.	Implemented. Reps could be pulled from other programs during times of high call volume
8	Increase training for Peak Saver representatives on how to inform customers who call the hotline and then revise any guidelines or phone scripts to accommodate unexpected issues.	Implemented.
	Residential Lighting Program	
1	As EISA is phased in, ramp up customer education about EISA and energy-efficient light bulb choices through the ePower Website, manufacturer and retailer partners, and CFL give-away events.	Implemented. CSP has developed a Next Generation of Lighting Brochure that will be distributed to customers to educate them on the EISA standards and their choices for energy efficient bulbs. Education will be conducted through retail events, give away events and the ePower website (a copy of the brochure is available to download from the website).
2	Reduce standard CFL incentives.	Implemented. Incentive levels have been adjusted to meet the required savings targets.
3	Continue educating customers about and providing incentives for specialty CFLs.	Implemented. Incentive levels have been adjusted to meet the required savings targets. Customers will be educated on energy efficient bulbs (including specialty bulbs) at retail and community events as well as the ePower website.
4	Ramp up LED promotion as more LED options become available and as prices drop.	Implemented. LEDs will be offered in the first year of Phase II and will continue to be discounted as the price decreases and more options become available.

5	Expand the informational campaign about CFL disposal at participating retailers—through retailer training and point-of-purchase displays (as permitted by retailers) —and during CFL give-away events.	Implemented. A recycling campaign is being developed to educate our customers on the proper way to recycle CFLs as well the locations where they can recycle CFLs. Recycling pails will be offered to participating retailers (in addition to the retailers in Phase I) so customers can conveniently recycle their CFLs.
6	On the ePower Website, display a link listing CFL recycling locations more prominently.	Implemented. CSP has changed the "look and feel" of their website portal which includes prominently display CFL recycling locations.

Table D-8: PPL 2013 Process Evaluation Recommendations and Responses

PPL 2013		
	Recommendation	**Response**
RESIDENTIAL EFFICIENT EQUIPMENT INCENTIVE PROGRAM		
1	Leverage existing PPL marketing and outreach to promote the additional rebates and incentives through this channel.	Implemented. Expansion being considered for Phase II. PPL provided information/marketing materials about other programs to participants in the Phase I appliance recycling program. For Phase II, PPL has expanded the role of its E-Power Team to provide more face-to-face marketing, including information about PPL's Phase II programs. PPL will consider expanding this recommendation for Phase II if it helps to achieve marketing (and savings) objectives at a lower program cost. This recommendation is specific to the following conclusion from PPL's evaluator: "Only 28% of [residential] program participants were aware of other PPL energy conservation rebates or incentives." That conclusion may be true but the type and extent of marketing must be closely matched to the desired savings objectives (i.e. actual progress compared to goal). The budget for most programs (and the portfolio) was fully subscribed by the end of Phase I and PPL's Phase I savings were 50% greater than the compliance target. Therefore, additional marketing and outreach would not have provided a benefit and may have caused programs to go dark before the end of Phase I (would have reached full funding too early).

2	Because the specifications for TVs change so rapidly, PPL Electric should ensure that the models for which incentives are being offered in Phase II are a step ahead of standard specifications to reduce freeridership	Implemented. PPL's approved Phase II EE&C Plan includes a mid-stream delivery channel for television rebates. PPL agrees with its evaluator's conclusion that "Maintaining a high NTG ratio will depend on the ability to influence retailers to carry more high-efficiency models (possibly multiple tiers above the standard) than they would have without the incentive. Maintaining an understanding of the rapidly changing market for this measure has proven difficult for other utilities." Therefore, PPL is planning to delete this as an eligible measure because it likely is not practical to ensure the TV models are a step ahead of standard specifications and, therefore, the program would likely have unacceptably high freeridership.
	COMMERCIAL EFFICIENT EQUIPMENT	
1	Consider expanding the Direct Discount program to include measures that are commonly installed by small businesses receiving non-lighting rebates, where the measure is a good fit with the delivery channel's structure.	Rejected. Adding these measures to the Direct Discount delivery mechanism would merely "displace" other measures (such as lighting) and, therefore, would not increase total savings (program or portfolio) within the existing funding. In addition, since those additional measures are not more cost-effective than the measures currently in DD (primarily lighting), the benefit-cost ratio would likely decline.
2	Consider opportunities to improve Direct Discount participant experience, such as conducting a random sample of QA/QC site-visits or phone calls to ensure projects are going smoothly	Implemented. PPL has reviewed this recommendation with the C&I CSP and corrective actions have been implemented to include QA/QC questions in post inspections. The C&I CSP will address the customers' satisfaction and quality concerns with the specific contractor.
3	Bring general financial savings information for eligible measures more front-and-center on the PPL Electric website	Implemented. Expansion being considered for Phase II. In Phase I, PPL used case studies on specific projects by C&I customers (with the customer's permission) in advertising (print, direct mail, digital, broadcast). PPL recently won 1st place for its print ad showing savings for a small business customer. PPL will evaluate this recommendation further for Phase II and expand it if necessary to achieve savings objectives within budget. Providing "too much" information to customers is not necessarily ideal and the level of information/program promotion must be closely matched to the desired savings objectives (i.e. actual progress compared to goal). Otherwise, programs will go dark (exhaust their funding) too early.
4	Highlight new Phase II measure offerings when working with trade allies and on website and program brochures	Implemented.
5	Repeat customers with multiple facilities have the opportunity to install the same measure types across	Implemented.

	multiple locations. PPL key account managers should continue to look for opportunities for their customers to install other measures and apply for rebates.	
6	Limit the time between equipment installation and rebate application by requiring that customers submit their applications within six months after they install (or purchase) their equipment. In Phase II, PPL has already implemented rules requiring an in-service date of 6/1/13 or later (installed and operable).	Implemented. PPL's approved Phase2 EE&C Plan and rebate forms require customers to submit the rebate form within 180 days of installing the measure. In addition, PPL is proposing to change its EE&C Plan by requiring non-residential customers to get pre-approval of their application before purchasing the measure.
7	Establish an internal QC procedure to check variables such as space cooling type, fixture code variables, and building type identification in the PA Lighting worksheet (TRM Appendix C) used to calculate ex-ante savings to improve lighting project realization rates.	Implemented. PPL has recommended this additional QA/QC to its C&I CSP who is responsible for nonresidential lighting. A realization rate as close as possible to 100% will help PPL ensure its reported savings (monitored in near real-time) are reasonably representative of the verified savings (determined in November each year) that will count toward compliance.
RESIDENTIAL LIGHTING PROGRAM		
1	Increase education regarding bulb disposal.	Implemented. PPL is proposing a change to its Phase II EE&C Plan that will eliminate incentives for CFLs by PY6, provide incentives for LEDs instead, and will provide additional CFL recycling sites for consumers.
2	Increase education regarding the Energy Independence and Security Act.	Implemented. PPL is proposing a change to its Phase II EE&C Plan that will eliminate incentives for CFLs by PY6 and provide incentives for LEDs instead. That change will include consumer education and awareness about the benefits of LEDs (compared to CFLs and incandescents) and, directly or indirectly, information about EISA. PPL thinks it is more important for consumers to understand the relative differences in performance and savings between lighting technologies, not necessarily the details about EISA per se.
3	Work with program CSP to improve retailer stocking and promotion of specialty CFLs and LEDs.	Implemented. PPL is proposing a change to its Phase II EE&C Plan that will eliminate incentives for CFLs by PY6 and provide incentives for LEDs instead.
4	Increase incentive levels for specialty CFLs and LEDs.	Implemented. PPL is proposing a change to its Phase II EE&C Plan that will eliminate incentives for CFLs by PY6 and provide incentives for LEDs instead.
CUSTOM INCENTIVE PROGRAM		
1	Consider ways to improve communications with customers.	Being Considered. PPL will review these recommendations with its C&I CSP and implement them if warranted to improve customer satisfaction or to achieve savings objectives within budget.

2	Identify opportunities to streamline the application and paperwork process.	Being Considered. PPL will review these recommendations with its C&I CSP and implement them if warranted to improve customer satisfaction or to achieve savings objectives within budget.
3	Add new measure codes in EEMIS, tailored to the Custom Program measures (PPL has already implemented this recommendation).	Implemented.
4	Continue the real time evaluation approach and coordination between implementation and evaluation teams.	Implemented.
	ENERGY EFFICIENCY BEHAVIOR & EDUCATION PROGRAM	
1	Provide additional information to educate participants about the neighbor comparisons in the Home Energy Reports.	Being Considered. PPL will review this recommendation with its program CSP in early 2014 and implement it if warranted to improve customer satisfaction or to achieve savings objectives within budget.
2	Consider offering a way for participants to update details about their homes. The Home Energy Reports could account for features of the home and actions that have already been undertaken by participants. A possible approach would be to allow participants to update their information on the web.	Being Considered. PPL will review this recommendation with its program CSP in early 2014 and implement it if warranted to improve customer satisfaction or to achieve savings objectives within budget.
3	Continue to promote other PPL Electric energy-efficiency program offerings in the Home Energy Reports.	Implemented. This is planned to continue in Phase II.
	APPLIANCE RECYCLING PROGRAM	
1	Explore incentives that would encourage participants to recycle primary appliances that are in use for a greater portion of the year. Monitor and weigh the impact of this strategy on replacement rates.	Being Considered. PPL will review this recommendation with its program CSP and implement it if warranted to achieve savings objectives within budget.
2	Cross-market other PPL E-Power programs to ARP participants, such as including program materials and brochures in JACO's drop-off materials during appliance pick-up.	Implemented. Expansion being considered for Phase II. PPL did this in Phase I (see recommendations 2 & 3). PPL will evaluate expanding this recommendation further in Phase II and will implement it if necessary to achieve savings objectives within budget. Providing "too much" information to customers is not necessarily ideal and the level of information/program promotion must be closely matched to the desired savings objectives (i.e. actual progress compared to goal). Otherwise, programs will go dark (exhaust their funding) too early.

3	Consider ways to target participants who would be most likely to keep their appliances in the absence of the program.	Being Considered. PPL will review this recommendation with its program CSP and implement it if warranted to achieve savings objectives within budget or to prevent high freeridership.
	HOME ENERGY ASSESSMENT AND WEATHERIZATION PROGRAM	
1	Continue to make eligibility for the weatherization rebates contingent upon participation in the audit part of the program.	Implemented. In addition, PPL is proposing changes to its Phase II program that will increase the audit rebate if customers install measures recommended by the audit.
2	Explore partnering with financial institutions or independent organizations to refer customers to for help with financing weatherization upgrades.	Rejected/Being Considered. PPL will consider expanding the information/links to existing financing sources on its website. However, PPL's research does not indicate a widespread or compelling need for financing in order for PPL to achieve its savings compliance targets.
	PEAK SAVER PROGRAM	
1	Should PPL Electric choose to implement a similar air conditioning cycling program in the future, clearly describe the potential for temperature increases during conservation events. Clearly describe how long the events will last.	PPL agrees.
2	Should PPL Electric choose to implement a similar air conditioning cycling program in the future, increase the number of Peak Saver hotline representatives who are on call, or, explore options to improve the hotline experience.	PPL agrees.

D.4 FirstEnergy

Table D-9: FirstEnergy 2011 Process Evaluation Recommendations and Responses

	FirstEnergy 2011	
	Recommendation	**Response**
	FirstEnergy 2011 - Low Income Low Use	
1	**Continue to offer the program through using an "opt-out" method.** Very few participants (less than one percent) chose the opt-out option which resulted in a smooth and quick process of getting kits out to customers. In addition, more customers are able to benefit from the program by not having to have an audit or energy analyzer.	Implemented.

2	**Revisit the installation instructions for the furnace whistle.** For customers that did not install the furnace whistle, the most common reason was because participants did not know how. By providing clear instructions and descriptions of the installation process, customers will be more likely to install the measure. Consider adding more detailed, step-by-step instructions on how to install the whistle including pictures at every step. Additionally, customers do not understand why the equipment should be installed, so by providing detailed and descriptive information on the benefits of the furnace whistle, customers may be more likely to install the equipment.	Being considered for Phase II.
3	**Consider combining the energy education material and installation material into one booklet.** With 25 percent of participants not reading the education materials and an additional eight percent that did not recall seeing the material, consider putting the education, installation instructions and other material into one booklet. While there are cost implications associated with this, it may increase the likelihood of customers seeing the materials but also reading the information. It may also be worth reviewing how the kits were assembled and where the educational material were located within the kit.	Implemented in Phase II. A trifold brochure is being used to consolidate instruction and disposal information material.
	FirstEnergy 2011 – Home Audit Program	
1	**Provide more formalized training to walk-through auditors to promote a more standardized audit approach**, including guidance on deciding which low-cost measures are appropriate for certain types of customers and the appropriate manner of installation (i.e., auditor may only count as savings those measures which the auditor directly installed). Also, consider BPI training for all walk-through auditors.	Implemented. Guidance provided thru Honeywell mgmt. Did not implement BPI training as program was to be discontinued in Phase II.
2	**Supply all walk-through auditors with FirstEnergy marketing materials and rebate applications they can provide to customers along with training on appropriate marketing opportunities.**	Implemented. Materials were available - guidance on use provided thru Honeywell mgmt.
3	**Target customers who have not already completed the online Home Energy Analyzer and who were not already mailed an energy conservation kit to maximize the effectiveness of low-cost measures.**	Implemented.
4	**Consider cost-effective strategies to offset a portion of the $50 co-pay to encourage participation in the program.** One idea would be to eliminate or reduce the co-pay amount based upon installation of minimum number of upgrade opportunities. The program might also consider offering a mail-in rebate to offset the $50 co-pay based upon installation of a minimum number of upgrade opportunities. Another option might be to offer to install more measures to provide greater value to the participant. The program would need to evaluate the cost-effectiveness of any of these or other strategies.	Implemented for MetEd in September of 2012. Penelec and Penn Power programs were on track, so not implemented at those EDCs.
5	**Track specific recommendations made to customers of other FirstEnergy rebate programs.** Also consider following-up directly by telephone or via web survey with walk-through audit participants to see if they have moved	Under investigation.

	forward with any of the auditors recommendations, and if so, whether or not they pursued a FirstEnergy rebate.	
6	**Based on auditors' feedback of the Home Energy Analyzer tool, evaluate the usefulness of completing the Home Energy Analyzer for walk-through audit participants, or explore the feasibility of an offline version of the tool.**	Implemented as practicable.
7	**Continue to work to bridge geographical separation and to strengthen internal communication between auditors and other program implementation staff.** One idea would be to organize more formal opportunities, such as monthly conference calls, where walk-through auditors can share their experiences and discuss any concerns.	Implemented.
8	**Provide additional guidance to walk-through auditors on where to install LED night lights in order to realize the estimated savings from these measures.** Walk-through auditors should only install LED night lights when replacing less efficient lighting.	Implemented.
9	**Continue to inform participants about other FirstEnergy Utility programs and educate customers on how to take advantage of program incentives. Emphasize return-on-investment and payback information for energy efficiency improvements and the role that FirstEnergy Utility program incentives can play in overcoming first-cost barriers.**	Implemented.
10	**Continue direct marketing efforts such as utility bill inserts, direct mailings, and email blasts.** These approaches were the most common ways participants first heard about the program and/or the most preferred methods for receiving additional information on FirstEnergy Utility programs.	Implemented.
11	**Target customers who have not participated in the Online Home Audit program to maximize energy savings opportunities for low-cost measures. Those who have completed the online home energy analyzer are more likely to have already installed eligible low-cost measures because they were mailed an energy conservation kit with similar measures included. To address this issue, Honeywell has recently implemented a pre-assessment process to identify whether customers have already received an energy conservation kit prior to scheduling a walk-through audit.**	Implemented.
12	**Conduct additional research to assess the extent of free-ridership and spillover. Additional quantitative research to quantitatively evaluate free-ridership and spillover rates should be conducted to inform program design improvements and program planning.**	Implemented.

13	**To support future evaluation efforts, supplement utility customer contact information with contact information collected in the process of scheduling/conducting walk-through audits. The evaluation team was unable to reach over 15 percent of all participants sampled due to bad telephone numbers tracked in the Vision database. One option to lower this rate is to cross-check evaluation samples with Honeywell tracking data for updated contact information prior to data collection. Another option is for FirstEnergy or Honeywell to supply the evaluation team with updated phone numbers (where available) for participants the evaluation team is unable to reach with the phone numbers tracked in the Vision database.**	Not Implemented. Address as appropriate for future evaluations.
14	Consider providing walk-through auditor staff with portable appliance electricity monitoring devices. One of the recommendations for changes to the program offered by participants was to meter the energy usage of appliances during the walk-through audit. To encourage appliance upgrades, the program might consider providing each auditor with a portable appliance meter and providing interested customers with a visual demonstration of actual usage of older appliances compared to new Energy Star qualified items (if the outlet is easily accessible without risk of property damage).	Considered and rejected due to risk of property damage.
	FirstEnergy 2011 - Whole-House Audit	
1	**Continue recent efforts to educate whole-house contractors about other FirstEnergy Utility programs and encourage them to educate customers on how to take advantage of these program incentives.** As the primary face of the programs for many participants, there is potential for participating whole-house contractors to play a broader role in customer outreach and portfolio marketing efforts. Several participation contractors expressed interest in learning more about FirstEnergy's offerings and obtaining informational materials they can supply to their customers.	Implemented through contractor education and training, continuing education credits supporting BPI certifications, marketing materials.
2	**Consider alternative customer outreach and marketing strategies to boost participation in the program.** The program has seen limited participation to date; however, there is evidence to suggest the program has the potential to produce substantial energy savings and be a valuable part of residential portfolio. Test-out audits have proven to yield significant per-project energy savings and conversion rates to the test-out component of the program that are in-line with industry standards. To stimulate customer interest, participating contractors recommended additional outreach strategies such as partnering with trade organizations, presenting at trade shows, and ramping up marketing efforts in the fall season when customers are preparing their homes for winter. Other strategies that have been successful in other states include public educational sessions and workshops, partnering with home improvement stores to place informational brochures in stores, and targeted-market radio advertising.	Implemented.

3	**Explore additional strategies to more fully leverage contractor relationships in customer recruitment efforts. Along with its own customer outreach efforts, the program should also explore ways to stimulate contractor promotion of the program to encourage broader participation.** One idea would be to expand cooperative marketing efforts with participating contractors, such as encouraging more contractors to put links or information about the program on their company's website. Another possibility is offering a financial incentive program to participating customers based on the number of projects they bring in and the performance of those projects. FirstEnergy might also consider offering incentives to other HVAC and insulation contractors not enrolled in the program for referring customers to the Whole-House Audit program or participating whole-house contractors. A similar strategy was implemented by Wisconsin's Focus on Energy for its Home Performance with ENERGY STAR program, which is similar to the Whole-House Audit program in its design.	Implemented (see #1 above).
4	**Conduct additional research with nonparticipating customers and less active contractors to understand reasons why participation has been limited and gather feedback on how to increase participation levels.** One potential pool of nonparticipating customers is those who have participated in the Online Audit program but not the Whole-House Audit program. These customers have shown at least some interest in their home's energy use and may be more likely to benefit from major test-out measures. Future evaluation efforts should also include additional research with contractors who have been largely inactive in the program to better understand market barriers to participation and how to overcome these barriers. Research with nonparticipants will also help inform additional marketing and outreach strategies discussed above.	Under investigation for Phase II
5	**Conduct additional research to assess the extent of free-ridership and spillover.** Additional research to quantitatively evaluate free-ridership and spillover rates should be conducted to inform program design improvements and program planning. Research should also include more extensive interviews with auditors focused on free-ridership and spillover issues.	Implemented.
6	**Review rebate turn-around times to ensure rebates are being paid within a reasonable timeframe to maintain customer satisfaction.** Participants were least satisfied with the time it took to receive program rebates. Typically, residential programs aim to pay rebates within six weeks of receiving a valid rebate application. Rebate times may be longer for the Whole-House Audit program given the dependence on participating contractors entering data into Green Energy Compass and submitting the required documentation for test-out rebates. In addition, new contractors are subject to QC inspections which can further delay payment of test-out rebates. While program staff are optimistic that rebate lag times will shorten as contractors gain more experience with the program, rebate lag times should continue to be monitored. The program may also consider notifying customers of any delays caused by factors mentioned above,	Implemented.

	given that many of these processes are invisible to the customer.	
7	**To support future evaluation efforts, supplement utility customer contact information with contact information collected in rebate applications.** The evaluation team was unable to reach over 15 percent of all participants sampled due to bad telephone numbers tracked in the Vision database. One option to lower this rate is to cross-check evaluation samples with Honeywell or PSD tracking data for updated contact information prior to data collection. Another option is for FirstEnergy or Honeywell to supply the evaluation team with updated phone numbers (where available) for participants the evaluation team is unable to reach with the phone numbers tracked in the Vision database.	Not Implemented. Address as appropriate for future evaluations.
8	**Consider additional program-specific marketing and outreach strategies focused on educating customers about the benefits of comprehensive home energy audits.** Contractor recommendations included partnering with local trade organizations, presenting at trade shows, and increasing marketing efforts during the fall.	Implemented.
9	**Equip participating contractors with informational materials about all of FirstEnergy's residential programs to help them inform customers about other FirstEnergy rebate offerings.** Feedback from FirstEnergy program staff indicate that the program already has plans to send information brochures on all FirstEnergy residential programs to participating contractors.	Implemented.
10	**Evaluate program guidelines around the minimum quantity of low-cost measures that contractors are required to purchase at one time and from whom they are allow to purchase.** Also consider the feasibility of providing low-cost measures directly to contractors.	Implemented.
11	**Continue to explore methods to enhance training on Green Energy Compass, especially on calibrating the model with utility bills.**	Implemented.
12	**Continue to evaluate current rebate levels in relation to the cost charged by the contractor, especially for test-in audits, to ensure they are sufficient to encourage participation in the program.** The evaluation team will assess the impact of the program rebates on customers' decision to participate and their satisfaction with rebate levels in the customer surveys. Also, consider the feasibility of offering prescriptive rebates, or developing materials for the contractors to provide rebate information to help customers understand the benefits of going forward with the improvements (e.g., average rebate for insulation, air sealing).	Implemented.

Table D-10: FirstEnergy 2012 Process Evaluation Recommendations and Responses

FirstEnergy 2012		
	Recommendation	**Response**
FirstEnergy 2012 - Residential HVAC		
1	**Watch participation trends for equipment installations, and consider modifications to program design elements in light of reduced Federal tax credits.** The reduction in Federal tax credits likely had an impact on equipment installations throughout this program period. The data underscore the influence the federal funding has had on program participation. Nearly three-quarters of respondents stated that the funding had some impact on their decision to purchase the high-efficiency equipment.	Under consideration in Phase II.
2	**Target tune-up participants who do not have pre-existing maintenance contracts in order to maximize program savings, or offer an enhanced tune-up not currently offered as standard practice.** Most contractors confirmed that their standard maintenance tune-ups met the rebate-qualifying tune-up criteria, which allows them to combine the rebate into annual or semi-annual maintenance contracts. Because of the high number of instances where tune-up rebates are being bundled into pre-existing maintenance contracts, the attribution for tune-ups is low (25 percent). Over half of the tune-up respondents (57 percent) indicated they had a maintenance contract prior to participating in the program. Nearly 94 percent of those who previously had a maintenance contract indicated that their contract included annual tune-ups. These customers negatively affect the program's attribution, as they would have had the maintenance performed with or without the aid of the program.	Rejected due to practical challenges of data availability.
3	**Market the program through an aggressive multi-tiered approach.** Given the high proportion of respondents who learned of the program through their contractor, as well as the high number of respondents who indicated they would prefer to receive program information through direct mailings (61 percent), the program should continue utilizing a multi-tiered marketing effort. Marketing the program effectively to contractors encourages them to educate their customers. In turn, cross-marketing efforts from program to program may also help bolster participation across the residential portfolio, as the programs may help funnel participants into pursuing additional energy-saving activities. Not only do program leave-behind materials ensure that participants have a comprehensive understanding of the program, they also emphasize other avenues the participant can explore in order to increase their household's energy efficiency.	Implemented.

4	**Refine the application process to ensure it is both streamlined and user-friendly.** The program currently accepts paper applications. One recommendation from contractor interviews was to provide an online application submission option to expedite the application process. Key documentation would be populated in the computer systems automatically by the applicant and contractor submissions rather than having implementation staff manually data enter the information from the application forms. Contractors interviewed believe that using an automated process will reduce data errors from transcribing applicant documents associated with manual entry or handling the data inputs multiple times.	Implemented as appropriate. Online applications are not available.
5	**For the PY3 evaluation effort, incorporate a quantitative contractor survey (also known as an influential vendor survey) that assesses the level of influence the program has over contractors.** Implementing a quantitative contractor survey will make it possible to develop a more complete assessment of the program's influence and support more accurate attribution analyses. The contractor survey will also identify whether program offerings should be revisited and revised based on their standard practices.	Implemented.
	FirstEnergy 2012 - Appliance Turn-in	
1	**Consider adopting more aggressive cross-marketing strategies.** Cross-marketing efforts, from program to program, may help bolster participation across the residential portfolio, as the programs may help funnel participants into pursuing additional energy-saving activities. Not only do program leave-behind materials ensure that participants have a comprehensive understanding of the program, but they also emphasize other avenues the participant can explore in order to increase their household's energy efficiency.	Being considered in Phase II.
2	**Emphasize environmental issues and convenience factors in program marketing materials.** When asked to rate the level of influence various aspects had on their decision to participate in the program, using a scale of zero to ten, the most influential factors cited by respondents were that the appliance was disposed of in an environmentally safe way, the free pick-up/removal, followed by the desire to save energy).	Implemented.
3	**Reinstate the $35 incentive offering for refrigerators and freezers.** When asked to identify the primary reason for their participation, nearly 60 percent of participants said that the reason the participated in the program was the incentive level. However, the differences between the influence of the different levels of rebates offered between calendar year 2010 and 2011 ($35 and $50, respectively) for refrigerators and freezers are negligible. This finding suggests that the change in incentive level has a minimal effect on a participant's decision to recycle an appliance through the program. Furthermore, when asked whether they would have participated in the program had the incentive level been lower, over three quarters of survey respondents confirmed they would have participated for	Rejected - program results indicate that the higher rebate level was required to support participation goals.

	a lower incentive.	
4	**Continue to target recycling primary appliances, as well as secondary appliances that will not be replaced.** Appliances recycled through the program are replaced approximately 68 percent of the time. Refrigerators are the most likely to be replaced with another refrigerator (73 percent).	Implemented.
5	**Consider dropping room air conditioners from the roster of eligible equipment types.** Forty-one percent of room air conditioners were not being used prior to participation in the program. This suggests that the recycling of room air conditioners is more likely to result in a lower program attribution and, therefore, lower program net savings.	Implemented. In Phase II we will only pick up RAC in conjunction with a large appliance.
6	**Do not move ahead with a program referral incentive.** 72 percent of respondents indicated that they had already recommended the program to others and approximately 98 percent of surveyed participants indicated that they would be willing to recommend the program in the future.	Did not implement referral concept.
7	**If the program is ever required to report net savings, consider methods to screen out free-riders.** The preliminary attribution estimate yielded an attribution rate of 59 percent, overall. The evaluation team conducted secondary research of other appliance recycling programs to provide a preliminary gauge of how well the program is performing against other, more mature appliance recycling programs. The results of this review indicate that the FirstEnergy Utilities' PATI free-ridership rate is in-line with other Pennsylvania evaluations, and lower than recycling programs operated in other more mature jurisdictions.	Will consider when appropriate.
FirstEnergy 2012- Easy Cool Rewards Participant and Dropout Survey: Penelec and Penn Power		
1	**Email newsletters or other promotional material about programs like Easy Cool Rewards to customers.** Participants indicated a strong preference for receiving information about similar programs via direct mail, which FirstEnergy is already providing. Respondents also noted a desire to receive information from FirstEnergy through email. Sending monthly newsletters highlighting upcoming energy efficiency programs directly to customers' inboxes may increase participation in this and other programs.	Insight considered in implementing programs generally.
2	**Create increased awareness of FirstEnergy's Home Energy Analyzer tool.** Of participants with Internet access, 35 percent are aware of the feedback options FirstEnergy has in place through the Home Energy Analyzer to provide analysis of their energy consumption. Even fewer participants have personally used the tool to review their electricity reduction after energy reduction events. Increasing the awareness of the Home Energy Analyzer tool would create greater awareness of the effectiveness of the program in reducing electricity consumption and producing electricity bill savings to customers.	Insight considered in implementing programs generally.

3	**If customer participation is a concern, consider offering referral bonuses to existing participants to increase enrollment.** Fewer than ten percent (9.1 percent) of program participants indicated they first heard about the Easy Cool Rewards program through word of mouth. Offering existing customers a referral bonus – either a small cash incentive or a small decrease in their monthly bill – would encourage participants to promote the program to groups of people that have established trust in their judgment, such as friends and relatives. Despite a high percentage of respondents indicating they had no concerns about participating in the program (74.4 percent), several participants (10.0 percent) indicated they were concerned that the program seemed to be "illegitimate" or "a scam." Leveraging the trust existing participants have built with friends and family while simultaneously incenting participants to promote the program could lead to increased levels of enrollment in future iterations of Easy Cool Rewards.	Will consider in the future if demand response goals resume.
FirstEnergy 2012 -Energy Efficient Products West Penn Power		
1	**Consistent outreach to retail store staff. West Penn Power program staff actively market the program to "big box" and smaller, local retail appliance stores.** As most participants reported hearing about the program from the retail store or contractor, this method is having the intended effect of marketing the program. With the additional selling tools of West Penn Power rebates, retail store staff effectively act as a self-motivated "sales force" for the program. Consistent outreach, on a quarterly basis, will help account for retail staff turnover.	Implemented.
2	**Any direct marketing to potential participants should focus on utility bill inserts, brochures, and email newsletters.** When asked about the preferred methods for receiving new program information, both bill inserts, brochures and newsletters were most frequently mentioned. The disparity between how appliance participants actually hear about the program (i.e., retailer/contractor), compared to how they would like to hear about program offerings perhaps suggests a general customer interest in knowing what types of programs and rebates are available prior to shopping for appliances at a retail store or hiring contractors.	Implemented.
3	**In PY4, review measure offering and efficiency levels of appliances promoted by the program.** Given the indications of high free-ridership among participants, review program measures and incentivized efficiency levels in PY4 informed by the results of a rigorous net-to-gross study.	Will be implemented in Phase II
4	**Limit the eligibility period after installation to 90 days.** Thirty-two percent of the appliance participants overall reported that they had already purchased the equipment before they were aware of the rebate, indicating a high level of free-riders. Currently, the program does not limit a time frame in which participants must submit applications after installation (the current application mentioned the potential for rebates for equipment purchased prior to 2012).	Implemented 180 day eligibility in Phase II.
FirstEnergy 2012 - West Penn Power: Draft Results Low-income Joint Utility Usage Management and Home Check-up		

Programs		
1	**Adjust the water savings impacts in the Energy Savings Calculator by rate of receipt of water devices and incidence of natural gas water heaters.** The savings calculations assume that all customers that receive water saving devices have electric water heaters. Survey data indicates this is not the case and, in fact, only 12 percent of JUUMP and 57 percent of HCU participants have electric water heaters (combined 49 percent), with an additional eight percent of customers saying they do not know the type of water heater they have.	Rejected - Ex-post reflects appropriate savings. In addition, program guidelines were clarified to only install measures in homes with electric water heaters.
2	**Report a realization rate of 1.0 for CFLs.** The survey self-report data indicates that some households report varying numbers of CFLs than documented in the program data. There are several possible explanations for this deviation in results. The first is that the program data is incorrect. But perhaps more likely is the case that customers do not accurately recall the exact number of CFLs. Additionally, it is evident that a number of respondents are confusing the JUUMP and HCU offerings with CFLs received through the CFL give-away offerings. Provided these issues and the potential for inaccurate self-reporting we recommend the CFL savings not be adjusted based on verification findings for CFLs.	Implemented
3	**Report a realization rate of 1.0 for refrigerators and room air conditioners.** The survey self-report data verified a nearly 100 percent receipt rate of refrigerators and room air conditioners; only one case said they did not receive a refrigerator which may be a self-report rather than a database error.	Implemented
4	**Reinforce to auditors that measures be directly installed and not simply left behind.** Although per the Pennsylvania TRM savings can be claimed for measures received regardless of installation, it is within this program's design and directives that the measures be directly installed. The survey data indicates this is not happening consistently, although most notably with CFLs than water saving measures.	Implemented
5	**Strive for more equity in provision of services between multifamily and single-family residences.** There is some evidence that multifamily residences are not receiving the same level of attention from auditors. If it is not feasible for the auditor to meet with these hard-to-reach multifamily customers, then the program may consider leaving behind additional information or literature providing similar information as that discussed through the walk-through audit.	Implemented
FirstEnergy 2012 - West Penn Power Residential Participant Survey: Energy Efficient HVAC Equipment Program		
1	**Continue outreach to HVAC distributors and contractors.** As most participants reported hearing about the program from their contractor, this method is having the intended effect of recruiting HVAC contractors and distributors into the program.	Implemented

2	**Any direct marketing to potential participants should focus on utility bill inserts and email newsletters.** When asked about the preferred methods for receiving new program information, utility bill inserts were most frequently mentioned. About one-third of HVAC equipment participants and significantly fewer tune-up participants were aware of the rebate prior to interaction with their contractor. This suggests an opportunity, particularly with tune-ups, to increase customer awareness and demand of tune-up rebates through direct marketing. The direct marketing combined with continued outreach to contractors would create a "push/pull" marketing campaign—raising awareness among HVAC contractors so they can use the program as a sales tool (push) and increasing interest in potential customers so they approach contractors regarding equipment replacement (pull).	Implemented.
3	**Limit the eligibility period after installation to 90 days.** Thirty-five percent of the participants overall reported that they had already purchased the HVAC equipment before they were aware of the rebate. Currently, the program does not limit a time frame in which participants must submit applications after installation (the current application mentioned the potential for rebates for equipment purchased prior to 2012).	Implemented 180 day eligibility in Phase II.
4	**Monitor program eligibility efficiency levels and associated rebates to ensure more cost effective program design.** An upward adjustment to rebate levels (which has occurred from the alignment with the other FirstEnergy PA programs) or increases in the efficiency levels for eligible equipment may help ensure the program is cost-effectively using its financial resources to encourage energy efficiency.	Implemented.
5	**Create educational materials regarding the correct usage of programmable thermostats.** As a high percentage of participants reported that they either did not have a programmable thermostat or used a programmable thermostat in its "manual" setting, participants may not be realizing all of the benefits of their new, high efficiency equipment (or their recently maintenance equipment). Working with HVAC contractors to develop instructional materials about the proper set-points and the benefits of using those set-points should increase the savings seen by participants. Similarly, promoting sales of programmable thermostats to tune-up participants could also help to increase savings.	Being Considered in Phase II.
FirstEnergy 2012 - West Penn Power Residential Participant Survey: Recycling Program		
1	**Direct marketing to West Penn Power customers should focus on utility bill inserts and brochures.** When asked about the preferred methods for receiving new program information, bill inserts were most frequently mentioned by a wide margin. Even though program participants are slightly older on average, about 28 percent of participants indicate that they would prefer to hear about programs via an email newsletter.	Implemented.
2	**Promote appliance purchase rebates to "recycle only" participants.** A high percentage of participants are replacing their recycled appliances outside the West Penn Power programs. Through these recycling participants,	Implemented cross-marketing tactics in Phase I to program participants who recycled thru WPP. Under

	there is an opportunity for the program to market rebates available for new high efficiency appliances; and moreover, marketing for other programs such as HVAC equipment, CFL giveaways, and demand response programs.	consideration for Phase II.
3	**Keep JACO Environmental as the program's recycling implementer.** Though the Residential Survey did not collect detailed information about JACO Environmental, both the 2011 and 2012 residential surveys found highly positive participant satisfaction, suggesting that JACO staff is providing good, professional customer service. Moreover, the program's free pick-up services are a highly influential aspect of the customer's decision to participate in the program.	Implemented.
FirstEnergy 2012 - West Penn Power Residential Participant Survey: Critical Peak Rebate Program		
1	**Provide customers with reminders about what they can do to save energy during savings events.** Continuing to reiterate what customers can do to reduce usage throughout the 2012 summer will keep the information fresh and serve as a reminder about the Energy Saver Rewards program. Messaging can be targeted – for example, specific messaging to those with air conditioning - and via the method selected for event notifications. Follow-up email for those with an email address provided is also recommended.	Implemented in Phase I.
2	**Provide customers with reminders about the Home Energy Analyzer tool.** Thirty-five percent of the customers visiting the WPP website are aware of the feedback options about home energy usage available through the Home Energy Analyzer tool.	Implemented in Phase I.
3	**Provide customers with near-immediate feedback on energy savings after an event.** Benchmarking data and information indicates that programs that provide immediate, or regular, feedback on performance throughout the program reap higher savings. Providing real-time feedback can lead to greater savings - several pilots found 2-4% more savings from real-time feedback compared to other interventions such as energy-savings advice and more frequent enhanced bills. Additionally, a lack of feedback can lead to passive un-enrollment, or customers remaining enrolled in the program but who take no action to reduce usage when called upon to do so.	Implemented in Phase I.
4	**Consider allowing customers to receive communication via email and phone enabled methods, such as a phone app or a text message.** The growing number of people with smart phones may make this information more accessible and, hence, actionable.	Implemented in Phase I.
5	**Consider conducting a study with non-participants in the CPR program in which a test group receives additional information during peak demand periods to reduce usage.** Since there are indications that that information alone may drive customers to reduce usage during peak demand times, further exploration of this finding could identify new methods for achieving demand reductions that do not require incentives. Expanding the study to include a group of participants in the OPower program may also provide	Program ended - will be considered as appropriate for future phases.

	useful information.	

Table D-11: FirstEnergy 2013 Process Evaluation Recommendations and Responses

FirstEnergy 2013		
	Recommendation	**Response**
HOME ENERGY AUDIT AND OUTREACH PROGRAM		
1	Provide more formalized training to walk-through auditors to promote a more standardized audit approach.	Implemented
2	Provide walk-through auditors with First Energy marketing materials and rebate applications to provide to customers along with training on appropriate marketing opportunities.	Implemented
3	Target customers who have not already completed the online Home Energy Analyzer and who were not already mailed an energy conservation kit to maximize the effectiveness of low-cost measures.	Implemented
4	Consider cost-effective strategies to offset a portion of the $50 co-pay for the Walk-Through Audit program to encourage participation in the program.	Implemented
5	Track specific recommendations made to customers of other First Energy rebate programs. Also consider following-up directly by telephone or via web survey with walk-through audit participants to see if they have moved forward with any of the auditors recommendations, and if so, whether or not they pursued a Penn Power rebate.	Being considered
6	Based on auditors' feedback of the Home Energy Analyzer tool, evaluate the usefulness of completing the Home Energy Analyzer for walk-through audit participants, or explore the feasibility of an offline version of the tool.	Implemented
7	Continue to work to bridge geographical separation and to strengthen internal communication between auditors and other program implementation staff.	Implemented
8	Provide additional guidance to walk-through auditors on where to install LED night lights in order to realize the estimated savings from these measures.	Implemented
9	Continue to inform participants about other First Energy Utility programs and educate customers on how to take advantage of program incentives. Emphasize return-on-investment and payback information for energy efficiency improvements and the role that First Energy program incentives can play in overcoming first-cost barriers.	Implemented

10	Continue direct marketing efforts such as utility bill inserts, direct mailings, and email blasts.	Implemented
11	To support future evaluation efforts, supplement utility customer contact information with contact information collected in the process of scheduling/conducting walk-through audits.	Rejected; will address contact data needs as appropriate for future evaluation efforts
12	Consider providing walk-through auditor staff with portable appliance electricity monitoring devices.	Rejected due to risk of property damage
13	Conduct additional research to assess the extent of freeridership and spillover.	Implemented
	RESIDENTIAL APPLIANCE TURN-IN PROGRAM	
1	Consider adopting enhanced cross-marketing strategies.	Being considered in Phase II.
2	Emphasize environmental issues and convenience factors in program marketing materials.	Implemented.
3	Consider lowering incentives for recycled appliances.	Rejected - program results indicate that the higher rebate level was required to support participation goals.
4	Continue to target recycling primary appliances, as well as secondary appliances that will not be replaced.	Implemented.
	RESIDENTIAL ENERGY EFFICIENT HVAC PROGRAM	
1	Watch participation trends for equipment installations, and consider modifications to program design elements in light of reduced Federal tax credits.	Being considered for Phase II.
2	Target tune-up participants who do not have pre-existing maintenance contracts in order to maximize program savings, or offer an enhanced tune-up not currently offered as standard practice.	Rejected due to practical challenges of data availability.
3	Market the program through an aggressive multi-tiered approach: contractor marketing, cross-marketing between programs, program leave-behind materials, etc..	Implemented.
4	Refine the application process to ensure it is both streamlined and user-friendly and consider online applications.	Implemented as appropriate. Online applications are not available.
	RESIDENTIAL BEHAVIORAL MODIFICATION AND EDUCATION PROGRAM	
1	Increase confidence in the HERs by addressing misperceptions and perceived inaccuracies, particularly with how neighbors are explained (through meaningful illustrations of households that may or may not be included in its comparison group, for example).	Being Considered

2	Emphasize over-time comparisons rather than neighbor comparisons.	Being Considered
3	Encourage the use of on-line tools cautiously and clearly outline an added value for customers. For example, present a compelling case for on-line use that addresses common complaints about the paper HERs (e.g., cost-efficiencies, more accurate neighbor comparisons or customized energy-saving tips).	Being Considered
4	Motivate energy-saving behavior by telling a success story— outline how a typical household that has low to moderate efficiency can take specific and practical steps to improve their energy efficiency. Link this story to tracking information available in the HER or on-line to help customers understand how they can use this information as tools for themselves.	Being Considered
COMMERCIAL / INDUSTRIAL SMALL SECTOR EQUIPMENT PROGRAM		
1	Collect all participation data electronically including all project information including such as detailed equipment description (old and new) and the quantity of equipment installed, when appropriate.	Being Considered
2	Consider additional marketing efforts. The preferred methods of contact mentioned most often were through email, mail or the First Energy website. First Energy may want to consider more strategic marketing efforts, particularly to small businesses.	Being Considered
3	Provide a means (such as website notification or periodic e-blasts) for contractors and customers to check the status of the program prior to applying to the program.	Being Considered
4	Review the rebate application process to ensure requirements are easy to understand and that rebates are issued in a timely fashion.	Being Considered
COMMERCIAL / INDUSTRIAL LARGE SECTOR EQUIPMENT PROGRAM		
See Section 11. Commercial/Industrial Small Sector Equipment		
COMMERCIAL / INDUSTRIAL DEMAND RESPONSE PROGRAM – CSP MANDATORY AND VOLUNTARY CURTAILMENT PROGRAM		
A process evaluation was not conducted for this program as it was a one-time offering not planned for Phase II.		
GOVERNMENTAL / NON-PROFIT PROGRAM		
See Section 11. Commercial/Industrial Small Sector Equipment		
GOVERNMENTAL / REMAINING NON-PROFIT PROGRAM		
See Section 11. Commercial/Industrial Small Sector Equipment		

Appendix E Net-to-Gross Methodologies

This appendix summarizes the net-to-gross (NTG) methodologies used by each electric distribution company (EDC) to estimate program free-ridership and/or spillover, from which an NTG ratio (NTGR) for a program (or if appropriate, a subprogram or group of programs) was derived for estimating energy efficiency and conservation (EE&C) program net savings.

E.1 Duquesne

E.1.1 Methodology Summary

NTG methodologies were developed for residential, commercial, and industrial sectors with little variation in methods among the programs in each sector. Duquesne's evaluation contractor, Navigant, developed a survey instrument template that was tailored for each program. To assess free-ridership, the surveys included questions that asked about the respondent's intention to procure the program measure(s) in the absence of the program and to estimate the level of influence the program had on the participant's decision. Participants were asked free-ridership questions about each measure they procured. Navigant developed an algorithm to estimate a level of free-ridership for each survey respondent based on the participant's answers to key survey questions. The individual participant scores were weighted by the verified kWh savings achieved by each measure to calculate the overall free-ridership rate for the program. The free-ridership rate represents the percentage of savings that would have occurred in the absence of the program.

To assess spillover, survey respondents were asked whether or not they had taken any additional energy saving actions after participating in the Duquesne program, and if these actions were influenced by the respondent's participation in the program. Deemed savings values were used to calculate energy savings for the top five actions reported by program participants. Respondents were also asked, on a 1 to 10 scale, how likely they would have been to take the spillover action if there had been no program (10 = extremely likely). The likelihood was converted to a program effect, (10-reported likelihood)/100, and averaged with the program influence score to determine the average program influence.

Average influence scores were applied to the spillover savings per respondent who took the action, in order to calculate a spillover value for each of the top five actions in each program component. The spillover values for each action were summed and then used to determine an average spillover value for each respondent in the program component (i.e., total spillover savings attributed by the respondents for all program component actions/number of respondents). This average spillover per respondent was multiplied by the total number of participants for each program component, which led to a total spillover savings for each program component. The total spillover savings was then divided by the gross program energy savings to determine a spillover factor.

E.1.1.1 Residential Energy Efficiency Program (REEP)

The Residential Energy Efficiency (REEP) Rebate Program has four components: Energy Efficiency Kits, REEP Rebates, Upstream CFL, and O-Power. Duquesne supplies energy efficiency kits that contain compact fluorescent lights (CFLs) and in some cases smart strips and limelight nightlights to customers attending certain community outreach events. REEP Rebate provides financial incentives for customers to install energy efficient measures. The Upstream CFL component was initiated in July 2010 and provides point-of-purchase discounts for customers and incentives for retail store participation. Finally, O-Power was added to REEP during PY4 and provides home energy reports that contain personalized information on customer energy usage.

Duquesne's evaluation contractor followed the method for determining free-ridership and spillover as described above. Self-reporting surveys were used to estimate free-ridership for the Energy Efficiency Kit and REEP Rebate components of REEP. For the Upstream CFL component in PY4, two free-ridership scores were calculated based on results from participant in-store intercept and telephone surveys. The first score was determined by using responses from both surveys to estimate a free-ridership percentage for each respondent. The second score was determined by dividing the number of bulbs that would have been purchased at the normal retail price by the number of bulbs purchased. The two free-ridership scores were averaged together to determine a free-ridership percentage for each respondent. The total Upstream CFL free-ridership was calculated by weighting standard CFL, specialty CFL, and light-emitting diode (LED) free-ridership percentages by the savings associated with each. NTG research was not completed for the O-Power component in PY4.

In order to determine the overall-free ridership ratio for REEP, the free-ridership scores the Energy Efficiency Kits, REEP Rebates, and Upstream CFL components were weighted by the verified savings achieved by each measure type. The overall REEP free-ridership and spillover ratios for PY4 were 50% and 12.5%, respectively. The overall REEP NTGR of 62% was determined by weighting the NTGR for each of the above three program components by the associated verified savings.

E.1.1.2 Residential School Energy Pledge (SEP)

Residential SEP encourages students and their families to install energy efficiency measures provided in a free SEP Energy Efficiency Tool Kit. For PY4, Navigant assumed the NTGR from PY3 (86%) because there were no surveys completed for verification purposes in PY4, there were no program changes from PY3 that could affect the NTGR, and the program had limited savings and budget. The NTGR from PY3 did not include spillover effects and was estimated using the methodology described above.

E.1.1.3 Residential Low-Income Energy Efficiency Program (LIEEP)

Residential LIEEP provides services to help low-income households conserve energy and reduce electricity costs. These services are delivered by the following LIEEP subprograms: REEP's Energy Efficiency Kits, REEP Rebates, and Upstream Lighting; Residential SEP; and the Residential Appliance Recycling Program (RARP). Duquesne's evaluation contractor estimated a free-ridership and spillover score for each of these subprograms by using survey responses from low-income participants. For PY4, the total free-ridership was 50% and spillover was 5.6%, resulting in an NTGR of 56%.

E.1.1.4 Residential Appliance Recycling Program (RARP)

RARP offers incentives and free services to remove operable but inefficient refrigerators and freezers from participants' homes. Free-ridership and spillover were assessed using the self-report survey approach described above. In PY4, the NTGR of 76% was calculated based on 25% free-ridership and 0.59% spillover.

E.1.1.5 Commercial Program Group

Duquesne's Commercial Program Group includes an overall umbrella market program and five market segment programs. The programs are designed to help commercial customers assess the potential for energy efficiency project implementation and for cost and energy savings, and for appropriate customers, to provide follow-through by installing measures and verifying savings.

Only one NTGR was calculated for the Commercial Program Group, and NTGR was not evaluated separately for the five market segment programs. Free-ridership for the program was determined by evaluating data collected from in-person interviews with decision-makers of projects included in the verification sample and from telephone interviews with decision-makers of projects not included in the verification sample. The two approaches had a slightly different set of questions and free-ridership algorithms. The free-ridership score determined from the interviews was weighted based on the verified savings for each project. The overall free-ridership rate of 50% for the program in PY4 was calculated as the average of the free-ridership rates calculated from the two data sets. Spillover questions were asked as part of the NTG interviews, but Duquesne's evaluation contractor could not quantify the results and therefore spillover was not incorporated in the NTG calculations. The NTGR was estimated to be 50% for PY4.

E.1.1.6 Industrial Program Group

The Industrial Program Group includes an overall umbrella program and three specialized programs that address the following market segments: primary metals, chemical products, and mixed industrials. The programs are intended to provide a comprehensive approach to energy savings and permanent demand reduction, and to address a full range of opportunities from low-cost improvements to entire system upgrades. The NTG methodology used for the Industrial Program Group was the same that used for the Commercial Program Group. The NTGR for PY4 was 72%.

E.1.1.7 SWE Net-to-Gross Audit Summary

Duquesne's evaluation contractor conducted NTG analysis for six energy efficiency programs at the basic rigor level in PY4. Five of the six analyses administered self-reporting surveys to program participants to estimate free-ridership and spillover scores. However, the NTGR for the Residential Low-Income Energy Efficiency Program (LIEEP) was a weighted average of NTGRs from other Duquesne programs.

With respect to the Upstream CFL component of REEP, NTG research was not completed for PY3. However, Duquesne's evaluation contractor did conduct a basic rigor NTG analysis in PY4 by evaluating participant in-store intercept and telephone survey responses. For Phase II, the SWE recommends conducting NTG research for cross-sector sales in the Upstream CFL component of REEP, because it was discovered in PY4 that commercial customers were purchasing incentivized bulbs offered through residential programs instead of commercial programs.

Instead of conducting individual NTG analyses for each subprogram in the Commercial Program Group and the Industrial Program Group, Duquesne's evaluation contractor aggregated survey responses from individual subprograms to determine an overall NTGR for the Commercial Program Group and for the Industrial Program Group. Duquesne's evaluation contractor stated that certain commercial and industrial programs were grouped based on shared characteristics to conduct cost-effective evaluation, measurement, and verification (EM&V) as directed by the Duquesne's EM&V plan and Sampling Design Memorandum. While the reasons behind this approach were explained, the SWE recommends conducting NTG research at the technology level instead of the program level. An overall program NTGR does not give insight into what specific measures (lighting, VFDs, refrigeration, etc.) had high free-ridership.

The overall transparency of the NTG analysis of the Duquesne programs was very high. Duquesne's evaluation contractor provided descriptions of the survey instrument and how the instrument was developed, as well as the free-ridership algorithms used for each program. Survey scores were provided based on the free-ridership algorithm and the calculation of the programs' free-ridership values were easily understood. Spillover methodologies were equally transparent. Duquesne's evaluation contractor explained how survey responses were scored and provided the scoring results in its report. Deemed savings values for spillover measures were documented along with an explanation for the rationale of using selected deemed values. The spillover methodology used was robust and delivered an estimated spillover kWh per participant for each program. Duquesne's evaluation contractor did not incorporate spillover effect in the NTG analysis for the Residential School Energy Pledge (SEP) Program, Commercial Program Group, and Industrial Program Group in PY4, because they felt the approach used was not rigorous enough to rely on for quantified estimates, relative to requirements in other jurisdictions. However, estimation of spillover and its application in net-to-gross estimates in Phase II will be performed using a standard methodology that will calculate a spillover rate for each program or program group and that rate will be incorporated into the NTGRs for the programs.

NTG methodologies and results were reported consistently among programs. Duquesne's evaluation contractor used the same methodology for each residential program and a similar methodology for the commercial and industrial programs. Duquesne's evaluation contractor was also very consistent in reporting the number of surveys conducted and subsequent results. It is recommended that Duquesne's evaluation contractor continue this level of consistency in subsequent evaluation reports.

E.2 PECO

E.2.1 Methodology Summary

PECO's evaluation contractor, Navigant, provided varying levels of detail for the NTG methodology it applied to each program. For the Smart Equipment Incentives and Smart Construction Incentives programs, PECO's evaluation contractor provided an explanation of the survey instrument used and how it was scored. However, survey responses were not provided, and therefore the actual scoring could not be verified. The remaining programs provided a very high level explanation with little discussion regarding NTG methodology. The program summaries below describe the NTG methodologies used for each program.

E.2.1.1 Smart Lighting Discounts Program

PECO's Smart Lighting Discounts (SLD) Program offers PECO customers discounted CFLs and promotes customer awareness and education regarding CFLs. During PY1 and PY2, the SLD Program was responsible for the largest proportion of total PECO portfolio savings among all of the ACT 129 PECO programs. In the beginning of PY3, PECO reduced the SLD program size by 95% to align overall Phase I savings with the previously established EE&C plan targets. PECO also shifted the focus of the program from standard spiral CFLs to specialty CFLs. These changes were maintained in PY4. In the last two years of Phase I, SLD program participation significantly decreased which, combined with the upstream nature of the program, would have required a very large sample of PECO customers for NTG analysis. Due to the insufficient number of surveys completed, PECO's evaluation contractor used PY2 sales-weighted NTGR to calculate PY3 and PY4 net savings.

The PY2 NTGR of 38% was the average of NTGR values collected from general population telephone surveys, in-store intercept surveys, trade ally surveys, and revealed preference purchase modeling. The weighted average of these separate studies was used to determine the NTGR. The PY2 NTG estimates were then applied to the PY3 and PY4 distribution of standard and specialty CFL sales to determine the overall NTGRs for PY3 and PY4. The NTGRs for PY2, PY3, and PY4 were all estimated to be 38%.

E.2.1.2 Smart Appliance Recycling (SAR) Program

The Smart Appliance Recycling (SAR) Program provides services and incentives for PECO customers who want to remove inefficient but operational refrigerators, freezers, and room air conditioners from their home. The program has largely remained the same throughout the four program years, but in PY4 the incentive was reduced and the air conditioning measure was eliminated from the program. The lower incentive level caused customer participation to decrease by more than two-thirds from PY3 to PY4.

In PY4, the retailer-sourced units were expanded to estimate the influence of the SAR in all cases where an existing unit has been replaced. The NTGR was calculated using a two-step process. First, participants were surveyed to understand unit disposal absent the SAR program. Second, participants who replaced existing units and indicated that they would have had their unit removed by the dealer from whom they got the replacement unit were interviewed to assess free-ridership. PECO's evaluation contractor did not assess the spillover rate because it was assumed to be insignificant. A total of 256 surveys were administered, with 224 refrigerator respondents and 38 freezer respondents. The number of respondents exceeded the number of surveys completed because six respondents had both types of units. The NTGRs for participants who did not replace their existing unit and those who replaced their unit were 72% for refrigerators and 63% for freezers.

PECO's evaluation contractor also calculated an NTGR for program-induced replacements to determine if the program influenced customers to replace their unit after the old unit was removed by the program and recycled. The NTGR for this effect was +0.01 in magnitude and was added to the final NTGR. Interview results from three retailers that provided replacement units were used to estimate free-ridership scores for each retailer (59% ,79%, and 70%). The NTGR represented 1 minus the percentage of units that otherwise would have been deconstructed in the absence of the SAR Program. The retailer-associated responses were weighted with the participant responses to determine the NTGR of 56% across the entire program for PY4.

E.2.1.3 Smart Home Rebates (SHR) Program

The Smart Home Rebates (SHR) Program offers customers rebates for a total of 22 types of qualifying appliances: lighting, heating, and cooling equipment. In PY4, PECO's evaluation contractor conducted 200 telephone surveys and learned that 30 participants (15%) had purchased and 2 respondents (1%) had ordered the rebated appliances before learning about the rebates. Free-ridership was calculated to be 16%, which was consistent with the free-ridership ratio of 16% in PY3 and 15% in PY2. PECO's evaluation contractor also applied a more rigorous method, the Energy Trust of Oregon (ETO's)[536] method, to estimate a free-ridership that ranged between 38% and 87.3% with a mid-point of 63%.

Spillover data were also collected as part of the NTG survey. PECO's evaluation contractor reported that 56 (28%) of the 200 respondents indicated that they had installed a total of 411 additional measures without receiving a rebate. The main measures installed included CFLs, windows, and LEDs. Based on the free-ridership of 63% and the spillover rate of 12%, the NTGR was calculated to be 49% for PY4.

E.2.1.4 Smart Equipment Incentives: Commercial and Industrial (SEI C&I) Program

The SEI C&I Program offers incentives to PECO customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote eligible equipment. The NTG analysis was conducted by collecting participant data via a survey instrument that focused on:

- Influences that determined when and what type of measure to procure.
- Influences of the program components on a participant's decision to procure the measure.
- The likelihood that the participant would have procured the measure now or at a later date if the program was not available.

Scores for each of these three factors were calculated for each surveyed participant, on a scale of 0 to 10. The lower the score, the higher the level of free-ridership. The three scores were averaged to determine a measure-level free-ridership score.

In PY4, in addition to using the survey instrument from PY3, PECO's evaluation contractor also used a separate ratio estimation statistical method to calculate a net of free-ridership ratio at the program level. First, separate net of free-ridership ratios were calculated for each stratum and then applied to the population savings in each stratum. Then the sum of the verified net savings for each stratum was calculated and compared with the sum of the verified gross saving. Spillover questions were incorporated into the survey; however, the questions were not designed to quantify an actual spillover

[536] Phil Degens and Sarah Castor, Energy Trust Free Ridership Methodology, Energy Trust of Oregon, August 2013.

score but rather indicated if spillover was occurring in the program. Participants were asked how the energy savings of the un-incentivized measures compared with savings of all of their incentivized projects. The percentage was then multiplied by the amount of influence PECO's program had on the decision to install the additional measures. The program spillover percentage was determined by dividing the total self-reported kWh by the total incentivized kWh savings obtained by the program. Free-ridership and spillover ratios were not reported. Instead, PECO's evaluation contractor provided the combined kWh-weighted NTGR at the program level of 78% and the kW-weighted NTGR of 79% for PY4.

E.2.1.5 Smart Equipment Incentives – Government, Nonprofit, Institutional (SEI GNI) Program

The SEI GNI Program provides the same services as the SEI C&I Program to GNI customers. The NTG analysis for the SEI GNI Program was conducted using the same methodology as that for the SEI C&I Program. In PY4, the combined kWh-weighted NTGR was 64% and the combined kW-weighted NTGR was 65%.

E.2.1.6 Smart Construction Incentives (SCI) Program

The SCI Program provides facility designers and builders with training, design assistance, and incentives to incorporate energy efficient systems and construction practices into newly constructed facilities or facilities undergoing complete renovation or reconstruction. PECO's evaluation contractor conducted NTG analysis by surveying design firms and interviewing trade allies.

For each sampled participant, the survey focused on a single project. If a participant completed multiple projects, the project with the largest energy savings was considered. The results from the survey were used to calculate three free-ridership scores: Influence, Program Components, and Quantity and Efficiency. The Influence score reflected the influence of the SCI Program on the customer's decision to procure the specific program measure. The Program Components score indicated the influence of the program components on the customer's decision to implement the measures. The Quantity and Efficiency score estimated the likelihood that the same quantity and efficiency level of measures were installed.

Each free-ridership score was normalized to a percentage scale and the overall free-ridership for the program was calculated by using Equation E-1.

Equation E-1: PECO Equation Used to Calculate Free Ridership (FR) for the SCI Program

$$FR = \frac{1}{3} \times [(1 - Influence) + (1 - Program\ Components) + (Quantity\ and\ Efficiency)]$$

Since survey respondents did not indicate any spillover, the NTGR was calculated using the free-ridership rate. For PY4, NTG inputs were collected from 17 of the program's 101 projects, and the NTGR was estimated to be 44%.

E.2.1.7 SWE Net-to-Gross Audit Summary

As described in Appendix B.5.2 the SWE defined three levels of rigor for the NTG analysis – basic, standard, and enhanced. PECO has implemented seven EE programs, six of which were considered candidates for an NTG analysis according to the SWE. The SWE recommended that a basic rigor be used for the analysis of all programs except the Smart Lighting Discounts (SLD) Program, for which an enhanced level of rigor was recommended.

PECO's evaluation contractor conducted NTG analyses in PY4 for five of the six programs recommended for analysis by the SWE.[537] PECO's PY4 annual report provided varying and sometimes limited levels of information on the NTG methodology for each program. Five analyses were conducted at the basic level of rigor; the SLD Program was evaluated at the enhanced level of rigor in PY2, as explained later in this paragraph. The basic analyses included self-reporting surveys with program participants to determine free-ridership scores and an assessment of program spillover. However, spillover was not assessed for the SAR , and it was not quantified for the SEI C&I and SEI GNI programs. PECO's evaluation contractor did not collect data in PY4 for an NTG analysis of the SLD Program due to a change in program strategy that decreased program participation significantly. The PY2 evaluation was conducted at the level recommended by the SWE, and PY2 NTG estimates were applied to PY4 distribution of standard and specialty CFL sales to determine the overall NTGRs. Despite its dramatic reduction in participation, the SLD Program contributed the largest energy savings of PECO's residential programs in PY4. Therefore the SWE recommends that PECO's evaluation contractor conduct NTG research at the enhanced level of rigor early in Phase II, once the new program design is implemented. The SWE also recommends conducting NTG research for cross-sector sales in the SLD Program, because many commercial customers purchased incentivized bulbs offered through residential programs.

The overall transparency provided for the NTG analysis of PECO's programs can be improved. While the explanation of free-ridership methodologies varied by program, information regarding the methodology, data collection, sampling, survey design, algorithm design, or analysis was often insufficient. Some overall free-ridership or NTGRs were presented with minimal explanation or description of how they were derived. In some cases, PECO's evaluation contractor stated that free-ridership and spillover research was conducted, but the resulting values were not reported. The exception to this was the report of the NTG analysis for the non-residential programs. These programs did include a description of the survey instrument and of how scores were calculated.

Spillover methodologies for applicable programs were somewhat more descriptive than the methodologies for the free-ridership sections. General descriptions were provided for how spillover was calculated, and for certain programs, such as the SLD Program,[538] a description of the survey instrument was provided. PECO's evaluation contractor described, when applicable, how the spillover score affected the overall NTGR. It is recommended that PECO's evaluation contractor improve the level of

537 The NTGR for the SLD Program was based on PY2 research. The PECO evaluator felt that conducting a new NTG evaluation in PY3 and PY4 was not a prudent use of resources because the PY2 research was extensive and thorough and the findings were likely applicable to PY3 and PY4 program structure.

538 Spillover descriptions of the SLD Program referred to the analysis conducted in PY2.

transparency into net savings analysis in future annual reports. A description of the full NTG methodology should be provided along with descriptions of the algorithms and surveys used and an explanation for how free-ridership and spillover scores were calculated to arrive at the final NTGR.

Presentation of NTG methodologies and results was not always consistent across programs. As noted above, the level of detail provided for residential versus non-residential programs varied considerably. Due to the general lack of methodology description, it is unknown how consistent the analysis steps (e.g., sampling and data collection) were among programs; however, the report is consistent in presenting free-ridership scores as well as spillover scores when applicable. It is recommended that future reports provide similar descriptions of NTG methodologies for all evaluated programs. Some of the PECO programs (Smart Home Rebates and Smart Equipment Incentives) rebate a wide range of technologies that likely have varying NTGRs. Navigant should focus NTG research on high-impact measures within these programs to explore which measures have high free-ridership and may require a change in program offerings.

E.3 PPL

E.3.1 Methodology Summary

Cadmus, PPL's evaluation contractor, followed a similar methodology for the NTG analysis for each of PPL's EE&C program and tailored survey instruments to programs when necessary. Self-reporting surveys served as the primary data collection method for the NTG analyses. The purpose of the surveys was to gather feedback from program participants regarding their intention to procure the rebated measure(s) outside of the program and to estimate the level of influence the program had on their decision.

PPL's evaluation contractor developed a model to score the level of free-ridership based on survey responses. The evaluation contractor also calculated the standard error of the free-ridership scores based on the scores' distribution. PPL's evaluation contractor explained that its model calculates varying levels of partial free-ridership based on the survey responses. A detailed description of the calculation used in the model was not provided in the PY4 evaluation because a full explanation of the methodology and scoring model was provided in the PY3 final report, Appendix E.

Participant Spillover was also assessed for most programs through participant surveys. The spillover survey instrument was designed to understand to what extent a participant had taken any additional energy saving actions after participating in the program and to what extent the program had influenced a participant to take these additional energy saving actions. PPL's evaluation contractor used a top-down approach to calculate spillover savings. Only energy efficient measures such as ENERGY STAR appliances, CFLs, and high-efficiency air conditioners qualified for spillover savings. Measures that were not in the TRM or that required additional data to compute savings, such as insulation and windows, were not quantified in the spillover analysis, however, findings were discussed qualitatively. PPL's evaluation contractor reviewed spillover data collected from the surveys and filtered qualified responses that met spillover requirements, which included a high level of influence from PPL programs. The energy savings for the qualified portion of sampled spillover participants was calculated to determine the percentage of spillover savings for the program. PPL's evaluation contractor summed the total spillover energy savings achieved per survey respondent and estimated the program spillover score as the ratio of total spillover savings to total program savings for the sample.

E.3.1.1 Efficient Equipment Incentive Program

The Efficient Equipment Incentive Program offers PPL customers incentives to purchase and install a range of high-efficiency HVAC, lighting equipment, and electric appliances.

In PY4, PPL's evaluation contractor calculated the NTGR using three self-reporting surveys that targeted residential participants, non-residential lighting participants, and non-residential non-lighting participants. There was no specific algorithm that explained how the free-ridership score was calculated, but PPL's evaluation contractor reported a residential free-ridership score of 34%, and non-residential free-ridership of 77% for non-lighting measures and 23% for lighting measures. Cadmus did not provide an explanation of why free-ridership for non-residential (non-lighting) measures was so high. However, it was noted that the non-residential (non-lighting) participant group had the lowest number of respondents (41) compared with the residential (77) and non-residential (166) groups. The spillover score of 5.9% was only calculated for the residential sector, resulting in an NTGR of 72%. The spillover scores for non-residential non-lighting and non-residential lighting were weighted by program energy savings, and the resulting NTGRs were 23% and 77%, respectively. The residential EEIP NTGR of 72% was determined from 34% free-ridership and 5.9% spillover.

E.3.1.2 Residential Lighting Program (RLP)

RLP is an upstream CFL discount lighting program that offers incentives for CFL and LED manufacturers. The SWE recommended that RLP be subject to an enhanced level of rigor in PY3 because the program accounted for 34% of portfolio savings for PY2. However, based on the methodology description provided by the PPL evaluation for PY4, RLP is considered by the SWE to have met a standard level of rigor. The NTG analysis was based on a per-CFL basis and only considered responses from customers who purchased one or more CFLs in the past three month, including those who were aware of RLP and those who weren't.

In PY4, PPL's evaluation contractor conducted a telephone survey that resulted in 301 respondents (where 154 purchased CFLs and were included in the NTG analysis). The evaluation contractor calculated a net free-ridership score and NTGR using Equation E-3. and Equation E-3.

Equation E-2: PPL Equation Used to Calculate Net Free-Ridership for RLP

$$Net\ FR = \frac{(CFL_{Aware} \times FR_{Aware}) + (CFL_{Unaware} \times Not{-}Influenced_{Unaware}) - (CFL_{Unaware} \times Influenced_{Unaware})}{CFL_{Total}}$$

Equation E-3: PPL Equation Used to Calculate NTGR for RLP

$$NTGR = 1 - Net\ FR$$

Where:

Net FR = Net free-ridership, defined as free-ridership minus spillover

CFL_{Aware} = Number of CFLs recently purchased by respondents who were aware of the program

FR_{Aware} = Free-ridership for respondents who were aware of the program

$CFL_{Unaware}$ = Number of CFLs recently purchased by respondents who were not aware of the program

$\text{Not-Influenced}_{Unaware}$ = Percent of CFLs purchased by respondents who were not aware of the program and were not influenced by it (considered free-riders)

$\text{Influenced}_{Unaware}$ = 1 - $\text{Not-Influenced}_{Unaware}$ = Percent of CFLs purchased by respondents who were not aware of the program but were influenced by it (considered spillover)

CFL_{Total} = Total number of CFLs recently purchased by respondents

It was estimated that 85 survey respondents who were aware of the program purchased 743 CFLs and had a free-ridership rate of 39%. The same free-ridership rate was assumed for the 69 respondents who were unaware of the program, because purchasers who were unaware of the program would not be more likely to be free-riders than purchasers who were aware of the program. A total of 458 CFLs were purchased by customers who were unaware of the program. The spillover rate for purchasers who were unaware of the program was calculated to be 61%. Finally, a total of 1,201 CFLs were purchased by respondents. The net free-ridership was calculated to be 16%, resulting in an overall NTGR of 84% for RLP.

E.3.1.3 Custom Incentive Program

The Custom Incentive program offers incentives and a delivery channel for measures not offered by the Prescriptive Equipment Program. The Custom program is open to all customers but is particularly focused on commercial and industrial (C&I) customers.

In PY4, NTG analysis was conducted using 70 self-reporting surveys that included PY3 (43) and PY4 (27) customers. Partial free-ridership scores were assigned to participants who had plans to install the measure prior to the program, but for whom the program or other market characteristics exerted some influence over their decision. Free-ridership scores were weighted by verified project savings and calculated at 48% for the program. No specific spillover score was calculated for CIP, but four respondents reported that the program had a large influence in the installation of additional energy efficiency equipment without incentives. Therefore, the overall NTGR for CIP was 52%.

E.3.1.4 Appliance Recycling Program (ARP)

ARP offers PPL customers free pick-up and recycling of inefficient but operational refrigerators, freezers, and room air conditioners. In PY4, incentive increased from $35 to $50 per appliance for refrigerators and freezers.

PPL's evaluation contractor conducted 303 telephone surveys to assess free-ridership and spillover. The free-ridership rate was calculated by determining the percentage of participants who would have disposed of their appliances in the absence of the program. This was assessed using data collected from survey responses in which customers stated whether they would have kept using the participating appliance or kept it and left it unused. Free-ridership was estimated to be 33%. Spillover questions evaluated if ARP had influenced participants to take any additional energy efficiency actions for which they did not receive a rebate. Survey responses described spillover actions as installing CFLs, windows, central air conditioning, and insulation. A spillover score of 0.77% was calculated based on survey responses from seven spillover participants. The NTGR for PY4 was calculated to be 68%.

E.3.1.5 Home Energy Assessment and Weatherization Program (HEAWP)

HEAWP offers PPL's residential customers residing in single-family homes personalized information on their home's energy performance and recommended energy efficiency actions. PPL's evaluation contractor did not perform a free-ridership analysis for the energy audit and assumed that it was very unlikely for a customer to pay for an audit without the incentive offered through HEAWP. However, a free-ridership and spillover score was calculated for customers installing the recommended measures.

PPL's evaluation contractor surveyed participants who installed the recommended energy efficiency measures. A free-ridership score was calculated for each respondent, and the score was weighted by the participant's verified energy savings. In PY4, 70 surveys were conducted and the free-ridership score was estimated to be 25%. Spillover was assessed by calculating the percentage of participants who took additional energy efficiency actions as a result of the program. The spillover score was 0.09% for PY4, resulting in an NTGR of 75%.

E.3.1.6 Load Curtailment Program (LCP)

LCP offers incentives for large C&I customers to reduce peak electricity consumption. The SWE conducted an NTG analysis of LCP, and a total of 17 surveys were completed. See Appendix B.5.2 for the SWE's analysis.

E.3.1.7 HVAC Tune-Up Program

The HVAC Tune-Up Program offers incentives to contractors who perform tune-ups using diagnostic tools required by the program. NTGR was not assessed in PY4. Instead it was estimated from PY2 research, which assessed free-ridership by identifying contractors who were using diagnostic tools similar to the tools used in PPL's program. These contractor interviews in PY2 assessed each contractor's level of free-ridership. Only one contractor was considered a free-rider in PY2, and that contractor did not participate in PY4. No additional free-ridership assessment was conducted in PY4. Results from PY2 were used to estimate the NTGR, which was 100%.

E.3.1.8 SWE Net-to-Gross Audit Summary

As described in Appendix B.5.2 the SWE defined three levels of rigor for the NTG analysis – basic, standard, and enhanced. PPL implemented 12 EE&C programs, 10 of which were EE programs (the remaining 2 were demand response [DR] programs, which do not undergo NTG analysis). Of the 10 EE programs, 8 were considered candidates for NTG analysis according to the SWE. The SWE recommended a basic level of rigor for the analysis of seven programs. For the Residential Lighting Program (RLP, a CFL campaign), an enhanced level of rigor was recommended, subject to budget considerations. Two programs were offered specifically to the low-income population and the SWE's NTG white paper recommended no NTG study for these programs. (No NTG analysis was proposed in the evaluation plan nor conducted.)

PPL's evaluation contractor reported NTGRs for 6 of PPL's 10 EE programs. Five of the six analyses were conducted with basic rigor, while that for RLP was conducted with standard rigor. Another program, the Customer Behavior and Education program determines net savings through the pre-post difference of differences regression model. Therefore, this program was evaluated using standard levels of rigor. In general, PPL's evaluation contractor administered self-reporting surveys to program participants to arrive at free-ridership scores, and an assessment of spillover was conducted for both participants and non-participants (where non-participant surveys were administered). Additionally, an analysis of the Renewable Energy Program was attempted; however, the analysis could not be completed due to insufficient survey responses.

For all programs, the level of rigor used by PPL's evaluation contractor in its NTG analyses was specified in the evaluation plans that were approved by the SWE. Based on PY3 results, the SWE recommended increasing the level of rigor for the PY4 evaluation of RLP, and RLP did receive a heightened level of analysis that involved self-reporting surveys in addition to a review of CFL sales data and interviews with manufacturers. This additional research allowed PPL's evaluation contractor to create a more appropriate metric to evaluate free-ridership and spillover. However, based on the SWE definition of enhanced rigor, which includes using multiple NTG methods and conducting an analysis for combining these methods, the analysis conducted for RLP in PY4 did not meet the recommended level of rigor. An econometric price response model was planned in PY4, following the SWE recommendation. The contractor will conduct the analysis in PY5. PPL did conduct an additional cross-sector sales study in PY4. It was discovered in PY4 that many commercial customers were participating in residential upstream lighting programs such as RLP. But the NTG analysis for RLP did not assess free-ridership among commercial participants, and thus the SWE recommends exploring the NTGR of these cross-sector sales.

The overall level of transparency in the PY4 annual report for the NTG analysis of PPL's programs could be improved. In PY3, PPL's evaluation contractor provided an appendix that described the NTG methodology, which included a description of the survey instrument and the number of surveys administered to assess free-ridership and spillover. However, in PY4 the appendix only provided additional information on the NTG methodology used in RLP. This is because the methodology described in each of the program chapters showed that the methods and the survey instruments for the other EE programs did not change from PY3. However, a specific reference to the PY3 Appendix E would have been helpful.

PPL's evaluation contractor included a summary of how free-ridership and spillover were scored based on survey responses. Spillover calculations were more straightforward with regard to how they were scored and ultimately factored into the NTGR.

After scores for free-ridership and spillover had been derived, PPL's evaluation contractor did provide formulaic descriptions for how the final NTGR was calculated. Moreover, PPL's evaluation contractor provided confidence and precision statistical metrics for each NTGR based on the number of surveys administered.

PPL's NTG methodologies and results were very consistent among programs. PPL's evaluation contractor used the same methodology for each program while tailoring survey questions for certain programs. The evaluator was also very consistent in reporting the number of surveys conducted and subsequent results. It is recommended that PPL's evaluation contractor continue this level of consistency in subsequent evaluation reports.

E.4 FirstEnergy Legacy Companies (Met-Ed, Penelec, and Penn Power)

E.4.1 Methodology Summary

FirstEnergy's evaluation contractor, ADM Associates/Tetra Tech, developed a survey instrument template that was tailored for each residential EE&C program. The intention of the survey was to gather feedback from program participants regarding their intention to procure the rebated measure(s) outside of the program and to estimate the level of influence the program had on participants' decisions. A free-ridership rate was calculated based on survey responses for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, non-response, and differential energy savings. "Unlike" spillover was evaluated at the customer level and was expressed as a percentage of program gross energy savings. "Unlike" spillover occurs when a participant buys an energy efficient product unrelated to the program he or she was involved in but due to the influence of the program. A spillover rate was calculated for each participant surveyed by dividing spillover savings attributable to the program by the participant's total program gross energy savings. Individual scores were then weighted to account for disproportionate sampling, non-response, and differential program energy savings.

NTG research was conducted for combined Commercial/Industrial and Government/Non-Profit Equipment programs or sectors, using the same methodology. FirstEnergy's evaluation contractor stated that NTG studies were conducted once for each program in Phase I, and as a result, no NTG analysis was conducted in PY4.

E.4.1.1 Residential Home Energy Audits and Outreach Program

The Residential Home Energy Audits and Outreach Program offers participants an audit of their homes to identify energy savings opportunities. It also provides direct installation of basic low-cost measures. FirstEnergy's evaluation contractor followed the method for determining free-ridership and spillover as described above.

The Met-Ed NTGR of 87.9% was calculated from a free-ridership score of 24.8% and a spillover score of 12.7%. Of the three FirstEnergy Legacy Companies, Penn Power had the highest NTGR, 91.9%, which was calculated from 22.5% free-ridership and 14.3% spillover. Penelec had a free-ridership rate of 39.6% and a spillover rate 23.2%, resulting in the lowest NTGR, 83.6%.

E.4.1.2 Residential Appliance Turn-in Program

The Residential Appliance Turn-In Program offers customers a cash incentive and removal of inefficient but operable refrigerators, freezers, and room air-conditioners at no cost to the participant. Free-ridership was calculated using the methodology described above. Spillover was not quantified because the program's design and implementation are not structured to induce additional non-program saving, and based on a review of the survey data, any potential spillover effects were considered minimal. Additionally, NTG studies of appliance recycling programs in other jurisdictions have shown spillover attributed to this type of program to be in the order of 1% to 2%.

The NTGRs for the three EDCs were consistent with each other. Met-Ed had a free-ridership rate of 38.5% and an NTGR of 61.5%. Penn Power's free-ridership rate was estimated to be 38.3%, resulting in an NTGR 61.7%. Penelec had a free- ridership rate of 35.6% and an NTGR of 64.4%

E.4.1.3 Residential Energy Efficient HVAC Program

The Residential Energy Efficiency HVAC Program provides financial incentives for customers and support to retailers who sell high-efficiency heating and cooling systems. Free-ridership was evaluated at the measure level for each participant surveyed for the program. A free-ridership rate was calculated for each measure category for each participant. Adjustments were made to the preliminary free-ridership score to account for various channels through which the program may have influenced the participant. A downward adjustment to the free-ridership score was made for participants who stated that any previous participation in FirstEnergy programs was influential in their decision to install the energy efficient equipment.

To quantify spillover savings, FirstEnergy's evaluation contractor referred to a variety of sources, including the TRM and the California Database for Energy Efficient Resources (DEER). "Unlike" spillover was evaluated at the customer level and expressed as a percentage of program gross energy savings. A spillover rate was calculated using the methodology described above.

The Met-Ed NTGR of 57.7% was determined from 41.0% free-ridership and 0.3% spillover. Penn Power's NTGR of 64.7% was estimated from 35.8 % free-ridership and 0.5% spillover. Penelec's NTGR of 59.4% was calculated from 41.0% free-ridership and 0.4% spillover.

E.4.1.4 Residential Energy Efficient Products Program

The Residential Energy Efficient Products Program provides financial incentives to customers and support to retailers who sell energy efficient products such as ENERGY STAR-qualified appliances or CFLs. The NTG methodology for this program was the same as for the Residential Energy Efficient HVAC Program.

The Met-Ed NTG research indicated estimates of 56.5% free-ridership and 7.0% spillover, for an NTGR of 50.5%. Penn Power had the highest free-ridership (69.2%) and spillover (11.9%) and the lowest NTGR (42.7%). Penelec had 55.6% free-ridership, 8.4% spillover, and 52.8% NTGR.

E.4.1.5 Small and Large Commercial & Industrial (C&I) Equipment Programs

There are two distinct components to the C&I Equipment programs. The equipment component of the programs provides rebates for implementing cost-effective, high-efficiency lighting, HVAC, motor, and custom measures. The energy audit and technical assessment component provides participants with technical assistance on how they can save energy in their facility, a list of auditors, and funding for CFL installations.

The NTG analysis was conducted for the Small and Large C&I Equipment programs as a program group. Free-ridership and spillover calculations were based on customer decision-maker survey responses and followed the methodology described above. The survey also included a series of questions to assess additional "like" energy saving actions taken by customers since participating in the programs and the extent of the programs' influence on these actions. The questions addressed recent purchases (since program participation) of any additional energy efficient equipment of the same type as those the customer had implemented through the programs, but that were purchased without any technical or financial assistance from the utility. A "like" spillover estimate was computed based on how much more of the same energy efficient equipment the participant installed outside the programs and did so due to program influence.

The Met-ED program NTG research indicated estimates of 43.4% free-ridership and 8.9% spillover, for an NTGR of 65.5%. Penn Power had the lowest free-ridership rate, 12.5%, and a spillover rate of 0.4%, for an NTGR of 87.9%. The Penelec NTGR of 84.2% was estimated from 31.2% free-ridership and 15.4% spillover.

E.4.1.6 Government/Non-Profit Programs

FirstEnergy sectors that are in the government/non-profit sector are eligible for the same measures and services as customers in the C&I sector. The NTG methodology and the NTGR for this program was the same as for the Small and Large C&I Equipment programs.

E.4.1.7 SWE Net-to-Gross Audit Summary

As described in Appendix B.5.2 the SWE defined three levels of rigor for the NTG analysis – basic, standard, and enhanced. The SWE recommended that a basic rigor be used for the analysis of each FirstEnergy Legacy Company program except two: the Residential Energy Efficient Products Program, for which a standard level of rigor was recommended, and the low-income WARM Program, for which no study was recommended.

FirstEnergy's evaluation contractor conducted NTG analyses for 8 of the 11 programs (or subprograms) recommended for analysis by the SWE in PY3. The evaluation contractor did not conduct an NTG analysis for the Residential Behavioral Modification and Education Program or the Residential Multi-Family Program because no participation was recorded for them in PY3. No NTG research was conducted for the Governmental/Non-Profit Street Lighting Program, likely because participation was very low in PY3. FirstEnergy's evaluation contractor conducted a basic level of rigor (self-reporting surveys) for the Residential Energy Efficient Products Program instead of a standard level. There is no indication of plans to perform billing analysis, market analysis, or market-based studies, given work performed in the potential studies. No NTG analysis was conducted for any of the EE&C programs in PY4.

Although the NTG methodology and program design were the same across the FirstEnergy companies, the NTGR for the Small and Large C&I Equipment Programs, the Non-Profit Program, and the Government/Non-Profit Program for Met-Ed was 65.5%, compared with 84.2% and 87.9% for Penelec and Penn Power, respectively. The SWE recommends further research to determine what differences, if any, could account for this variance or if the difference is due to project-related sample characteristics specific to PY3.

A specific note of recommendation involves the NTG analysis and reporting for the Met-Ed customers installing motors and drives as a part of the Large C&I Equipment Program. The evaluator calculated a 100% free-ridership rate from its analysis. However, the population and sample size was small (3) and NTGR for motors and drives was higher for Penelec then for Met-Ed. Due to the small population and sample for motors and drives, the SWE recommends that Met-Ed combine results with other FirstEnergy EDCs that offer the same program to assess NTG in the future. Combining results across EDCs is not typically encouraged, but the SWE feels that in this case a larger sample size would provide FirstEnergy with a more statistically valid assessment of the motors and drives program across its operating companies.

The NTG summaries for each program for which NTG research was performed were straightforward and easy to understand. For the Residential New Construction Program, FirstEnergy reported that "Per the 2011 TRC Order, EDCs are required to use NTG for program planning purposes. NTGRs are not applied to gross savings for compliance purposes. FirstEnergy's evaluation contractor completed NTG program research which was used to inform program design for Phase II of Act 129."[539] There is no explanation for what the "NTG program research" consisted of or what is planned. In addition, there is no clear explanation for why the basic level of rigor was applied to the Residential Energy Efficient Products Program instead of the recommended standard level.

The spillover methodologies in the supplemental NTG memos were straightforward, as were the descriptions of spillover and how it was calculated, but there were no examples of survey instruments or excerpts from the sources used for some programs to quantify spillover savings. While all requested information was provided in PY3 in the form of supplemental memos, the SWE recommends that more specific information relative to treatment of NTG methodology and results be included in future annual reports.

E.5 West Penn Power

E.5.1 Methodology Summary

[539] ADM Associates, Tetra Tech, NMR Group, and Metropolitan Edison Company, Final Annual Report to the Pennsylvania Public Utility Commission, November 2013.

For PY4, the NTG methodologies used to assess the West Penn Power programs were the same as the approach used to determine NTGR for other FirstEnergy companies in PY3. Self-reporting surveys were administered by West Penn Power's evaluation contractor, ADM Associates/Tetra Tech, and the results were used to inform free-ridership and spillover rates. West Penn Power's evaluation contractor did not conduct NTG research in PY3 because of the transition from the legacy program design to the FirstEnergy program model.

E.5.1.1 Residential Home Performance Program

The Residential Home Performance Program helps home owners identify energy saving opportunities, installs basic low-cost measures, and informs customers of other energy efficient programs offered by West Penn Power. The program consists of five subprograms: Online Audit, Walk-Through Audit, Whole House Comprehensive Audit, Behavior Modification and Education, and Opt-In Kits. Customers who complete the on-line audit receive information on their energy use and an energy conservation kit. In the walk-through audit, customers receive an on-site audit with direct-installation of low-cost energy savings measures. The whole house comprehensive audit provides comprehensive diagnostic assessments of households followed by direct installation of selected low-cost measures plus incentives to implement measures addressing building shell, appliances, and other energy-consuming features. The Behavior Modification and Education Program focuses on ways customers can implement no-cost or low-cost measures and behaviors that offer opportunities to reduce energy consumption or demand. Finally, the opt-in kits distribute CFLs through several West Penn Power promotional channels.

In PY4, West Penn Power's evaluation contractor used self-reporting surveys to assess the NTGR for the Whole House Comprehensive Audit. Other subprograms were not considered because the Online Audit, Walk-Through Audit, and Opt-In Kits were already evaluated for other FirstEnergy companies in PY3. No NTG research was conducted for the Behavioral Modification and Education Program due to the design of the program; this program is set up as a random control trial with treatment and control groups—an approach that inherently controls for free-ridership and participant spillover.

Surveyed participants were sampled for up to two of the following categories of measures that they received or were rebated for through the program: (1) test-out improvements, (2) CFLs, (3) smart strips, (4) hot water equipment, and (5) LED nightlights. A free-ridership score was calculated at each measure level and then weighted to account for disproportionate sampling, non-response, and differential program energy savings. A spillover rate was calculated for each participant by dividing spillover savings attributable to the program by the participants' total gross energy savings. Individual scores were then weighted again to reduce bias. The overall program free-ridership was 18.1%, spillover was 7.7%, and NTGR was 89.6% for PY4.

E.5.1.2 Residential Appliance Turn-in Program

The Residential Appliance Turn-in Program offers cash incentives and removal of inefficient but operational refrigerators, freezers, and room air conditioners. Data from 201 self-reporting surveys were used to estimate free-ridership and calculate "unlike" spillover for the program. However, West Penn Power's evaluation contractor did not quantify spillover because the program's design and implementation were not structured to induce additional non-program savings, and based on a review of the survey data, any potential spillover effects were considered minimal. In PY4 the overall program free-ridership score was 38.5%, resulting in an NTGR of 61.5%.

E.5.1.3 Residential Energy Efficient HVAC Program

The Residential Energy Efficient HVAC Program provides incentives to retailers and customers who are selling or buying ENERGY STAR-compliant HVAC equipment. West Penn Power's evaluation contractor completed 116 participant surveys, and a weighted free-ridership score was calculated at the equipment level (heat pump and central air-conditioning). The score was then adjusted to account for various channels through which the program might have influenced the participant.

West Penn Power's evaluation contractor also calculated "unlike" participant spillover for each participant by dividing spillover savings attributable to the program by the participant's total gross energy savings. Individual scores were then weighted to account for disproportionate sampling, non-response, and differential energy savings. In PY4, the NTG analysis resulted in 42.6% free-ridership and 0.3% spillover, for an NTGR of 57.7%.

E.5.1.4 Residential Energy Efficient Products Program

The Residential Energy Efficient Products Program provides financial incentives for customers and support to retailers who sell energy efficient products. The NTG methodology for this program was the same as for the Residential Energy Efficiency HVAC Program. West Penn Power's evaluation contractor completed 131 self-reporting surveys and estimated a free-ridership of 56.5% and 7% spillover, for an NTGR of 50.5% in PY4.

E.5.1.5 Commercial & Industrial Small/Large Sector Equipment Program

The Commercial and Industrial Small/Large Sector Equipment Program consists of two distinct components. The equipment component provides rebates for implementing cost-effective, energy efficient lighting, HVAC, motor, and custom measures. The energy audit and technical assessment component provides participants with technical assistance on how they can save energy in their facility, a list of auditors, and funds for CFL installations.

West Penn Power's evaluation contractor conducted one NTG analysis for small and large C&I equipment and government/non-profit sector participants. Self-reporting surveys were administered, and the sampling frame for the customer-decision survey was C&I Small/Large Sector Equipment Program participants from PY3. Customers were surveyed for all equipment types except lighting, where only a statistically significant number of participants were surveyed.

Free-ridership and "like" spillover were estimated from 70 participant surveys. The analysis resulted in estimates of 43.4% free-ridership and 8.9% spillover, for an NTGR of 65.5% at the combined measure level.

E.5.1.6 Customer Resources Demand Response Program – CSP Mandatory and Voluntary Curtailment Program

The purpose of the Customer Resources Demand Response Program – CSP Mandatory and Voluntary Curtailment Program is to solicit conservation service providers (CSPs) to supply customer curtailable load during West Penn Power's 100 hours of highest demand. West Penn Power's evaluation contractor did not conduct an NTG analysis for this program because it was conducted by the SWE. Refer to Section 3.5,"SWE Demand Response Study," in the main body of this report for the SWE NTG research.

E.5.1.7 SWE Net-to-Gross Audit Summary

West Penn Power's evaluation contractor did not conduct NTG research in PY3 due to the transition from the legacy program design to the FirstEnergy program model. NTG methodologies used to assess the West Penn Power programs in PY4 were the same those used to determine NTGR for the three FirstEnergy Legacy Companies in PY3. West Penn Power's evaluation contractor conducted NTG analysis at the basic level of rigor for seven EE programs. Instead of conducting individual NTG analyses for the small and large C&I equipment and government/non-profit programs, West Penn Power's evaluation contractor aggregated survey responses to determine an overall NTGR for these programs combined. These programs also incentivize a wide range of technologies that likely have varying NTGRs. The SWE recommends focusing NTG research on high-impact measures within these programs to explore which measures have high free-ridership and may require a change in program offerings.

Appendix F Program Year 4 Audit Activities and Findings

F.1 Electric Distribution Company M&V Activities and Findings

This section summarizes the measurement and verification (M&V) activities conducted by each electric distribution company's (EDC's) evaluator during Program Year 4 (PY4), based on details provided in PY4 annual reports and information obtained from SWE data requests and audits.

F.1.1 Duquesne

Table F-1 shows Duquesne's PY4 program realization rates.

Table F-1: Duquesne PY4 Program Realization Rates

Program	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
		PYTD Verified Gross Demand Reductions in the Top 100 Hours by Program	PYTD Total Verified Gross Demand Reductions by Program
Residential EE Program (REEP) - Rebate Program	75%	68%	68%
Residential EE Program (Upstream Lighting)	98%	98%	98%
Residential School Energy Pledge	63%	67%	67%
Residential Appliance Recycling	101%	101%	101%
Residential Low-Income EE	83%	87%	87%
Residential Low-Income EE (Upstream Lighting)	98%	98%	98%
Commercial Sector Umbrella EE	99%	104%	104%
Commercial Sector Umbrella EE (Upstream Lighting)	99%	104%	104%
Healthcare EE	99%	104%	104%
Industrial Sector Umbrella EE	102%	100%	100%
Chemical Products EE	102%	100%	100%
Mixed Industrial EE	102%	100%	100%
Office Building - Large - EE	99%	104%	104%
Office Building - Small - EE	99%	104%	104%
Primary Metals EE	102%	100%	100%
Public Agency/Non-Profit	102%	102%	102%
Retail Stores - Small - EE	99%	104%	104%
Retail Stores - Large - EE	99%	104%	104%
Residential Demand Response	NA	100%	100%
Large Curtailable Demand Response	NA	100%	100%
TOTAL PORTFOLIO	**97%**	**101%**	**101%**

Residential EE Program (REEP) – Rebate Program

The rebate program's low realization rates for both energy and demand savings result from a significant portion of participants having not installed the smart strips (45%) and Limelights (33%). The smart strips have a significant impact of the realization rate due to their high reported savings compared with that of Limelights.

Residential School Energy Pledge (SEP)

M&V of SEP was not completed for PY4. Rather, the evaluation relied on PY3 verification results for this program. These results indicated a realization rate of 63% for energy savings and 67% for demand reductions. Additional field verification of PY4 was not undertaken because (1) verification rates for PY2 and PY3 are essentially the same; (2) there were no program changes that might have led to changes in installation of distributed measures; and (3) the savings and budgets for this program are very small. Based on these considerations, the value of the information (VOI) did not justify additional field work for PY4.

Non-Residential

The energy and demand savings realization rates for all of Duquesne's commercial and industrial (C&I) programs ranged between 99% and 104%. The high level of agreement between the ex-ante and ex-post savings is due to rigorous data collection and application of Technical Reference Manual (TRM) algorithms and assumptions in Duquesne's Project Management and Reporting System (PMRS) tracking system and by Duquesne's evaluation contractor. This heavy correlation between reported and verified savings improves the sampling precision of the realization rate and the verified savings estimates but can propagate systematic uncertainty if TRM assumptions are flawed. The SWE is including thresholds in the 2014 TRM above which customer-specific data collection will be required in an attempt to mitigate some of this possible systematic uncertainty and improve the accuracy of savings estimates for large C&I projects.

F.1.2 PECO

Table F-2 shows PECO's PY4 program realization rates.

Table F-2: PECO PY4 Program Realization Rates

Program	Realization Rate-Energy Savings	Realization Rate - Demand Savings	
		Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Smart Lighting Discounts Program	96%	87%	87%
Smart Appliance Recycling Program	94%	94%	94%
Smart Home Rebates Program	100%	100%	100%
Low-Income Energy Efficiency Program	91%	84%	84%
Smart Equipment Incentives - C&I	86%	80%	80%
Smart Construction Incentives - C&I	120%	120%	120%
Smart Equipment Incentives - GNI	95%	108%	108%
Permanent Load Reduction	44%	167%	167%
Demand Response Aggregators	N/A	100%	100%
Distributed Energy Resources	N/A	100%	100%
Residential Smart A/C Saver	N/A	100%	100%
Commercial Smart A/C Saver	N/A	100%	100%
TOTAL PORTFOLIO	**82%**	**100%**	**97%**

Smart Lighting Discounts Program

The realization rate for both energy and demand savings is lower than 100% for the Smart Lighting Discounts Program because the M&V methodology accounts for the fact that 7.7% of program bulbs are going into commercial installations. Additionally, a literature review revealed the need to employ a peak load coincidence factor of 11.7% to ensure verification validity.

Smart Appliance Recycling Program

The energy and demand realization rates of 94% are the result of a phone survey that revealed that 6% of program participants were unable to verify that PECO's program had, in fact, collected their unit.

Low-Income Energy Efficiency Program (LEEP)

The low demand impact realization rate for LEEP is a result of differences in ex-ante and ex-post savings calculation methodologies. The ex-ante demand impact was calculated by multiplying energy savings by a coincident peak demand savings conversion factor that was a best available estimate derived from modeling and approved by the SWE as part of a 2010 LEEP custom measure protocol (CMP). The program evaluator calculated demand savings estimates for each participant based on measures installed at each site. The participant savings were averaged by measure group, and the energy realization rate was applied to the engineering estimated demand savings to determine verified demand impacts.

Non-Residential

The energy savings realization rate of 86% for PECO's Smart Equipment Incentives – C&I program resulted from multiple discrepancies between what the implementation conservation service provider (CSP) and evaluation contractor reported. Specifically, the implementation CSP used assumed values of 2 kWh and 0.0001 kW savings per square foot for energy management system (EMS) measures. However, the evaluation contractor disagreed with this approach as there is a high volatility in range of equipment controlled and operating schedules. Also, the realization rates were affected by: incorrect baseline classifications in ex-ante scenarios, hours of use and equipment quantity adjustments, and site visit findings varying from assumptions used in the ex-ante calculations.

The demand savings realization rate of 80% for PECO's Smart Equipment Incentives – C&I program resulted from many of the same discrepancies just discussed in calculating the program's energy savings. Additionally, the demand realization rate was affected by the ex-ante peak demand savings not being based on SWE-approved peak demand calculators.

The energy and demand savings realization rates for PECO's Permanent Load Reduction Program were 44% and 167%, respectively. The program only had one participant in PY4, so the realization rates were solely reliant on the one project. The differences in the ex-ante and ex-post savings were due to changes made in equipment operating conditions, equipment efficiencies, and use of the PA Act 129 PECO weather-dependent Peak Demand Savings Calculator.

F.1.3 PPL

Table F-3 shows PPL's PY4 program realization rates.

Table F-3: PPL PY4 Program Realization Rates

Program	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
		Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Appliance Recycling	89%	94%	94%
Custom Incentive	98%	102%	102%
Direct Load Control	N/A	100%	100%
Efficient Equipment Incentive	97%	88%	91%
Energy Efficiency Behavior & Education	104%	116%	116%
E-Power Wise	92%	92%	92%
Home Energy Assessment & Weatherization	100%	100%	100%
HVAC Tune-Up	100%	100%	100%
Load Curtailment	N/A	88%	88%
Renewable Energy	72%	78%	78%
Residential Lighting	100%[540]	58%	58%
WRAP	98%	98%	98%
Load Curtailment (Alternative Method)	N/A	100%	100%
TOTAL PORTFOLIO	**98%**	**90%**	**90%**

Appliance Recycling

The energy savings realization rate was almost entirely the result of responses received from a survey regarding appliance replacement. In the evaluation, measurement, and verification (EM&V) CSP survey results, significantly more customers reported replacing a refrigerator or freezer than was reported in Energy Efficiency Management Information System (EEMIS) (as reported by the program CSP during the customer sign-up process). The difference had a significant impact on the program realization rate, as savings associated with replaced units are lower. As a result, the energy savings realization rate was 89%.

Efficient Equipment Incentive

[540] Does not include the cross-sector sales adjustment.

While the overall realization rate for the Efficient Equipment Incentive Program was within 10% of the target, a few notable discrepancies between verified and claimed savings were found at the measure level. Measures that had the largest influence on the realization rates for each stratum are discussed below.

Residential Small Stratum Measures

The residential small stratum includes office equipment. The realization rate was 101% for energy savings and 101% for demand reduction. There are no major differences to report for this stratum.

Residential Solar Water Heaters

Two solar water heater projects were provided rebates in PY4. The realization rate was 294% for energy savings and 237% for demand reduction. Both projects were found to be ground-source heat pumps (GSHPs), and therefore the EM&V CSP used the GSHP algorithms from the 2012 TRM and information from the Air-Conditioning, Heating and Refrigeration Institute (AHRI) database to calculate the ex-post energy and demand reduction for these projects. Energy and demand reduction for GSHPs are higher than for solar water heaters.

Residential Medium Stratum Measures

The residential medium stratum includes ENERGY STAR refrigerators. The realization rate was 105% for energy savings and 100% for demand reduction. The difference between ex-ante adjusted and ex-post savings was due to differences found in model configurations when the manufacturer and model numbers in the records were verified.

Residential Large Stratum Measures

The residential large stratum includes heating, ventilation, and air conditioning (HVAC) measures. The realization rate was 92% for energy savings and 41% for demand reduction. The EM&V CSP verified 13 residential air-source heat pump measures and found variation between the ex-ante adjusted and ex-post demand reduction. The EM&V CSP found during record review that one measure was actually a ductless heat pump, and calculated energy savings for this measure using the ductless heat pump algorithms in the TRM. For the other measures, the EM&V CSP found a difference in the Energy Efficient Ratio (EER) values used to calculate savings in EEMIS (which are derived from the seasonal energy efficiency ratio [SEER] value by assuming 13 SEER is equivalent to 11 EER) and those verified using the AHRI database. The AHRI values were lower, resulting in lower demand reduction than the ex-ante adjusted values.

The EM&V CSP verified five central air conditioner measures. The ex-post energy savings decreased for two measures, and the demand reduction decreased for all five measures because the verified cooling capacity and verified efficiency according to the AHRI database were lower than that reported in EEMIS.

For ductless heat pumps, one reviewed record had an incorrect room type in EEMIS, which affected the energy savings. The EM&V CSP also verified the capacity and efficiency values by looking up the manufacturer and model number in the AHRI database. For some cases, this resulted in negative demand reduction as the EER values found in AHRI were lower than those in EEMIS, which are calculated by converting SEER to EER.

Lastly, the EM&V CSP found that several of the heat pump water heater measures were not actually heat pump water heaters. One measure was a ductless heat pump, two were air-source heat pumps, three were GSHPs, three were regular water heaters, and two were natural gas tankless water heaters. The standard water heaters and the natural gas tankless water heaters were assigned zero savings as they are ineligible for rebates. The other measures were assigned measures according to the algorithms in the TRM.

Energy Efficiency Behavior and Education

Both the energy and demand realization rates were above 100% for the Energy Efficiency Behavior and Education Program. This is due to the fact that the reported gross savings included savings for 13 months between May 2012, the last month of PY3, and May 2013. Thus the EM&V applied an ex-ante adjustment to remove the May 2012 savings, resulting in 35,138 MWh/yr. The ex-post verified savings were estimated at 36,470 MWh/yr, which provides a realization rate of 104% in PY4. Similarly, the implementation CSP reported ex-ante program savings of 6.1 MW/yr. The ex-post verified savings were estimated at 7.0 MW/yr. This implies a demand reduction realization rate of 116%.

Residential Lighting

The low realization rate for demand savings is the result of a problematic approach employed by the CSP to deliver savings data. Prior to the second quarter (Q2) of PY4, record-level savings were computed by the CSP and delivered to PPL via spreadsheets, for import into EEMIS. Over time, it became apparent that this approach was prone to error. In fact, in PY3 Q4 and PY4 Q1, the errors in the MW calculations provided by the CSP were significant. Therefore, beginning in PY4 Q2, EEMIS savings values have been computed using the same approach the EM&V CSP uses: EEMIS now applies bulb-specific inputs (from the CSP's database) to the current TRM savings equations. The few mismatched energy savings values from Q1 did not affect the overall PY4 energy savings realization rate (100%). However, the large number of mismatched savings values for demand in Q1 resulted in a PY4 realization rate for demand reduction of 58%.

Non-Residential

The energy and demand savings realization rates for PPL's Renewable Energy Program were 72% and 78%, respectively. The realization rates were primarily driven by two projects where the verified efficiencies were much lower than the reported equipment efficiencies. For example, at one project the average reported EER and Coefficient of Performance (COP) at the site were 18.7 and 3.7, respectively, while the average verified EER and COP at the site were 14.6 and 3.2. Additionally, the equipment efficiencies reported in the EEMIS system appeared to be higher than the verified estimates because the EEMIS equipment capacities and efficiencies corresponded to GSHPs while the evaluator chose to use equipment capacities and efficiencies corresponding to ground loop heat pumps since ground loop heat pumps are the most common system type.

F.1.4 Met-Ed

Table F-4 shows Met-Ed's PY4 program realization rates.

Table F-4: Met-Ed PY4 Program Realization Rates

Program	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
		Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Demand Reduction	N/A	100%	100%
Home Energy Audits and Outreach	89%	68%	68%
Appliance Turn-In	72%	76%	76%
EE HVAC	119%	97%	97%
EE Products	89%	85%	85%
New Construction	152%	335%	335%
Behavioral Modification and Education	100%	97%	97%
Multiple Family	100%	100%	100%
Warm Programs	163%	77%	77%
C&I Small Sector Equipment	90%	67%	67%
C&I Large Sector Equipment	90%	54%	54%
PJM Demand Response	N/A	96%	96%
Government/Non-Profit Street lighting	100%	0%	0%
Government/Non-Profit	98%	89%	89%
Governmental/Remaining Non-Profit	96%	76%	76%
TOTAL PORTFOLIO	**91%**	**86%**	**84%**

Home Energy Audits and Outreach

The low realization rate for the Home Energy Audits and Outreach program can be attributed to the baseline change for 23W to 26W compact fluorescent lights (CFLs) in the 2012 TRM. Reported savings were calculated with a 100W lamp as the baseline for such lamps, and the gross verified savings reported herein are calculated with a 72W baseline in accordance with the 2012 TRM. All else held constant, this lowered the realization rate by approximately 9%. Additionally, upon reviewing reported measure-level savings, ADM discovered that these savings included demand reductions for furnace whistles, whereas the 2012 TRM does not recognize demand reductions. Since most installed furnace whistles, particularly in Met-Ed territory, are installed in homes with central cooling, one would expect nonzero demand reductions from this measure. As such, the realization rate for demand reduction was lower than the realization rate for energy savings. Although the 2014 proposed TRM does recognize demand reductions for this measure, the gross verified impacts are calculated in accordance with the 2012 TRM and zero demand reductions are credited to this measure.

Appliance Turn-In

The low realization rate for the Appliance Turn-In program is a result of certain precautions undertaken by the evaluators to avoid double-counting of savings in the case that a refrigerator is replaced with an ENERGY STAR unit and rebated under the Efficient Products Program. ADM conducted a database lookup to identify customers who recycled a refrigerator or freezer, and also received rebates for ENERGY STAR refrigerators or freezers during the same program year. The savings associated with the ENERGY STAR refrigerators or freezers were then subtracted from the gross verified savings for the program. For refrigerators and freezers, the reported savings were calculated only for the “recycling without replacement” scenario. The gross verified impacts were calculated according to the process discussed above, which results in lower savings for refrigerators and freezers that are recycled with replacement. The realization rate for the program is attributable almost entirely to this difference.

EE HVAC

The EE HVAC program exhibited verified demand savings that closely matched claimed savings, whereas verified energy savings were 19% above claimed savings. Any variance between claimed and verified savings came as a result of using proper capacities, efficiencies, and deemed hours of operation rather than assumed averages.

EE Products

The majority of the variance between claimed savings and verified savings was the result of adjustments to reflect actual versus “typical” savings values, or baseline adjustments to reported savings, which were corrected during the “desk review” phase of verification. For example, the energy savings and demand calculations for room air conditioners used Harrisburg as the reference city in all cases. This was corrected by using a zip-code “lookup” to identify the closest reference city to the household in which the unit was used for each case. Additionally, the savings for dehumidifiers assumed that all of the rebated units had a capacity between 25 and 35 pints per day. This resulted in an understatement of energy savings attributable to dehumidifiers, as many of the units had capacities greater than that range (and accordingly greater deemed savings). While the Tracking and Reporting (T&R) system for the program did not have a data field listing the capacities of each dehumidifier rebated, these parameters are captured and recorded in the CSP tracking database, though in a format that precludes determination of these parameters for the census of the population. Accordingly, ADM sampled a sufficiently large number of rebated dehumidifiers to check the distribution of capacities. Deemed energy savings and demand reductions from the PA TRM were applied to this sample of dehumidifiers and compared with the claimed savings in the T&R system. The resulting realization rate was applied to the population of dehumidifiers rebated through the program.

Residential New Construction

The energy savings realization rate of 152% for Met-Ed's residential new construction program resulted from a difference in the methodologies used for ex-ante and ex-post savings estimation. The program implementer reported ex-ante savings as a direct output from REM/Rate, a home energy modeling software used to compare new homes with a baseline home for this program. The TRM, however, states that only savings from weather-sensitive measures, such as HVAC efficiency upgrades, should be outputs of REM/Rate; according to the TRM, savings for non-weather-sensitive measures should be estimated using TRM protocols. Therefore, in evaluating the energy savings, Met-Ed's evaluator had to remove the REM/Rate non-weather-sensitive measure portion of savings from the total savings and add back the TRM savings for the non-weather-sensitive measures present in the home. All homes in the evaluator's sample required this adjustment. The REM/Rate savings were generally lower than the TRM savings, and therefore a realization rate greater than 100% was found.

The demand realization rate of 335% for Met-Ed's residential new construction program also resulted from a difference in the methodologies used for ex-ante and ex-post savings estimation. The program implementer reported ex-ante savings as a direct output from REM/Rate. The TRM, however, states that demand savings are to be estimated using an algorithm provided in TRM that uses some REM/Rate outputs as inputs. All homes in the evaluator's sample required this adjustment. For each home, the TRM-estimated demand savings were significantly greater than the REM/Rate-estimated demand savings, and therefore a realization rate greater than 100% was found.

WARM Programs

The energy savings realization rate of 163% for Met-Ed's WARM Programs is due to updated statistical billing analysis results for the WARM Plus program. The reported savings for this program were based on the per-job savings from the PY3 evaluation.[541] In PY4 Met-Ed's program evaluator conducted a statistical billing analysis to determine PY4 WARM Plus impacts using a "difference in differences" approach, which consisted of analyzing the difference in relative energy impacts of treatment and control groups. More information on the evaluation approach can be found in Met-Ed's annual report. The average verified per-job savings found in the PY4 evaluation were higher than the PY3 evaluation, thus leading to the high realization rate. It should be noted that there has been variability in the WARM

[541] The three job types used by Met-Ed are as follows: electric heat jobs that involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

Plus per-job savings in Phase I. The verified savings in PY1 and PY2 of WARM Plus were based on Low-Income Usage Reduction Program (LIURP) billing analysis results. The PY3 verified savings were determined based on a statistical billing analysis of WARM Plus participants, and there was a significant reduction per-job savings relative to the LIURP results. Finally, the PY4 WARM Plus billing analysis results were higher than PY3 but lower than the LIURP results used in PY1 and PY2.

Met-Ed's WARM Programs' 77% demand savings realization rate was the result of two factors. First, the reported per-job WARM Plus energy impacts were reduced from previous years' LIURP billing analysis results to the PY3 WARM Plus billing analysis results, and the reported per-job WARM Plus demand impact was reduced in proportion to the energy reduction. However, the reduction was asymmetric and led to an increase in the kW to kWh ratio and to the reported demand impacts being overstated relative to the verified savings. Second, the evaluator used a conservative modeling approach of cooling and non-cooling savings in the top 100 hours for the verified per-job savings.

Non-Residential

The energy savings realization rates of 90% for Met-Ed's Small and Large C&I Equipment programs were the result of an overall low realization rate among many strata. Specifically, the custom and non-standard lighting strata included large savings contributions but low realization rates of 0.80, 0.84, and 0.49 for the three largest strata when ranked by savings contribution. See Appendix F for a full discussion.

The demand savings realization rates of 67% and 54% for Met-Ed's Small and Large C&I Equipment programs, respectively, was the result of low realization rates in the photovoltaic (PV) project strata, which had realization rates between 44% and 49%. The low realization rate for the PV Strata are due to the difference between the non-coincident peak demand reductions reported by the implementer and the top 100 hour peak demand reductions calculated by the evaluator. The SWE noted in the Met-Ed project file review (see Appendix F, section F.4.4.3) that the PV projects evaluated sometimes did not rely on on-site verification for inputs into the System Advisory Model (SAM) calculator, which could lead to high variability in calculated savings based on assumptions.

F.1.5 Penelec

Table F-5 shows Penelec's PY4 program realization rates.

Table F-5: Penelec PY4 Program Realization Rates

Program	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
		Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Demand Reduction	N/A	97%	97%
Home Energy Audits and Outreach	88%	66%	66%
Appliance Turn-In	76%	79%	79%
EE HVAC	88%	131%	131%
EE Products	88%	89%	89%
New Construction	100%	100%	100%
Behavioral Modification and Education	100%	100%	100%
Multiple Family	100%	100%	100%
Warm Programs	108%	0%	54%
C&I Small Sector Equipment	103%	121%	121%
C&I Large Sector Equipment	79%	87%	87%
PJM Demand Response	N/A	87%	87%
Government/Non-Profit Street lighting	99%	0%	0%
Government/Non-Profit	89%	77%	77%
Governmental/Remaining Non-Profit	66%	85%	85%
TOTAL PORTFOLIO	**85%**	**88%**	**88%**

Home Energy Audits and Outreach

The low realization rate for the Home Energy Audits and Outreach Program can be attributed to the baseline change for 23W to 26W CFLs in the 2012 TRM. Reported savings were calculated with a 100W lamp as the baseline for such lamps, and the gross verified savings reported herein are calculated with a 72W baseline in accordance with the 2012 TRM. All else held constant, this lowered the realization rate by approximately 9%. Additionally, upon reviewing reported measure-level savings, ADM discovered that these savings included demand reductions for furnace whistles, whereas the 2012 TRM does not recognize demand reductions. Since most installed furnace whistles, particularly in Penelec territory, are installed in homes with central cooling, one would expect nonzero demand reductions from this measure. As such, the realization rate for demand reduction was lower than the realization rate for energy savings. Although the 2014 proposed TRM does recognize demand reductions for this measure, the gross verified impacts are calculated in accordance with the 2012 TRM and zero demand reductions are credited to this measure.

Appliance Turn-In

The low realization rate for the Appliance Turn-In Program is a result of certain precautions undertaken by the evaluators to avoid double-counting of savings in the case that a refrigerator is replaced with an ENERGY STAR unit and rebated under the Efficient Products Program. ADM conducted a database lookup to identify customers who recycled a refrigerator or freezer, and also received rebates for ENERGY STAR refrigerators or freezers during the same program year. The savings associated with the ENERGY STAR refrigerators or freezers were then subtracted from the gross verified savings for the program. For refrigerators and freezers, the reported savings were calculated only for the “recycling without replacement” scenario. The gross verified impacts were calculated according to the process discussed above, which results in lower savings for refrigerators and freezers that are recycled with replacement. The realization rate for the program is attributable almost entirely to this difference.

EE HVAC

The EE HVAC program exhibited verified energy savings that closely matched claimed savings, whereas verified demand savings were 31% above claimed savings. Variances between the gross reported and gross verified savings were attributable to the application of PA TRM protocols to gross reported savings that were estimated based on “typical” rather than actual capacities, efficiencies, and heating and cooling hours.

EE Products

The majority of the variance between claimed savings and verified savings was the result of adjustments to reflect actual versus “typical” savings values, or baseline adjustments to reported savings, which were corrected during the “desk review” phase of verification. For example, the energy savings and demand calculations for room air conditioners used Harrisburg as the reference city in all cases. This was corrected by using a zip-code “lookup” to identify the closest reference city to the household in which the unit was used for each case. Additionally, the savings for dehumidifiers assumed that all of the rebated units had a capacity between 25 and 35 pints per day. This resulted in an understatement of energy savings attributable to dehumidifiers, as many of the units had capacities greater than that range (and accordingly greater deemed savings). While the T&R system for the program did not have a data field listing the capacities of each dehumidifier rebated, these parameters are captured and recorded in the CSP tracking database, though in a format that precludes determination of these parameters for the census of the population. Accordingly, ADM sampled a sufficiently large number of rebated dehumidifiers to check the distribution of capacities. Deemed energy savings and demand reductions from the PA TRM were applied to this sample of dehumidifiers and compared to the claimed savings in the T&R system. The resulting realization rate was applied to the population of dehumidifiers rebated through the program.

WARM Programs

Penelec's WARM Programs' 54% demand savings realization rate was the result of two factors. First, the reported per-job WARM Plus energy impacts were reduced from previous years' LIURP billing analysis results to the PY3 WARM Plus billing analysis results, and the reported per-job WARM Plus demand impact was reduced in proportion to the energy reduction. However, the reduction was asymmetric and led to an increase in the kW to kWh ratio and to the reported demand impacts being overstated relative to the verified savings. Second, the evaluator used a conservative modeling approach of cooling and non-cooling savings in the top 100 hours for the verified per-job savings.

Non-Residential

The energy savings realization rate of 66% for Penelec's Governmental/Remaining Non-Profit Program was the result of low realization rates in all but one of the program's strata. Realization rates ranged from 29% in the prescriptive stratum to 86% in the non-standard lighting stratum. No single reason for the consistently low realization rate was found by the SWE.

The demand savings realization rate of 87% for Penelec's Large C&I Equipment program was, again, the result of low realization rates in all but one of the program's strata. Realization rates ranged from 67% in the custom stratum to 95% in the non-standard lighting stratum. No single reason for the consistently low realization rate was found by the SWE. However, an individual project file review consisting of large variable frequency drive (VFD) additions indicated that trend data taken to calculate ex-post savings showed much lower hours of use than what was reported in the ex-ante calculations.

F.1.6 Penn Power

Table F-6 shows Penn Power's PY4 program realization rates.

Table F-6: Penn Power PY4 Program Realization Rates

Program	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
		Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Demand Reduction	N/A	100%	100%
Home Energy Audits and Outreach	97%	77%	77%
Appliance Turn-In	76%	76%	76%
EE HVAC	114%	82%	82%
EE Products	89%	86%	86%
New Construction	179%	2,248%	2,248%
Behavioral Modification and Education	100%	3%	3%
Multiple Family	99%	100%	100%
Warm Programs	N/A	0%	0%
C&I Small Sector Equipment	89%	95%	95%
C&I Large Sector Equipment	81%	81%	81%
PJM Demand Response	N/A	106%	106%
Government/Non-Profit Street lighting	N/A	0%	0%
Government/Non-Profit	N/A	0%	0%
Governmental/Remaining Non-Profit	60%	62%	62%
TOTAL PORTFOLIO	**87%**	**99%**	**96%**

Home Energy Audits and Outreach

The low demand savings realization rate for the Home Energy Audits and Outreach Program can be attributed to the baseline change for 23W to 26W CFLs in the 2012 TRM. Reported savings were calculated with a 100W lamp as the baseline for such lamps, and the gross verified savings reported herein are calculated with a 72W baseline in accordance with the 2012 TRM. All else held constant, this lowered the realization rate by approximately 9%. Additionally, upon reviewing reported measure-level savings, ADM discovered that these savings included demand reductions for furnace whistles, whereas the 2012 TRM does not recognize demand reductions. Since most installed furnace whistles, particularly in Penn Power territory, are installed in homes with central cooling, one would expect nonzero demand reductions from this measure. As such, the realization rate for demand reduction was lower than the realization rate for energy savings. Although the 2014 proposed TRM does recognize demand reductions for this measure, the gross verified impacts are calculated in accordance with the 2012 TRM and zero demand reductions are credited to this measure.

Appliance Turn-In

The low realization rate for the Appliance Turn-In Program is a result of certain precautions undertaken by the evaluators to avoid double-counting of savings in the case that a refrigerator is replaced with an ENERGY STAR unit and rebated under the Efficient Products Program. ADM conducted a database lookup to identify customers who recycled a refrigerator or freezer, and also received rebates for ENERGY STAR refrigerators or freezers during the same program year. The savings associated with the ENERGY STAR refrigerators or freezers were then subtracted from the gross verified savings for the program. For refrigerators and freezers, the reported savings were calculated only for the "recycling without replacement" scenario. The gross verified impacts were calculated according to the process discussed above, which results in lower savings for refrigerators and freezers that are recycled with replacement. The realization rate for the program is attributable almost entirely to this difference.

EE HVAC

The EE HVAC Program exhibited verified demand savings that were 18% below claimed savings, whereas verified energy savings were 14% above claimed savings. Any variance between claimed and verified savings came as a result of using proper capacities, efficiencies, and deemed hours of operation rather than assumed averages.

EE Products

Both energy and demand savings were verified to be approximately 10% lower than the initial estimate. The majority of the variance between claimed savings and verified savings was the result of adjustments to reflect actual versus "typical" savings values, or baseline adjustments to reported savings, which were corrected during the "desk review" phase of verification. For example, the energy savings and demand calculations for room air conditioners used Harrisburg as the reference city in all cases. This was corrected by using a zip-code "lookup" to identify the closest reference city to the household in which the unit was used for each case. Additionally, the savings for dehumidifiers assumed that all of the rebated units had a capacity between 25 and 35 pints per day. This resulted in an understatement of energy savings attributable to dehumidifiers, as many of the units had capacities greater than that range (and accordingly greater deemed savings). While the T&R system for the program did not have a data field listing the capacities of each dehumidifier rebated, these parameters are captured and recorded in the CSP tracking database, though in a format that precludes determination of these parameters for the census of the population. Accordingly, ADM sampled a sufficiently large number of rebated dehumidifiers to check the distribution of capacities. Deemed energy savings and demand reductions from the PA TRM were applied to this sample of dehumidifiers and compared with the claimed savings in the T&R system. The resulting realization rate was applied to the population of dehumidifiers rebated through the program.

Residential New Construction Program

The energy savings realization rate of 179% for Penn Power's residential new construction program resulted from a difference in the methodologies used for ex-ante and ex-post savings estimation. The program implementer reported ex-ante savings as a direct output from REM/Rate, a home energy modeling software used to compare new homes to a baseline home for this program. The TRM, however, states that only savings from weather-sensitive measures, such as HVAC efficiency upgrades, should be outputs of REM/Rate; according to the TRM, savings for non-weather-sensitive measures should be estimated using TRM protocols. Therefore, in evaluating the energy savings, Penn Power's evaluator had to remove the REM/Rate non-weather-sensitive measure portion of savings from the total savings, and add back the TRM savings for the non-weather-sensitive measures present in the home. All homes in the evaluator's sample required this adjustment. The REM/Rate savings were generally lower than the TRM savings, and therefore a realization rate greater than 100% was found.

The demand realization rate of 2,248% for Penn Power's residential new construction program also resulted from a difference in the methodologies used for ex-ante and ex-post savings estimation. The program implementer reported ex-ante savings as a direct output from REM/Rate. The TRM, however, states that demand savings are to be estimated using an algorithm provided in TRM that uses some REM/Rate outputs as inputs. All homes in the evaluator's sample required this adjustment. For each home, the TRM-estimated demand savings were significantly greater than the REM/Rate-estimated demand savings, which were very low and in some instances negative, and therefore, a realization rate significantly greater than 100% was found.

Non-Residential

The energy and demand realization rates for Penn Power's Remaining Government/Non-Profit Program were 60% and 62%, respectively. The low energy realization rate was primarily driven down by the 29% realization rate in the smaller custom projects stratum, while the low demand realization rate was primarily driven down by the 44% realization rate in the non-standard lighting stratum.

F.1.7 West Penn Power

Table F-7 shows West Penn Power's PY4 program realization rates.

Table F-7: West Penn Power PY4 Program Realization Rates

	Realization Rate - Energy Savings	Realization Rate - Demand Savings	
Program	Verified Gross Energy Savings by Program	Verified Gross Demand Reductions in the Top 100 Hours by Program	Total Verified Gross Demand Reductions by Program
Residential Appliance Turn-In	81%	83%	83%
Residential Energy Efficient Products	90%	96%	94%
Residential Energy Efficient HVAC Equipment	103%	74%	74%
Residential Home Performance	96%	19%	28%
Critical Peak Rebate (CPR)	74%	100%	73%
Limited-Income Energy Efficiency (LIEEP)	117%	114%	114%
Joint Utility Usage Management (JUUMP)	135%	9%	9%
Commercial & Industrial Equipment - Small	103%	90%	95%
Commercial & Industrial Equipment - Large	91%	116%	116%
Customer Resources Demand Response	N/A	100%	100%
Conservation Voltage Reduction (CVR)	89%	100%	84%
Governmental and Institutional	84%	93%	93%
TOTAL PORTFOLIO	**94%**	**97%**	**95%**

Residential Appliance Turn-In

The low realization rate for the Residential Appliance Turn-In Program is a result of certain precautions undertaken by the evaluators to avoid double-counting of savings in the case that a refrigerator is replaced with an ENERGY STAR unit and rebated under the Residential Efficient Products Program. ADM conducted a database lookup to identify customers who recycled a refrigerator or freezer, and also received rebates for ENERGY STAR refrigerators or freezers during the same program year. The savings associated with the ENERGY STAR refrigerators or freezers were then subtracted from the gross verified savings for the program. For refrigerators and freezers, the reported savings were calculated only for the "recycling without replacement" scenario. The gross verified impacts were calculated according to the process discussed above, which results in lower savings for refrigerators and freezers that are recycled with replacement. The realization rate for the program is attributable almost entirely to this difference.

Residential Energy Efficient Products

The majority of the variance between claimed savings and verified savings was the result of adjustments to reflect actual versus "typical" savings values, or baseline adjustments to reported savings, which were corrected during the "desk review" phase of verification. For example, the energy savings and demand calculations for room air conditioners used Harrisburg as the reference city in all cases. This was corrected by using a zip-code "lookup" to identify the closest reference city to the household in which the unit was used for each case. Additionally, the savings for dehumidifiers assumed that all of the rebated units had a capacity between 25 and 35 pints per day. This resulted in an understatement of energy savings attributable to dehumidifiers, as many of the units had capacities greater than that range (and accordingly greater deemed savings). While the T&R system for the program did not have a data field listing the capacities of each dehumidifier rebated, these parameters are captured and recorded in the CSP tracking database, though in a format that precludes determination of these parameters for the census of the population. Accordingly, ADM sampled a sufficiently large number of rebated dehumidifiers to check the distribution of capacities. Deemed energy savings and demand reductions from the PA TRM were applied to this sample of dehumidifiers and compared with the claimed savings in the T&R system. The resulting realization rate was applied to the population of dehumidifiers rebated through the program.

Residential Energy Efficient HVAC Equipment

The Residential EE HVAC Program exhibited verified energy savings realization rate slightly above 100%, whereas verified demand savings were 26% below claimed savings. Any variance between claimed and verified savings came as a result of using proper capacities, efficiencies, and deemed hours of operation rather than assumed averages.

Residential Home Performance

The low demand savings realization rate for the Residential Home Performance Program can be attributed to the baseline change for 23W to 26W CFLs in the 2012 TRM. Reported savings were calculated with a 100W lamp as the baseline for such lamps, and the gross verified savings reported herein are calculated with a 72W baseline in accordance with the 2012 TRM. All else held constant, this lowered the realization rate by approximately 9%. Additionally, upon reviewing reported measure-level savings, ADM discovered that these savings included demand reductions for furnace whistles, whereas the 2012 TRM does not recognize demand reductions. Since most installed furnace whistles, particularly in West Penn Power territory, are installed in homes with central cooling, one would expect nonzero demand reductions from this measure. As such, the realization rate for demand reduction was lower than the realization rate for energy savings. Although the 2014 proposed TRM does recognize demand reductions for this measure, the gross verified impacts are calculated in accordance with the 2012 TRM and zero demand reductions are credited to this measure.

Low-Income Energy Efficiency Program (LIEEP)

The LIEEP energy and demand realization rates were the result of in-service rates used in the verified savings analysis that were greater than deemed in the TRM. West Penn Power's program evaluator conducted telephone surveys and found that in-service rates ranged between 90% and 100%. Based on the survey results and relative contribution of each measure to the program savings, the program evaluator assumed an in-service rate of 1.0 for all measures.

Joint Utility Usage Management Program (JUUMP)

The energy savings realization rate of the JUUMP was 135% in PY4, largely explained by two factors. First, the reported per-job JUUMP savings (1,140 kWh) in PY4 was based on the Penelec PY3 WARM Plus verified savings for baseload and water heat jobs. The PY4 JUUMP evaluation consisted of a desk audit to determine savings for a random sample of 10 PY4 JUUMP participants. The desk audit included a review of project documentation, use of the TRM protocols, and adjustments to in-service rates based on quality assurance and quality control inspection contractors' reports. An average per-job savings was calculated based on the audit, and the result (2,208 kWh per job) was applied to the population.

The second factor was related to TRM in-service rate adjustments based on survey data collected through the evaluation. The program evaluator conducted telephone surveys of a sample of participants who received Low-Income, Low-Use, and Substitute Kits through JUUMP and found that in-service rates were higher than deemed in the TRM for several measures. Therefore the verified savings for these kits was greater than the reported savings.

Non-Residential

The energy realization rate of 84% for the Government and Institutional Program was low primarily due to the non-standard lighting – 1 and custom – 1 strata having realization rates of 76% and 81%, respectively, and accounting for a combined 59% of the program's total reported gross energy savings.

The demand realization rate of 116% for the C&I Equipment – Large program was the result of the non-standard lighting stratum having a realization rate of 118% and accounting for 59% of the program's total reported gross demand savings. While the reason for the relatively high realization rates for this stratum is not clear and can vary from project to project, potential sources for high realization rates for lighting generally include baseline equipment efficiencies, increased hours of use, or using a more efficient lighting technology than was originally planned. The evaluator did note that the biggest discrepancy between reported and verified demand savings was based on claimed versus logged hours of use and corresponding coincidence factor. That is, three shift facilities were claiming 7,000 to 8,000 hours of use yet only a CF of .77 or .80. Verified estimates found the CFs to be closer to 1.0 in those cases.

F.2 Audit Activity Detail: Residential Programs

F.2.1 Duquesne

F.2.1.1 Upstream Lighting

The SWE reviewed the data tracked in Duquesne's PMRS database and tracking system to confirm that the appropriate algorithms and protocols from the 2012 TRM were followed for the upstream lighting buy-down and giveaway programs. The SWE also reviewed and confirmed a selection of five invoices per quarter supplied with the tracking database to verify that they were assigned to the appropriate measure entries and that there were no invoice issues. The SWE found that Duquesne and the evaluation contractor used the correct algorithms, appropriate baseline assumptions, and final savings calculations.

F.2.1.2 Appliance Recycling

The SWE reviewed a total of 40 JACO Work Orders and their corresponding database entries in PY4 for the Appliance Recycling Program to verify consistency across the work orders and Duquesne's database as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the invoices and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

Many customers denoted on the JACO invoice that they would not be replacing their recycled appliance. However, for several of these customers, the savings in the Duquesne database reflected the reduced "replacement" kWh savings value instead of the full "non-replacement" value from the 2012 TRM. The SWE team has since learned from Duquesne that when the recycled appliance is considered by the customer to be the "primary" appliance, the evaluator assumes that appliance will be replaced and thus uses the reduced value regardless of whether the customer denotes they will be replacing it. The SWE agrees with this methodology and does not consider the differences found to be inconsistencies.

Additionally, the SWE found that one customer in PY4Q1 who denoted he would be replacing his recycled appliance was given the full savings value and not the reduced "replacement" kWh savings value. The SWE confirmed with Duquesne that this was a database error that was later corrected in PY4.

Lastly, the SWE found a customer in PY4Q3 who received rebates for two different recycled units, where one was replaced and the second was not replaced. Duquesne mistakenly used the full savings values for both units instead of the "replacement" value for the unit that was replaced.

F.2.1.3 Residential Energy Efficiency Program (REEP) – Rebate Program

The SWE reviewed a total of 40 REEP Rebate Applications and their corresponding database entries in PY4 for the Residential Energy Efficiency Program to verify consistency across the rebate applications and Duquesne's database as well as the appropriate use of deemed savings values from the 2012 TRM.

While most database entries were consistent with the rebate applications and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

Most measures rebated through Duquesne's program used the correct kWh and kW savings value from the 2012 TRM. However, several measures rebated including some models of ENERGY STAR Refrigerators, ENERGY STAR Freezers, ENERGY STAR Room Air Conditioners, and ENERGY STAR Dehumidifiers used a savings value not found in the TRM. The SWE has learned from Navigant, Duquesne's evaluator that these values are corrected in the "Verified Savings" by applying a realization rate to the program that modifies the total savings value for the program to be consistent with the TRM.

F.2.2 PECO

F.2.2.1 Smart Lighting Discounts Program

The SWE reviewed the data request response for residential lighting to confirm that the appropriate algorithms and protocols from the 2012 TRM were followed for the upstream lighting buy-down and giveaway programs. The SWE also reviewed and confirmed a selection of five invoices per quarter supplied with the tracking database to verify that they were assigned to the appropriate measure entries and that there were no invoice issues. While the data supplied was hard-entered with no logic, a parallel calculation confirmed that the EDC followed the appropriate TRM protocol. The SWE found that PECO and the evaluation contractor used the correct algorithms, appropriate baseline assumptions, and final savings calculations.

F.2.2.2 Appliance Recycling

The SWE reviewed a total of 40 JACO Work Orders and their corresponding database entries in PY4 for the Appliance Recycling Program to verify consistency across the work orders and PECO's database as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the invoices and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

In the 40 JACO Work Orders review, the SWE found three instances where customers denoted they would be replacing their recycled appliance on the JACO Work Order, but were given the full savings value and not the reduced "replacement" kWh savings value in PECO's database. One of these customers recycled two appliances and denoted that he would be replacing both of them. All three of these JACO order numbers are in the PECO database as not being replaced, which is why they got the higher savings numbers. This appears to be a data entry error.

F.2.2.3 Smart Home Rebates Program

The SWE reviewed a total of 40 Smart Home Rebate Applications and their corresponding database entries in PY4 for the Smart Homes Rebate Program to verify consistency across the rebate applications and PECO's database as well as the appropriate use of deemed savings values from the 2012 TRM. The database entries were consistent with the rebate applications and used the correct savings values.

F.2.3 PPL

F.2.3.1 Residential Lighting

The SWE reviewed the data request response to confirm that the appropriate algorithms and protocols from the 2012 TRM were followed for the upstream lighting buy-down and giveaway programs. The SWE also reviewed and confirmed a selection of five invoices per quarter supplied with the tracking database to verify that they were assigned to the appropriate measure entries and that there were no invoice issues. While the data supplied was hard-entered with no logic, a parallel calculation confirmed that the EDC followed the appropriate TRM protocol. The SWE found that PPL and the evaluation contractor used the correct algorithms, appropriate baseline assumptions, and final savings calculations.

F.2.3.2 Appliance Recycling

The SWE reviewed a total of 40 JACO Work Orders and their corresponding database entries in PY4 for the Appliance Recycling Program to verify consistency across the work orders and PPL's database as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the invoices and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

In the 40 JACO Work Orders review, the SWE found two instances where customers denoted they would be replacing their recycled appliance on the JACO Work Order, but were given the full savings value and not the reduced "replacement" kWh savings value in PECO's database. Additionally, the SWE found one instance where a customer denoted he would not be replacing his appliance, but was given the reduced "replacement" value. The SWE has learned from Cadmus, PPL's evaluator that Cadmus does not used the JACO records to determine whether the appliance was replaced. Instead, they use participant surveys to adjust replacement rates based on how participants responded to evaluator administered surveys. The SWE agrees with this methodology and does not consider the differences found to be inconsistencies.

F.2.3.3 Efficient Equipment Incentives Program

The SWE reviewed a total of 40 Efficient Equipment Incentives Program Rebate Applications and their corresponding database entries in PY4 for the Efficient Equipment Incentives Program to verify consistency across the rebate applications and PPL's database as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the rebate applications and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

Most measures rebated through PPL's program used the correct kWh/yr and kW savings value from the 2012 TRM. However, several measures rebated including some models of ENERGY STAR Refrigerators, ENERGY STAR Room Air Conditioners, and ENERGY STAR Printers used a savings value not found in the

TRM. The SWE has learned from Cadmus, PPL's evaluator that these values in the database are essentially "placeholders" that are trued-up in the "adjusted TRM *ex ante*" savings for the program.

F.2.4 FirstEnergy Companies (Met-Ed, Penelec, Penn Power, West Penn Power)

F.2.4.1 Residential Lighting

The SWE reviewed the data request response to confirm that the appropriate algorithms and protocols from the 2012 TRM were followed for the upstream lighting buy-down and giveaway programs. The SWE also reviewed and confirmed a selection of five invoices per quarter supplied with the tracking database to verify that they were assigned to the appropriate measure entries and that there were no invoice issues. The SWE found that an adjusted algorithm was initially used in order to incorporate a higher coincidence factor than suggested by the TRM language, producing higher demand savings than would be reported using the 5% CF in the TRM. A subsequent correction was made to all FirstEnergy calculations that were affected by the coincidence factor, and savings estimates were resubmitted using the correct algorithms. The SWE acknowledged the opinion of FirstEnergy in using the adjusted coincidence factor and that the savings would be reported for both scenarios in the final PY4 reports.

F.2.4.2 Appliance Turn-In Program

The SWE reviewed 40 JACO Work Orders and their corresponding database entries in PY4 for each of the FirstEnergy Companies' Appliance Turn-In Programs (160 total) to verify consistency across the work orders and FirstEnergy's databases as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the invoices and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

In the 160 JACO Work Orders review, the SWE found several instances where customers denoted they would be replacing their recycled appliance on the JACO Work Order, but were given the full savings value and not the reduced "replacement" kWh savings value in the corresponding database. Additionally, the SWE found a few instances where a customer denoted he would not be replacing his appliance, but was given the reduced "replacement" value. The SWE has learned from ADM, FirstEnergy's evaluator that ADM does not used the JACO records to determine whether or not the appliance was replaced. Instead they use participant surveys to adjust replacement rates based on how participants responded to evaluator administered surveys. The SWE agrees with this methodology and does not consider the differences found to be inconsistencies.

F.2.4.3 Energy Efficient Products

The SWE reviewed 40 Efficient Equipment Products Program Rebate Applications and their corresponding database entries in PY4 for each of the FirstEnergy Companies' Appliance Turn-In Programs (160 total) for the Efficient Equipment Products Program to verify consistency across the rebate applications and FirstEnergy's database as well as the appropriate use of deemed savings values from the 2012 TRM. While most database entries were consistent with the rebate applications and used the correct savings value, the SWE found a few irregularities in this audit. Their findings were as follows.

Most measures rebated through FirstEnergy's program used the correct kWh and kW savings value from the 2012 TRM. However, several measures rebated including some models of ENERGY STAR Refrigerators and ENERGY STAR Clothes Washers used a savings value not found in the TRM. The SWE has learned from ADM, FirstEnergy's evaluator that these values in the database are essentially "placeholders" that are trued-up in the "adjusted TRM *ex ante*" savings for the program.

F.2.4.4 New Construction

The following sections discuss the SWE's PY4 audit of the residential new constructions programs for Met-Ed, Penelec, and Penn Power. West Penn Power did not implement a residential new construction program in Phase I. Appendix B, section B.2.2.4, of this report discusses the general process used for the residential new construction audit.

F.2.4.4.1 Met-Ed

Met-Ed's Residential New Construction Program contributed 0.23% to total portfolio gross reported savings in PY4. Met-Ed's evaluator used stratified random sampling with four strata to evaluate the program. The SWE selected a sample of the evaluator's sample for its own desktop review, shown below in Table F-8.

Table F-8: PY4 Met-Ed Evaluator and SWE Residential New Construction Samples

Stratum	Evaluator Sample	SWE Sample
1 (highest kWh)	1	1
2	3	2
3	9	3
4 (lowest kWh)	9	3

The SWE found no issues in its sample of homes during the REM/Rate and Demand Savings Verification portions of the review. The SWE was additionally able to confirm that the homes were built by viewing builder certificates. The SWE did, however, find some issues in the Appliance and Lighting Savings Verification portion of its review.

The ex-ante savings reported by the implementer for this program were not consistent with TRM protocols. The TRM states that savings associated with non-weather-sensitive measures, such as appliances and lighting, should be a function of TRM algorithms, whereas the implementer reported savings as direct outputs from REM/Rate. Therefore, Met-Ed's evaluator had to subtract the appliance and lighting savings portion from the total REM/Rate savings and then add back the TRM estimated savings for appliances and lighting to achieve savings estimates consistent with the TRM.

For each home in the SWE sample in strata 3 and 4, the incorrect amount of savings was subtracted from total REM/Rate savings. The amount of savings subtracted should be the "Lights and Appliances" savings from the "REMRate QA Report" in the project documentation for each home. The SWE made adjustments to each home to correct the amount of savings subtracted, which resulted in a change in the overall program realization rate from 152% to 147%. As the total program savings is very small, the SWE did not feel a change in the reported program savings was warranted. However, Met-Ed's evaluator should ensure that this calculation is performed correctly in future years of Act 129.

F.2.4.4.2 Penelec

Penelec's Residential New Construction Program contributed less than 0.01% to total portfolio gross reported savings in PY4. Due to the low impact of the program, the SWE performed a desktop review of the evaluator's analysis for estimating verified savings. As there were only seven participants in the program for PY4 and the impacts of the program were extremely small, Penelec's evaluator only performed a REM/Rate model review for the sampled home and found no changes necessary. The SWE found this approach acceptable because of the small impact of the program. The SWE found no errors in the evaluator's analysis.

F.2.4.4.3 Penn Power

Penn Power's Residential New Construction Program contributed 0.18% to total portfolio gross reported savings in PY4. The evaluator used stratified random sampling with three strata to evaluate the program. Each stratum included two homes, for a total of six homes in the Penn Power evaluator's sample. The SWE reviewed the evaluator's analysis for each of these homes and performed its own review.

The SWE found no issues in its sample of homes during the REM/Rate and Demand Savings Verification portions of the review. The SWE was additionally able to confirm that the homes were built by viewing builder certificates. The SWE did, however, find one issue in the Appliance and Lighting Savings Verification portion of its review.

The ex-ante savings reported by the implementer for this program were not consistent with TRM protocols. The TRM states that savings associated with non-weather-sensitive measures, such as appliances and lighting, should be a function of TRM algorithms, whereas the implementer reported savings as direct outputs from REM/Rate. Therefore, Penn Power's evaluator had to subtract the appliance and lighting savings portion from the total REM/Rate savings and then add back the TRM estimated savings for appliances and lighting to achieve savings estimates consistent with the TRM.

For one home in the sample, there was an Excel formula error which caused the incorrect amount of savings to be subtracted from the total REM/Rate savings. The SWE corrected this error in its analysis, leading to a change in the program-level realization rate from 179% to 196%. As the total program savings is very small, the SWE did not feel a change in the reported program savings was warranted. However, Penn Power's evaluator should ensure that this calculation is performed correctly in future years of Act 129.

F.3 Audit Activity Detail: Low-Income Programs

F.3.1 Duquesne

Table F-9 shows the reported Low-Income Energy Efficiency Program (LIEEP) energy and demand savings as presented in Duquesne's annual report.[542] Also shown are the combined results of the quarterly program database extracts ("Database") that were submitted to the SWE following the close of each quarter. The difference between the annual report and the combined program database extracts is shown in the third row, as "Variance." Note that variance does not necessarily indicate inadequate quality assurance or quality control (QA/QC) or incorrect reported savings. Quarterly program tracking is a continuous process that is subject to adjustments after the SWE receives the quarterly database snapshots.

Table F-9: Duquesne PY4 LIEEP Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	3,891	0.274
Database	3,748	0.262
Variance	143	0.012

Duquesne explained that the variance was largely related to the fact that the low-income savings associated with the School Energy Pledge (SEP) program was omitted from the quarterly reporting, which accounted for 134 MWh and 0.0038 MW of the variance. The SWE requested the database extract for SEP to confirm the source of the variance. In addition, the reported savings for one of the kits distributed through LIEEP was adjusted at the conclusion of PY4 to reflect the actual measures contained in the kit and the 2012 TRM savings for all kits measures.

The SWE confirmed that all verified savings measure calculations were in accordance with the 2012 TRM. Duquesne adjusted in-service rates for some measures based on participant survey data. The SWE found that the in-service rate adjustments, per measure savings, and participant data all supported the LIEEP verified energy and demand savings presented in Duquesne's annual report.[543]

Duquesne used a local, third-party contractor to conduct site inspections of PY4 LIEEP installations. The SWE provided a site inspection report template for use by Duquesne's third-party contractor that

[542] The values in this table do not include the 20.4 percent of bulbs sold to low-income customers through the Upstream Lighting program. The percentage of upstream light bulbs sold to low-income customers was determined through telephone surveys, as described in Duquesne's Annual Report.

[543] For PY4, verification rates of 55% for energy and 67% for demand reduction for SEP were based on verification rates for PY3. No additional field verification was completed in PY4 due to consistency in verification rates between PY2 and PY3, the fact that no changes were made to this program in PY4, and because the savings and budgets for this portion of LIEEP are small.

outlined the data the SWE wanted collected during the site inspections. The data collected included the following:

- Quantity of reported measures installed and operational
- Location of CFLs
- Whether or not LED nightlights replaced incandescent nightlights
- Equipment plugged into smart strip plug outlets and whether the smart strips were installed in any energy saving configuration
- Confirmation that the old refrigerator had been removed, for those customers who received a refrigerator replacement

Duquesne's third-party contractor conducted 47 site inspections of PY4 LIEEP installations. The most significant findings of the sites inspections were as follows:

- All refrigerator removal and replacements were completed as reported.
- 59% of the reported CFLs were installed and operational at the time of the site inspections; 74% of the uninstalled CFLs were being held as spares by participants because eligible sockets already had CFLs installed.[544] The percentage of CFLs in storage reflects the increasing saturation of CFLs.
- 67% of inspected LED nightlights were installed. Of the LED nightlights installed, 45% replaced incandescent nightlights.
- 92% of inspected smart power strips were installed, and 46% were installed in an energy saving configuration.[545]

The SWE noted that installation rates for CFLs, LED nightlights, and smart power strips, as determined from Duquesne's third-party inspection contractor reports, were lower than found by Duquesne's program evaluator via telephone surveys. The SWE recommends that the program evaluator consider leveraging the results of the third-party inspection contractor reports for future evaluations, as this would expand the number of data points used for the evaluation and reduce any effects of response bias that may exist in telephone surveys. The SWE also recommends that future evaluations should account for whether LED nightlights are replacing incandescent nightlights or participants are installing LED nightlights as incremental energy-consuming measures.

Lastly, the SWE requested that Duquesne provide the list of measures offered in PY4 across all sectors and that Duquesne identify those measures that are counted toward the Act 129 requirement that the

[544] The exception was one participant who reported that the CFLs were being kept as spares until the existing incandescent bulbs burned out.

[545] Smart power strips are equipped with a "master" outlet, "control" outlets, and "always-on" outlets. Many electronics continue to draw power even when off, and therefore the smart power strip is intended to turn off electronics plugged into the control outlets when the power draw from the master outlet is reduced by a fixed percentage. Non-energy-efficient use of the smart strips occurs when participants plug equipment into the always-on outlets and do not use the control outlets.

number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Duquesne's service territory. The SWE reviewed the measure list and verified that Duquesne offered eight types of measures to the low-income sector in PY4, which is 15.7% of the total number of measures offered across all sectors and exceeds Duquesne's Act 129 requirement for proportion of measures offered, which is 7.88%.

F.3.2 PECO

The SWE reviewed PECO's PY4 annual report and quarterly reports and compared the reported Low-Income Energy Efficiency Program (LEEP) savings in the respective reports to the quarterly program tracking database extracts. The SWE confirmed that, as shown in Table F-10, all reported savings and participant counts were consistent with the quarterly program database extracts.

Table F-10: PECO PY4 LEEP Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	10,106	1.6
Database	10,106	1.6
Variance	0	0.0

PECO's evaluation of LEEP Component 1[546] consisted of a statistical billing analysis, which used a four-year rolling average of LIURP and LEEP data to calculate verified energy savings. Consistent with PECO's custom measure protocol (CMP), PECO's evaluator updated the four-year rolling average to include the results of PY1 and PY2 LEEP billing analyses and the 2008 and 2009 LIURP analyses. The PY2 LEEP billing analysis included 7,279 participants, which represented 83% of the PY2 Component 1 participants.

Verified savings for extra CFLs provided as part of LEEP Component 1 were evaluated using the TRM protocol for CFLs. Components 2 and 3 of PECO's low-income program also provided CFLs to customers. PECO provided verified savings for Components 2 and 3 using two different methods. The first method used the TRM protocol for CFLs. The second method used an alternative demand coincidence factor of 11.7% and included a lighting interactive effects factor for energy (1.02) and demand (1.19). The SWE replicated the verified savings calculations using the quarterly program database extracts, the TRM CFL protocol, and the proposed alternative values to confirm that the verified savings for both methodologies were accurate. Finally, the SWE confirmed that the Component 4 tracking database extracts and the TRM savings for refrigerator/freezer replacement were consistent with the Component 4 verified energy and demand impacts.

The SWE conducted 38 site inspections of PY4 LEEP installations. Site inspections were conducted quarterly for a random sample of installations and consisted of the following activities:

[546] Component 1 includes in-home audits, education, and direct install measures. See PECO PY4 Report, p. 75, for description of various program components.

- Verification of measure installation and operability
- Confirmation that all measures were accurately invoiced and reported in the PECO LEEP program database extract
- Inspection for missed opportunities
- Affirmation that Component 1 participants were assigned the proper job type based on site inspection findings and invoices

Following the quarterly site inspections, the SWE issued a report to PECO that presented the findings, recommendations, and commendations from the site inspections. The most significant findings of the site inspections were as follows:

- The SWE found that most measures are being installed by PECO's CSP and that eligible opportunities are being addressed by auditors.
- There were a small number of cases where measures were left with participants rather than installed by the auditor. There was also an instance where measures were installed in an unsafe location. PECO's CSP addressed these issues by providing refresher training for auditors and emphasizing with them the importance of not leaving measures with participants.
- Several participants reported buying additional CFLs following the audit and/or had CFLs in all possible sockets. This finding reflects the increasing saturation of CFLs and that the program is having a positive impact on energy consumption habits.

Based on the site inspection findings and a review of PECO's program database extract, all Component 1 job types were properly recorded. The SWE found one instance where the CFL savings for one participant was incorrectly calculated due to a tracking error.[547] The error was corrected by PECO.

The SWE requested that PECO provide the list of measures offered in PY4 across all sectors and that PECO identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in PECO's service territory. The SWE reviewed the measure list and verified that PECO offered 17 types of measures to the low-income sector in PY4, which is 14% of the total number of measures offered across all sectors and exceeds PECO's Act 129 requirement for proportion of measures offered, which is 8.05%.[548]

[547] During the database and invoice reconciliation, the SWE noted that one participant had 12 CFLs that were characterized as "< = 4."According to PECO's LEEP custom measure protocol, "the LIURP billing analysis data can only be extended to the LEEP program energy savings from the first 4 CFL's installed. For participants that are given more than 4 CFLs as part of Component 1 or Component 2, or given any CFLs as part of Component 3, the deemed savings for these CFLs will be based on the PA TRM." Therefore, 8 of the 12 CFLs' savings should have been reported using the PA TRM, but instead 0 were.

[548] PECO stated that its Act 129 proportion of measures target is 3.1%, which is incorrect. The target is 8.05% for Phase I of Act 129.

F.3.3 PPL

PPL's Act 129 Winter Relief Assistance Program (WRAP) is an extension of WRAP offered by PPL through its LIURP program since 1985. As shown in Table F-11, the SWE confirmed that Act 129 WRAP participant counts, and verified savings by job type in the quarterly database extracts, were consistent with the counts and savings reported in PPL's PY4 annual report.

Table F-11: PPL PY4 WRAP Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	6,911	0.01
Database	6,911	0.01
Variance	0	0.00

Act 129 WRAP savings are deemed by job type (baseload, low cost, and full cost) based on savings evaluated and reported by The Pennsylvania State University's Consumer Service Information System project. The Act 129 WRAP savings deemed for a given program year by job type is based on the most recent PA PUC-approved savings. In PY4 Q4, new estimates were provided by Penn State, which were to be used as the deemed values for PY4 Act 129 WRAP installations. However, PPL noted that the new estimates differed significantly from the previous year's estimates and requested that PPL's EM&V CSP produce comparison estimates. According to PPL's PY4 annual report, the differences between the EM&V CSP and Penn State estimates were "quite different." It was discovered that Penn State does not weather-normalize the customer usage data it receives from the EDCs and instead each utility is expected to provide weather-normalized customer usage data to Penn State. PPL decided to use the estimates provided by the EM&V CSP for the following reasons:

- The weather-normalization methodology produced results that more accurately reflect the effect that differences from normal weather have on load.
- The EM&V CSP's estimates have less year-to-year variation.
- The EM&V CSP's approach is consistent with *Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project.*[549]

It should be noted that the PY4 deemed savings for all job types decreased relative to PY3 deemed savings.

The SWE used the quarterly database extracts to confirm that the Act 129 WRAP-verified energy and demand impacts, as reported in PPL's annual report, were consistent with participant counts by job type, job installation dates, and verified savings by job type and program year. The SWE also took into

[549] Ken Agnew and M. Goldberg. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol.* U.S. Department of Energy, National Renewable Energy Laboratory. April 2013. (NREL/SR-7A30-53827) Available at www1.eere.energy.gov/office_eere/de_ump_protocols.html.

account the ex-post adjustments made by PPL's program evaluator to account for job installations entered into the program tracking database more than once.[550] The SWE found that the quarterly database extracts and ex-post adjustments were consistent with the verified energy and demand impacts reported in PPL's annual report.

PPL's third-party inspection contractor conducted 689 site inspections of Act 129 WRAP installations reported in PY4, from which the SWE selected a sample of 39 reports for review. PY4 WRAP savings are deemed by job type based on a billing analysis of participants in prior program years. Therefore, the SWE reviewed the audit forms and site reports to verify that the correct job type had been assigned in the participant database extract based on the comprehensiveness of measures installed, space heating fuel, and/or domestic hot water heating fuel. The SWE also reviewed the site inspection forms to ensure that all measures were being installed by contractors. Based on the SWE's review, contractors were installing measures appropriately and the measures and job types were being accurately recorded in PPL's program tracking database.

PPL's E-Power Wise program provides low-income customers with kits containing basic measures such as CFLs, faucet aerators, low-flow showerheads, and LED nightlights. The SWE reviewed the program quarterly database extracts and compared the data to the savings and participation reported in PPL's annual report. As shown in Table F-12, the SWE found no discrepancies between the two sources related to participation or ex-ante savings.

Table F-12: PPL PY4 E-Power Wise Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	1,454	0.01
Database	1,454	0.01
Variance	0	0.00

The adjusted ex-ante savings[551] were also verified to be consistent with the 2012 TRM and PPL-reported data regarding electric water heater saturation and flow rates of faucet aerators and showerheads distributed in the E-Power Wise kits. PPL's program evaluator ex-post adjustments included database reviews to ensure that only one kit was counted per household, and participant surveys to determine measure and delivery channel in-service rates. The ex-post adjustments made by PPL's program evaluator were appropriate, and the SWE replicated the ex-post savings calculations to confirm that the verified E-Power Wise energy and demand savings were accurate.

[550] Program installations for some sites required multiple visits from installation contractors and were recorded as separate jobs in the program tracking database. PPL's program evaluator adjusted the counts per job type so that single sites (physical location) were not counted more than once.

[551] PPL adjusts its ex-ante savings at the conclusion of the program year to account for differences among planning assumptions, the TRM assumptions, and equipment that was actually distributed to participants.

Lastly, the SWE requested that PPL provide the list of measures offered in PY4 across all sectors and that PPL identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in PPL's service territory. The SWE reviewed the measure list and verified that PPL offered 52 types of measures to the low-income sector in PY4, which is 37% of the total number of measures offered across all sectors and exceeds PPL's Act 129 requirement for proportion of measures offered, which is 8.64%.[552]

F.3.4 Met-Ed

Met-Ed's Act 129 WARM Program is an extension of LIURP and supports an increase in the number of income-eligible homes receiving comprehensive measures such as appliances, high-efficiency lighting, and weatherization. The evaluation approach for this program is a statistical billing analysis based on job type.[553]

Met-Ed's WARM Extra Measures program had active participation in PY4. This program provides WARM Program participants with additional electricity-saving measures, including CFLs, LED nightlights, furnace whistles, and smart power strips. The PY4 energy savings for the WARM Extra Measures program were calculated based on 2012 TRM algorithms.

Table F-13 shows the reported WARM Program energy and demand savings as presented in Met-Ed's annual report. It also shows the combined results of the quarterly program database extracts that were submitted to the SWE following the close of each quarter. The difference between the annual report and the combined program database extracts is presented in the third row, as "Variance." Note that variance does not necessarily indicate inadequate QA/QC or incorrect reported savings. Quarterly program tracking is a continuous process that is subject to adjustments after the SWE receives the quarterly database snapshots.

Table F-13: Met-Ed WARM Programs Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	674	0.28
Database	1,171	0.27
Variance	-497	0.01

[552] PECO stated that its Act 129 proportion of measures target is 3.1%, which is incorrect. The target is 8.05% for Phase I of Act 129.

[553] The three job types used by Met-Ed are as follows: electric heat jobs that involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters; and electric baseload jobs, which may include refrigerator/freezer replacement and lighting retrofits.

Met-Ed's program evaluator explained that the variance is explained by the fact that the WARM Plus per-job savings values were retroactively updated in PY4 Q4 for all PY4 participants based on the most recent evaluation results available at the time. The updated savings values were significantly lower than the old LIURP billing analysis results used in the database extracts for the first three quarters of PY4. For example, the reported savings for a space heat job entered in the PY4 Q2 program database extract was 3,329 kWh, but the reported savings for this job was updated to 1,650 kWh in PY4 Q4 based on the PY3 WARM Plus verified savings per job type. The SWE reviewed an updated PY4 database extract with all retroactive adjustments and confirmed that the change in per-job savings was the source of the difference between Met-Ed's annual report and the combined quarterly database extracts.

Met-Ed provided a summary workbook detailing WARM Plus billing analysis results for PY4 installations and WARM Plus PY4 participant tracking data. Met-Ed's program evaluator conducted a statistical billing analysis to determine PY4 WARM Plus impacts using a "difference in differences" approach, which consisted of analyzing the difference in relative energy impacts of treatment and control groups. It should be noted that, while three job types are defined for the WARM Plus program, there were not enough participants for each job type to provide statistically robust results differentiated by job type. Therefore, a single verified per-job savings value was used for all PY4 WARM Plus participants. The SWE confirmed that the per-job verified savings and participant database extracts supported the WARM Plus verified savings as reported in Met-Ed's annual report.

Met-Ed, as part of its annual data request to the SWE, also provided verified per-measure savings for WARM Extra Measures and WARM Extra Measures tracking data. Met-Ed's program evaluator made adjustments to the TRM measure in-service rates based on installation data obtain from a random sample of program QA/QC inspectors' reports. The SWE confirmed that all per-measure and program WARM Extra Measures verified savings were consistent with the appropriate TRM protocols, updated in-service rates, and the program tracking data.[554]

In addition to program tracking data, Met-Ed provided a sample of 10 third-party inspection contractor reports quarterly (total of 40 reports in PY4) to the SWE for review. These reports consisted of a mix of WARM Plus and WARM Extra Measures installations. For WARM Plus installations, the SWE reviewed invoices, project documentation, and site reports to verify that the correct job type had been assigned in the participant database extract. WARM Plus job types are based on the comprehensiveness of measures installed, space heating fuel, and/or domestic hot water heating fuel. For both WARM Plus and WARM Extra Measures the SWE reviewed the site inspection forms to ensure that all measures were being installed by contractors. Based on the SWE's review, contractors were installing measures appropriately, and the measures and job types were being accurately recorded in Met-Ed's program tracking database. In addition, the SWE found that the in-service rates used by the program evaluator

[554] The one exception was furnace whistle savings, which used the Pittsburgh region for the deemed savings. However, the SWE notes that the Pittsburgh region has the lowest deemed savings of any region and thus savings are conservative. Also, the differences in deemed savings by region are at most 8 kWh, and furnace whistles only account for 0.3% of Met-Ed's WARM Program savings.

for the WARM Extra Measures program were supported by the installation data in the reports reviewed by the SWE.

Lastly, the SWE requested that Met-Ed provide the list of measures offered in PY4 across all sectors and that Met-Ed identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Met-Ed's service territory. The SWE reviewed the measure list and verified that Met-Ed offered seven types of measures to the low-income sector in PY4, which is 17.1% of the total number of measures offered across all sectors and exceeds Met Ed's Act 129 requirement for proportion of measures offered, which is 7.84%.[555]

F.3.5 Penelec

Penelec's Act 129 WARM Program is an extension of LIURP and supports an increase in the number of income-eligible homes receiving comprehensive measures such as appliances, high-efficiency lighting, and weatherization. The evaluation approach for this program is a statistical billing analysis based on job type.[556]

Penelec's WARM Extra Measures program had active participation in PY4. This program provides WARM Program participants with additional electricity-saving measures, including CFLs, LED nigh lights, furnace whistles, and smart power strips. The PY4 energy savings for the WARM Extra Measures program were calculated based on 2012 TRM algorithms.

Table F-14 provides the reported WARM Program energy and demand savings as presented in Penelec's annual report. It also shows the combined results of the quarterly program database extracts that were submitted to the SWE following the close of each quarter. The difference between the annual report and the combined program database extracts is presented in the third row, as "Variance." Note that variance does not necessarily indicate inadequate QA/QC or incorrect reported savings. Quarterly program tracking is a continuous process that is subject to adjustments after the SWE receives the quarterly database snapshots.

Table F-14: Penelec PY4 WARM Programs Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	1,223	0.33
Database	1,506	0.30

[555] Met-Ed stated that its Act 129 proportion of measures target is 8.8%, which is incorrect. The target is 7.84% for Phase I of Act 129.

[556] The three job types used by Penelec are as follows: electric heat jobs that involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric baseload jobs, which may include refrigerator/freezer replacement and lighting retrofits.

Variance	-283	0.03

Penelec's program evaluator explained that the variance is explained by the fact that the WARM Plus per-job savings values were retroactively updated in PY4 Q4 for all PY4 participants based on the most recent evaluation results at the time. The updated savings values were lower for space heat and water heat jobs as compared with the old LIURP billing analysis results used in the database extracts for the first three quarters of PY4. For example, the reported savings for a space heat job entered in the PY4 Q2 program database extract was 2,554 kWh, but the reported savings for this job was updated to 1,514 kWh in PY4 Q4 based on the PY3 WARM Plus verified savings per job type. The SWE reviewed an updated PY4 database extract with all retroactive adjustments and confirmed that the change in per-job savings was the source of the difference between Penelec's annual report and the combined quarterly database extracts.

Penelec provided a summary workbook detailing WARM Plus billing analysis results for PY4 installations and WARM Plus PY4 participant tracking data. Penelec's program evaluator conducted a statistical billing analysis to determine PY4 WARM Plus impacts using a "difference in differences" approach, which consisted of analyzing the difference in relative energy impacts of treatment and control groups. It should be noted that, while three job types are defined for the WARM Plus program, there were not enough participants for each job type to provide statistically robust results differentiated by job type. Therefore, a single verified per-job savings value was used for all PY4 WARM Plus participants. The SWE confirmed that the per-job verified savings and participant database extracts supported the WARM Plus verified savings as reported in Penelec's annual report.

Penelec, as part of its annual data request to the SWE, also provided verified per-measure savings for WARM Extra Measures and WARM Extra Measures tracking data. Penelec's program evaluator made adjustments to the TRM measure in-service rates based on installation data obtain from a random sample of program QA/QC inspectors' reports. The SWE confirmed that all per-measure and program WARM Extra Measures verified savings were consistent with the appropriate TRM protocols, updated in-service rates, and the program tracking data.[557]

In addition to program tracking data, Penelec provided a sample of 10 third-party inspection contractor reports quarterly (40 total reports) to the SWE for review. The inspection reports consisted of a mix of WARM Plus and WARM Extra Measures installations. For WARM Plus installations, the SWE reviewed invoices, project documentation, and site reports to verify that the correct job type had been assigned in the participant database extract. WARM Plus job types are based on the comprehensiveness of measures installed, space heating fuel, and/or domestic hot water heating fuel. For both WARM Plus and WARM Extra Measures the SWE reviewed the site inspection forms to ensure that all measures

[557] The one exception for a portion of the projects was furnace whistle savings, which used the Pittsburgh region for the deemed savings. However, the SWE notes that the Pittsburgh region has the lowest deemed savings of any region and thus savings are conservative. Also, the differences in deemed savings by region are at most 8 kWh, and furnace whistles only account for 1.4% of Penelec's WARM Program savings.

were being installed by contractors. Based on the SWE's review, contractors were installing measures appropriately, and the measures and job types were being accurately recorded in Penelec's program tracking database. In addition, the SWE found that the in-service rates used by the program evaluator for the WARM Extra Measures program were supported by the installation data in the reports reviewed by the SWE.

Lastly, the SWE requested that Penelec provide the list of measures offered in PY4 across all sectors and that Penelec identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Penelec's service territory. The SWE reviewed the measure list and verified that Penelec offered seven types of measures to the low-income sector in PY4, which is 17.1% of the total number of measures offered across all sectors and exceeds Penelec's Act 129 requirement for proportion of measures offered, which is 9.51%.[558]

F.3.6 Penn Power

Penn Power's WARM Plus and WARM Extra Measures programs were closed in January 2012 and March 2012, respectively, because the programs had exceeded their EE&C Plan targets and there were minimal funds remaining in the budget for these programs. Therefore, there was no participation or savings associated with Penn Power's low-income programs in PY4.

The SWE requested that Penn Power provide the list of measures offered in PY4 across all sectors and that Penn Power identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Penn Power's service territory. The SWE reviewed the measure list, which indicated that Penn Power offered seven types of measures to the low-income sector in PY4 through the WARM Program. This appears to be incorrect since the WARM Program was closed in PY4. However, the SWE has verified in the past that Penn Power offered seven measure types in its EE&C plan to the low-income sector through the WARM Program before the program met its goals and closed. The seven measure types offered to the low-income sector accounted for 17.1% of the total number of measures offered across all sectors, which exceeds Penn Power's Act 129 requirement for proportion of measures offered, which is 8.16%.[559]

F.3.7 West Penn Power

West Penn Power's Limited-Income Energy Efficiency Program (LIEEP) and Joint Utility Usage Management Program (JUUMP) are an expansion of the existing Low-Income Usage Reduction Program (LIURP) offered outside Act 129. Several subprograms were offered under the program banner JUUMP. The JUUMP programs offered in PY4 with active participation were JUUMP, the Low-Income, Low Use

[558] Penelec stated that its Act 129 proportion of measures target is 10.2%, which is incorrect. The target is 9.51% for Phase I of Act 129.
[559] Penn Power stated that its Act 129 proportion of measures target is 10.6%, which is incorrect. The target is 8.16% for Phase I of Act 129.

program (LILU), Substitute Kits, WARM Plus, and WARM Extra Measures. It should be noted that LIEEP closed in July 2012 and that JUUMP closed in February 2013 once funding for the respective programs was depleted.

Table F-15 and Table F-16, respectively, provide the reported LIEEP and JUUMP energy and demand savings as presented in West Penn Power's annual report. They also show the combined results of the quarterly program database extracts that were submitted to the SWE following the close of each quarter. The difference between the annual report and the combined program database extracts is presented in the third row, as "Variance." Note that variance does not necessarily indicate inadequate QA/QC or incorrect reported savings. Quarterly program tracking is a continuous process that is subject to adjustments after the SWE receives the quarterly database snapshots.

Table F-15: West Penn Power PY4 LIEEP Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	522	0.07
Database	682	0.07
Variance	-160	0.00

Table F-16: West Penn Power PY4 JUUMP Reported Savings Summary, Database Summary, and Variance between the Two Sources

	MWh Impact	MW Impact
Annual Report	2,362	0.46
Database	2,478	0.24
Variance	-116	0.22

West Penn Power's program evaluator explained to the SWE that the discrepancy between the reported LIEEP energy savings and the program database extract was the result of a tracking error in PY4 Q1. The SWE noted that 203 fewer participants were reported in West Penn's annual report than in the quarterly database extracts. The source of this discrepancy may be related to the fact that the quarterly database extracts were based on 2011 TRM assumptions, which were likely updated to 2012 TRM assumptions at the conclusion of PY4 to calculate the annual reported savings. For example, the baseline used in the quarterly database extracts for 21- to 25-watt CFLs was 100 watts, but the baseline for this measure changed in the 2012 TRM from 100 watts to 72 watts.

The program evaluator's LIEEP evaluation consisted of using TRM algorithms and adjusting in-service rates based on the results of telephone surveys of program participants. The survey results indicated that in-service rates for all measures were between 0.9 and 1.0. Ultimately, based on the in-service rate data and relative contribution of savings of each measure to the program savings, the program evaluator assumed an in-service rate of 1.0 for all measures. The SWE found that applying the in-service rates determined through the surveys rather than assuming 1.0 for all measures would result in a 1%

reduction in program savings. Given the fact that applying the in-service rates requires little additional effort, the SWE recommends applying the actual per-measure in-service rates determined through surveys in future evaluations. Otherwise, the SWE verified that all program tracking data, TRM protocols, and verified program impacts were consistent.

JUUMP, in addition to basic measures such as CFLs, distributes more comprehensive measures such as insulation and infiltration. West Penn Power used a single per-job savings value to report savings for JUUMP participants. The program evaluator's JUUMP verified savings analysis consisted of a records review of 10 QA/QC inspection contractor reports to calculate installation rates of various measures. TRM protocols, the installation rates, and data specific to each job were used to determine an average per-installation savings estimate of the 10 installations reviewed, which was subsequently applied to the program population to calculate program verified savings. The SWE reviewed the program evaluator's assumptions and verified savings calculations and found no errors.

West Penn Power distributed LILU and Substitute Kits to customers who do not meet the minimum 600 kWh/month to qualify for the LIURP/WARM Program. The kits provide CFLs, furnace whistles, LED nightlights, and smart power strips. The SWE verified that all verified savings for LIURP and Substitute Kits were calculated in accordance with the 2012 TRM. The one variable adjusted by West Penn Power's program evaluator was the in-service rates for all measures other than CFLs. The adjustments were based on the results of telephone surveys of 30 program participants. The SWE confirmed that the verified savings per kit and program tracking data were consistent with the verified impacts listed in West Penn Power's annual report for this portion of JUUMP.

Also offered under JUUMP was the WARM Plus program. The program evaluator was unable to complete a statistical billing analysis of this program in PY4 because the program was first offered in PY4 and at least one year's worth of energy consumption data is needed for the analysis. Therefore, the reported savings were passed through as verified savings. The program evaluator noted that the reported estimates are reasonable, though lower than the recent analyses for the Met-Ed and Penelec WARM Plus programs. The SWE verified that participant data and per-job savings were consistent with the verified savings for WARM Plus.

At the SWE's request, West Penn Power provided a sample of third-party inspection contractor reports for the SWE's review. These reports contained data about whether program measures were installed and operational. Eighteen site inspection reports were reviewed by the SWE, which is less than prior years due to the programs being closed for a portion of the year. The SWE reviewed the site inspection forms to ensure that all measures were being installed by contractors. It was found that contractors were generally installing measures appropriately and that the measures and job types were being accurately recorded in West Penn Power's program tracking database. The SWE did find a few instances where measures were reportedly removed by participants. Overall, the SWE's review of the site inspection reports supported the in-service rates used by the program evaluator in the verified savings analysis.

Lastly, the SWE requested that West Penn Power provide the list of measures offered in PY4 across all sectors and that West Penn Power identify those measures that are counted toward the Act 129 requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in West Penn Power's service territory. The SWE reviewed the measure list and verified that West Penn Power offered 10 types of measures to the low-income sector in PY4, which is 23.8% of the total number of measures offered across all sectors= and exceeds West Penn Power's Act 129 requirement for proportion of measures offered, which is 9.7%.[560]

[560] West Penn Power stated that its Act 129 proportion of measures target is 9.7%, which is incorrect. The target is 8.50% for Phase I of Act 129.

F.4 Audit Activity Detail: Non-Residential Programs

F.4.1 Duquesne

This section contains details on the SWE's audit of Duquesne's PY4 non-residential programs.

F.4.1.1 Site Inspection Findings

Table F-17 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of Duquesne non-residential project installations. Details about the SWE site inspection process can be found in Appendix B, section B.2.2.6.2.

The Duquesne PY4 site inspection findings are categorized in two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table F-17: Duquesne PY4 Non-Residential Site Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
DLC-401	VFDs, HVAC optimization, ventilation controls, de-icing warm weather shutdown	RA	The evaluator's verified savings analysis weather-normalized the pre- and post-retrofit facility energy consumption for summer months only (June through September), although the SWE found that the correlation was much stronger when June through December consumption was weather-normalized (June through December used because a full year of post-retrofit data was unavailable). While the June through December R squared was marginal for the three years (ranging from 0.66 to 0.78), there was a non-negligible difference in savings when the consumption was weather-normalized versus not weather-normalized. Year-round weather dependence is also consistent with engineering assumptions about the facility and measures included in the project scope. The SWE also noted that the 2012 outdoor temperature was significantly milder than the two pre-retrofit data years and the 15-year average and thus not weather-normalizing would understate the project impact.	Eval	The evaluator revised the verified savings analysis to weather-normalize the data for pre-retrofit and post-retrofit months of June through December and applied the regression equations to the entire year of pre- and post-retrofit data.
			The evaluator used a simple average demand during all summer hours to determine the project's peak demand impact rather than the demand during the top 100 hours of system peak demand.	Eval	The evaluator revised the verified peak demand impact to reflect the project's impact during the top 100 hours of 2012 system peak demand.
DLC-402	High-speed overhead doors	RA	A portion of the evaluator's analysis was not consistent with the site contact's interview results regarding equipment operation.	Eval	The evaluator revised the verified savings analysis to be consistent with the site contact's interview results.
			There were inconsistencies in the source of weather data between this project and at least one other project that the SWE reviewed.	Eval	The evaluator revised the verified savings analysis to use TMY3 weather data and the SWE recommended that future evaluations use consistent sources of weather data (e.g. not use TMY2 data for one project and TMY3 data for another project).

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
DLC-403	Lighting	RA	Ten of the reported 109 fixtures were not installed.	Pro	The SWE recommended that Duquesne emphasize with implementers that only measures that are installed and operational should be reported.
DLC-404	Lighting	RA	An incorrect fixture type was reported for a portion of the project.	Pro	The SWE recommended that Duquesne emphasize with implementers the importance of accurately documenting and reporting measures as installed.
DLC-405	HVAC recommissioning, controls	RA	The implementer's normalization analysis did not take into account occupancy/events that affects variability in energy consumption.	Pro	The evaluator corrected the implementer's normalization analysis to more accurately reflect the project impact. The SWE recommended to Duquesne that analogous future projects should use a similar approach as the evaluator's.
DLC-406	VFDs	RA	The implementer and evaluator both used "estimated" motor efficiency values for pre-retrofit motors.	Pro/Eval	The SWE recommended to Duquesne that implementers and the evaluator use motor nameplate or TRM efficiency values for future evaluations and not estimates.
DLC-407	Lighting	RA	The ex-ante savings did not account for the fact that approximately 80% of the lighting fixtures were controlled by a new time clock and the remaining 20% were still 24 hr/day emergency fixtures. The ex-ante analysis assumed 100% of the fixtures were controlled by time clock.	Pro	The evaluator corrected the verified savings. It is recommended that Duquesne emphasize with implementers the importance of accurately documenting all project details, such as hours of use and controls.
			The reported fixture count was overstated because the site had received faulty fixtures that were subsequently replaced by the manufacturer, but some of the faulty fixtures were included in the reported fixture count in addition to their replacements (thus double counting the retrofit).	Pro	The SWE recommended to Duquesne that implementers only report fixtures that are installed and operational.
DLC-408	VFDs	RA	Motor horsepower was incorrectly reported for one of the motors affected by the project.	Pro	The evaluator corrected the error in the verified savings analysis. The SWE recommended that Duquesne stress the importance of accurate project detail reporting with implementers.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
			The evaluator adjusted load factors based on motor specification data. Using motor specification data only is not an option in the TRM as a basis for adjusting load factors. The TRM states that either the default load factor shall be used or adjustments can be made based on spot metering and nameplate information. The evaluator's spot metering data were deemed by the evaluator to be invalid.	Eval	The evaluator revised the verified savings analysis to use the TRM default load factor.
DLC-409	VFDs	RA	The reported VFD was not installed, and the motor that the VFD was reported to control did not appear to exist.	Pro	The evaluator removed the savings associated with the missing VFD in the verified savings analysis. The SWE recommended that Duquesne emphasize with implementers the importance of reporting accurate project details and only reporting measures that are installed and operational.
DLC-410	Lighting	RA	The evaluator did not credit savings for emergency fixtures that were installed and operational in a vacant portion of the facility.	Eval	For similar cases in the future, Duquesne's evaluator will credit savings to all fixtures that are operational.
DLC-411	Lighting	IND	All equipment was installed and operating as reported and savings were reported in accordance with TRM protocols.	N/A	The SWE had no recommendations based on its review of this project.
DLC-412	Lighting	IND	Incorrect ballast type was assumed in the implementer's savings calculations. Also, no area descriptions were provided in the implementer's Appendix C.	Pro	The SWE recommended that Duquesne emphasize the importance of complete and accurate reporting of project details with implementers.

F.4.1.2 Review of Savings Database

Duquesne lists 12 programs under its non-residential portfolio (excluding the Large Curtailable Demand Response Program). Eight of these programs are offered to the commercial and government/non-profit sectors, and four are offered to the industrial sector. Each of Duquesne's non-residential programs achieved energy (MWh) and demand (MW) savings during PY4. The Office Building - Large program achieved the largest energy savings for Duquesne's total portfolio savings, and the Primary Metals program achieved the largest demand savings. The gross reported energy savings for these programs was 122,514 MWh, and the gross reported demand savings was 94.44 MW. Table F-18 shows the reported number of participants, energy savings, and demand savings from non-residential programs in PY4. Demand savings figures were adjusted to reflect a peak line loss factor (LLF) of approximately 7.0% for all non-residential programs prior to reporting.

Table F-18: Duquesne Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial Sector Umbrella EE[561]	55	1,665	0.77
Healthcare EE	44	13,200	4.62
Industrial Sector Umbrella EE	26	79	3.86
Chemical Products EE	27	2,931	1.23
Mixed Industrial EE	138	9,453	9.07
Office Building Large EE	176	32,379	10.69
Office Building Small EE	133	4,413	1.03
Primary Metals EE	55	22,491	46.91
Public Agency/ Non-Profit	178	18,954	12.06
Retail Stores- Small EE	320	9,922	1.79
Retail Stores- Large EE	83	7,027	2.41
Totals	**1,235**	**122,514**	**94.44**

Following each quarter in PY4, Duquesne submitted program tracking data to the SWE for review. The SWE combined these quarterly data extracts and compared them with the values shown in Table F-18. Several of Duquesne's programs contain multiple subprograms. For example, Duquesne's Public Agency/Non-Profit program is made up of the Education, PAPP Public Agency Partnership, Non-Profit, Education-AF, PAPP Public Agency Partnership-AF, PAPP-RE, Education-CCx, and PAPP-CCx customer segments. Abbreviations that follow these subprograms further classify projects by type and conservation service provider (CSP) in Duquesne's tracking system, PMRS). The SWE counted energy and

[561] Does not include cross-sector sales adjustment from Upstream Lighting

demand savings from several subprograms from the extract-level databases for all four quarters for PY4 and matched them with the figures at the program level in Duquesne's PY4 annual report.

Table F-19 shows the participant count, energy impact (MWh), and demand impact (Total MW) by program according to the Duquesne database extract. The two Retail Stores programs (small and large) are presented together because the extract-level databases did not report the savings impacts for the two programs separately. The SWE applied a peak LLF of 7.0% to demand impacts for all non-residential programs to facilitate a comparison with reported figures.

Table F-19: Duquesne PY4 Non-Residential Programs Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial Sector Umbrella EE	55	1,665	0.78
Healthcare EE	44	13,200	4.41
Industrial Sector Umbrella EE	26	79	3.67
Chemical Products EE	27	2,931	1.07
Mixed Industrial EE	138	9,453	8.93
Office Building Large EE	176	32,379	10.67
Office Building Small EE	133	4,413	0.97
Primary Metals EE	55	22,491	38.10
Public Agency/ Non-Profit	178	18,954	12.43
Retail Stores- Small EE	403	16,949	3.78
Retail Stores- Large EE			
Totals	**1,235**	**122,514**	**84.80**

Table F-20 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Variance}$$

Table F-20: Duquesne Non-Residential Program PY4 Variances

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial Sector Umbrella EE	0	0	-0.072
Healthcare EE	0	0	-0.109
Industrial Sector Umbrella EE	0	0	-0.085
Chemical Products EE	0	0	0.082
Mixed Industrial EE	0	0	-0.527
Office Building Large EE	0	0	-0.775
Office Building Small EE	0	0	-0.011
Primary Metals EE	0	0	5.993
Public Agency/ Non-Profit	0	0	-1.288
Retail Stores- Small EE	0	0	0
Retail Stores- Large EE			
Total	**0**	**0**	**3.35**

As Table F-20 shows, there was variation between the PY4 report and the tracking data in the reported demand savings for some of Duquesne's non-residential programs. The SWE believes these variances are a product of Duquesne including peak demand reductions (MW) from its commercial and industrial (C&I) demand response (DR) program in its PY4 final report under the customer segment that funded the customer rebates. However the program each impact belongs in were not always clearly in the energy efficiency (EE) tracking data the SWE aggregated to produce Table F-19. This reporting convention is discussed further in Appendix F, section F.6.1 .

F.4.1.3 Review of Project Files

The SWE review of non-residential projects completed by Duquesne during PY4 was done using project documentation files that Duquesne uploaded to the SWE SharePoint site quarterly. These files included project-level savings calculation workbooks, equipment invoices, customer incentive agreements, and post-inspection forms. Many projects were found to be missing essential accompanying documents, most commonly specification sheets and application forms. Otherwise the documentation provided was thorough, well organized, and allowed for a comprehensive review of projects.

A sufficient number of project files from both the commercial and industrial sectors were found for all quarters in PY4. Table F-21 shows the compliance targets for PY4.

Table F-21: Duquesne PY4 Project Files Received by Program and Quarter

	Commercial				Industrial			
Quarter	Completed Projects	Required Sample Size	Projects Submitted to SWE	Compliance	Completed Projects	Required Sample Size	Projects Submitted to SWE	Compliance
1	146	10	9	✓	23	5	5	✓
2	199	10	10	✓	60	10	10	✓
3	160	10	9	✓	15	5	5	✓
4	294	10	10	✓	67	10	10	✓

Further review of project files revealed several deficiencies that were detrimental to the SWE's understanding of the scopes of work. Common deficiencies included inconsistent information across accompanying files, insufficient documentation to verify scope of work, values differing from those specified in the TRM, unclear assumptions, and measures applied incorrectly. These issues are addressed individually by project below.

Project number 3000628710.25.03 was found to have inconsistencies regarding the scope of work across all accompanying materials and is thus believed to have incorrect measures on the supplied application. The project provided incentives for a custom lighting installation. The incentive agreement signed by the customer defined the scope of work as removing both 34 4-lamp T8 fixtures and 34 400W high-pressure sodium (HPS) fixtures and replacing them with 66 250W HPS fixtures. The project file submitted by the CSP described the scope of work as removing 33 250W HPS fixtures and replacing them with 34 6-lamp T8 fixtures. The accompanying invoices supported this scope of work. It was noted in the project file that the installed 6-lamp fixtures were to be broken down into 34 2-lamp T8 fixtures and 34 4-lamp T8 fixtures on the Appendix C calculator, as only four of the six lamps were controlled by occupancy sensors. The submitted calculator, however, displayed installation of 34 4-lamp T8 fixtures controlled by occupancy sensors and 34 2-lamp T12 fixtures with 25W T12 lamps (fixture code: F42IAL-R). When the SWE requested clarification, the EDC explained that the documents described the original application that was processed prematurely and was later revisited and corrected. At this time the EDC submitted a true-up document detailing the corrected scope of work. The inconsistencies amongst all submittals are shown in Table F-22. Ultimately, while the SWE accepts that the final true-up document accurately reflects quantities and savings, they recommend that more organized records be kept and submitted for a more thorough SWE review.

Table F-22: Sample Duquesne PY4 Project with Inconclusive and Mismatching Data

Project Number 3000628710.25.03					
Document	**Existing Equipment**	**Installed Equipment**	**kW Savings**	**kWh Savings**	**Incentive**
Customer Incentive Agreement	(34) 4-Lamp T8 Fixtures (34) 400W HPS Fixtures	(66) 250W HPS Fixtures	-	-	$5,131.86
Appendix C Calculator	**(33) 250W HPS Fixtures**	**(34) 2-Lamp T8 Fixtures (34) 4-Lamp T12 Fixtures**	**3.77**	**47,894**	**$3,017.50**
Equipment Invoices	-	(34) 2-Lamp T8 Fixtures (34) 4-Lamp T8 Fixtures	-	-	-
Installation Report	(66) 250W HPS Fixtures	(34) 2-Lamp T8 Fixtures (34) 4-Lamp T12 Fixtures	11.04	102,637	$9,881.08
DLC Project File Review	(33) 250W HPS Fixtures	(34) 2-Lamp T8 Fixtures (34) 4-Lamp T8 Fixtures	-	-	-
Program Tracking Database	-	-	3.77	47,894	$3,017.50
Supplemental True-Up Document	**(66) 250W HPS Fixtures**	**(68) 2-Lamp T8 Fixtures (68) 4-Lamp T8 Fixtures**	**7.09**	**91,249**	**$5,748.67**

Project number 0000554320.26.03 presented the SWE with both insufficient and mismatching documentation. The project provided incentives to the customer for various prescriptive lighting measures. The savings claimed in the program tracking database were 10,390 kWh and 1.59 kW with an associated rebate of $565. While the Appendix C calculator matched these figures exactly, the application matched only the savings and provided an alternate associated rebate of $397. The additional $168 included on the worksheet was presented as measure code LF3, removal of 4-foot linear fluorescent lamp. No additional material was provided to justify this addition to the scope of work by the implementer.

Project number 5000008065.24.02 was found to have inconsistencies regarding the correct baseline across accompanying documents, and also displayed an undocumented variation in expected TRM values. The project incentivized the installation of 6-lamp T5 high-bay fixtures. There were discrepancies between the installation report and the application regarding the existing equipment. The application indicated that 31 400W metal halide fixtures (input wattage: 458W) and 15 400W HPS fixtures (input wattage: 465W) were removed, whereas the installation report revealed that 46 400W metal halide fixtures (input wattage: 458W) were removed. As the payout for the high-bay T5 fixture is prescriptive, this error does not affect the incentive amount, but it does produce a 2.1% difference in kW and kWh savings. In addition to this discrepancy, there was an inconsistency in the equivalent full load hours

(EFLH) without any explanation. The project worksheet listed EFLH at 5,460 with the TRM expecting either 4,730 for “Industrial – 2 Shift” or 6,631 for “Industrial – 3 Shift”. Upon further investigation, Duquesne was able to provide the SWE with an hours-of-use attestation that confirmed the facility-specific values used. While the SWE supports using facility-specific schedules when they differ significantly from TRM values, the SWE requests that Duquesne include sufficient supporting evidence in these occurrences to make audits as transparent as possible.

Project number 1000618752.17.03 did not provide enough information for the SWE to verify the installed quantities or to establish a baseline for the savings calculations. The project provided incentives for 294 electronically commutated motors (ECMs) to replace shaded pole motors in both walk-in and reach-in cases, and for 24 permanent split capacitor (PSC) motors to replace shaded pole motors in unspecified locations. Several of the documents in the project file, including the supplied cut sheets and invoices, referenced installation of LEDs and did not indicate any motors. While ECM motor calculators were supplied and appeared to have followed the algorithms set forth in the TRM, no documentation proving the purchase of ECM motors was provided, and it is unclear why the baseline was assumed to be shaded pole motors. There were no invoices specifically for ECM or PSC motors; the invoices included with the project file were for a 26-door reach-in case setup and a 6-foot frozen seafood case. From the given documents, it is unclear if the motors replaced were in existing cases that previously used shaded pole motors, or if the motors referenced in the application were for the incremental savings provided by the efficient motors in the newly purchased cases. If the application were completed for the incremental savings provided by the efficient motors in the newly purchased cases, supplemental documents proving the quantity of motors per case should have accompanied this application. This could have included cut sheets for each case purchased or itemized invoices specifically including the motors and their associated incremental cost. Also in this scenario, the SWE expects that the assumed baseline would be a PSC motor instead of a shaded pole motor, as shaded pole motors are no longer available for purchase. If the motors were installed in existing cases using shaded pole motors, invoices proving the quantity of motors purchased should be readily available. Upon further discussion with the EDC it was found that this project is only the first of seven phases of an ongoing renovation. While the organization of files across the seven phases was a bit convoluted, the EDC ultimately was able to provide the requested files to clear up the discrepancies.

In summary, the SWE review of the PY4 project files identified several issues prevalent throughout the sampled projects. While complete and coherent information was provided for the majority of the projects, several project files lacked conclusive evidence at the time of submittal to support the claimed savings without supplemental documentation. This was particularly noticeable in projects that underwent multiple revisions after the initial application. To remedy this for future projects, the SWE recommends that Duquesne audit its applications more thoroughly and keep more organized documentation of any changes supplemental to initial project submittal.

F.4.1.4 Review of Sample Design

Duquesne’s PY4 final annual report provided detailed information on the sample design for the PY4 gross impact evaluation of non-residential programs. Duquesne divided the non-residential sector into two overarching program groups, commercial and industrial, with each having multiple subprograms. Due to sampling requirements in the audit plan, government, non-profit, and institutional (GNI) programs were separated from the commercial programs into their own evaluation group, because GNI energy savings accounted for greater than 20% of the total kWh savings for the non-residential sector. Duquesne’s evaluation contractor therefore verified the savings from the non-residential sector by addressing three main evaluation groups:

- Commercial Program Group
- Industrial Program Group
- GNI Program Group

The target sampling precision was +/- 15% at the 85% confidence level for each of the three groups. The SWE Team reviewed this approach and determined that it aligns with the guidance in the SWE Audit Plan.

F.4.1.4.1 Commercial Program Group

The Commercial Program Group includes an overall commercial umbrella program and five market segment programs: small office, large office, public agency, retail, and healthcare. Projects were the sampling unit for this group. The stratification of the group was based on ex-ante kWh savings, and the ratio estimator calculated from the sample was used to adjust the ex-ante energy and demand savings contained in PMRS and to calculate ex-post savings for the group.

Two projects were moved to the “idiosyncratic commercial” stratum from the “large commercial” stratum, due to the lack of other similar projects in the population. One of the projects had incomplete reported savings by the contractor, and the other had a unique building type and usage pattern compared. One commercial project was removed by Duquesne’s evaluation contractor from the sample because of the impossibility of accurately quantifying the savings with the available data; however it was still kept in the population.

Duquesne’s PY4 commercial sector sampling strategy is shown in Table F-23. The achieved precision values in the table show that Duquesne met the 85%/15% confidence and precision level requirements for both energy and peak demand.

Table F-23: Duquesne's Commercial Program Sampling Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample Size
Large Commercial	2	0.5	0.00	0.00	0.0%	0.0%	1
Medium Commercial	14	0.5	0.27	0.38	14.3%	20.1%	6
Small Commercial	66	0.5	0.26	0.27	20.1%	20.5%	5
Very Small Commercial	561	0.82	0.68	0.88	38.7%	49.6%	8
Idiosyncratic Commercial	2	0.5	0.25	1.49	0.0%	0.0%	2
Commercial Total	**645**				**13.0%**	**8.5%**	**22**

F.4.1.4.2 Industrial Program Group

The Industrial Program Group is made up of an industrial umbrella program and three programs that address specific market segments: primary metals, chemical products, and mixed industrials. The PY4 evaluation strategy for this group was stratified ratio estimation. Unlike in the Commercial Program Group, measure-level sampling was used for the Industrial Program Group because of the large numbers of measures typically included in an industrial project. This approach is reasonable for such a heterogeneous population. The use of measure-level sampling increases the evaluation sample size and thus leads to improved precision values.

Duquesne's PY4 industrial sector sample strategy is shown in Table F-24. There was a significant difference between the targeted sample size and achieved sample size for the "small industrial" stratum because Duquesne's evaluation contractor verified both the specific measure that was selected for verification and any additional measures that could easily be verified on site.

Table F-24: Duquesne's Industrial Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample Size
Large Industrial	12	0.56	0.22	0.11	10.20%	5.20%	6
Medium Industrial	44	0.5	0.29	0.06	16.50%	3.70%	7
Small Industrial	411	0.88	0.66	0.24	13.20%	4.90%	47
Industrial Total	**467**				**7.10%**	**0.10%**	**60**

F.4.1.4.3 GNI Program Group

The sampling approach for the GNI Program Group was similar to that of the Commercial Program Group. The primary sampling unit was projects, and stratified ratio estimation was used to apply results from the evaluation sample to the program population and to calculate ex-post impacts. Three strata were defined for this group: large, medium and small. Table F-25 shows the sampling strategy for the GNI Program Group in more detail.

Table F-25: Duquesne's GNI Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample Size
Large GNI	3	0.5	0.08	0.28	0.0%	0.0%	3
Medium GNI	9	0.5	0.2	0.07	7.8%	2.8%	6
Small GNI	78	0.5	0.61	0.25	29.7%	12.5%	9
GNI Total	**90**				**8.4%**	**1.8%**	**18**

The achieved relative precision values in Table F-25 show that Duquesne's sampling error was well within the acceptable bounds established by the audit plan for both energy and demand.

F.4.1.5 Review of Verified Savings Analysis

Table F-26 shows the realization rates and relative precision values for verified energy and demand savings in each of Duquesne's non-residential EE programs for PY4, based on activities completed by Duquesne's evaluation contractor.

Table F-26: Duquesne Energy and Demand Realization Rates for Non-Residential EE Programs in PY4

Program	Energy Realization Rate	Relative Precision (Energy)[562]	Demand Realization Rate	Relative Precision (Demand)[563]
Commercial Sector Umbrella	99%	9.3%	104%	7.9%
Commercial Sector Umbrella (Upstream Lighting)	99%	9.3%	104%	7.9%
Healthcare	99%	9.3%	104%	7.9%
Industrial Sector Umbrella	102%	7.1%	100%	0.1%
Chemical Products	102%	7.1%	100%	0.1%
Mixed Industrial	102%	7.1%	100%	0.1%
Office Building - Large	99%	9.3%	104%	7.9%
Office Building - Small	99%	9.3%	104%	7.9%
Primary Metals	102%	7.1%	100%	0.1%
Public Agency/Non-Profit	102%	8.6%	102%	1.7%
Retail Stores - Small	99%	9.3%	104%	7.9%
Retail Stores - Large	99%	9.3%	104%	7.9%

The realization rate is a factor that compares the gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities. The general calculation for a realization rate is as follows.

$$\frac{\sum Verified\ Savings\ Estimates}{\sum Reported\ Savings\ Estimates} = Realization\ Rate$$

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants, or on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the evaluation team was able to verify all reported savings. A realization rate of less than 100% indicates that the gross savings were an overestimate, and a realization rate of more than 100% indicates that gross savings were an underestimate. In most cases, EDC evaluation contractors used a stratification approach in their sample designs, which are described in the previous section. Realization rates for energy savings from Duquesne's C&I programs range from 99% to 102%. Realization rates for demand reductions from these programs range from 100% to 104%.

[562] Relative precisions given at 90% confidence level.
[563] ibid.

In order to calculate these realization rates, Duquesne's evaluation contractor performed a variety of activities to verify Duquesne's reported savings. Evaluation activities were to be performed in accordance with Duquesne's evaluation, measurement, and verification (EM&V) plan issued July 15, 2010 as follows:

- Projects with rebates less than $2,000: Basic Level of Rigor
  Included document review with as-needed phone interviews of applicable parties
- Projects with rebates greater than $2,000: Enhanced Level of Rigor
  Included basic level of rigor plus on-site verification of key project parameters

Figure F-1 depicts the frequency of each type of M&V performed by the evaluation contractor in the C&I program groups and the associated verified energy savings for each M&V approach.[564] The figure indicates that the more expensive M&V methods (i.e., Options B, C, and D) were reserved for a small number of projects but accounted for a large share of program savings.

Figure F-1: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 C&I Programs

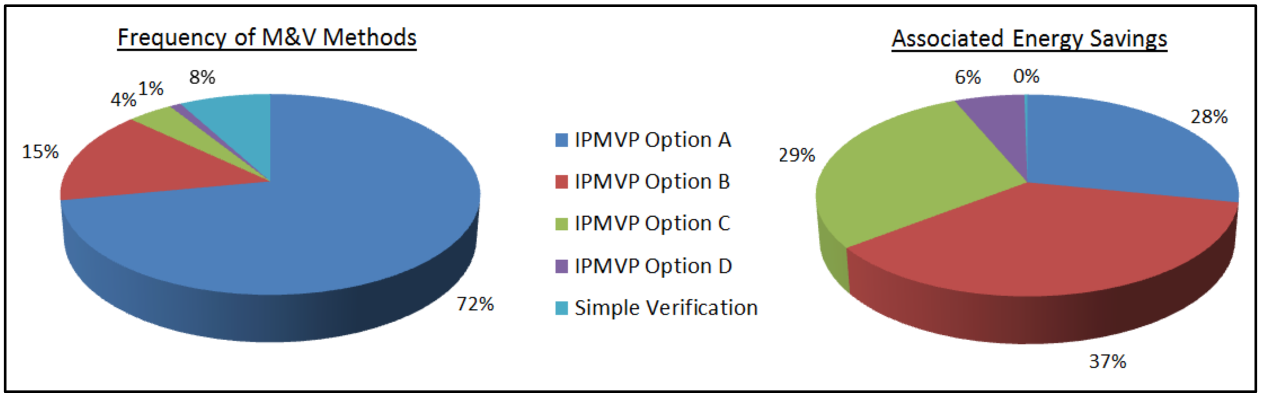


Figure F-1 indicates that 8% of the sampled measures in the C&I program groups (8 measures of 100 sampled) were evaluated using only a basic level of rigor ("Simple Verification"). The associated verified kWh savings for these eight measures accounts for less than 1% of the total verified savings (101,634 kWh out of 39,364,847 kWh total). This suggests that the use of basic rigor was appropriately used predominately for measures with smaller savings. Likewise, enhanced levels of rigor were used for 92% of the sampled measures, accounting for almost 100% of the savings achieved, proving that the use of enhanced rigor was appropriately used predominately for measures with larger savings.

Delving further into the enhanced levels of rigor for the C&I program groups, it is apparent that 72% of projects sampled were evaluated using IPMVP Option A (Partial Measure Retrofit Isolation). This approach uses a combination of measurement of key parameters of the retrofitted equipment, and the use of stipulated values for other parameters. IPMVP Option B (Retrofit Isolation: All Parameter Measurement) was used for 15% of projects sampled. This option involves more robust measurement of

[564] IPMVP methodologies are briefly defined in the Glossary.

the retrofitted system's energy usage, typically using short-term data logging. IPMVP Option C (Whole Facility Billing Analysis) accounted for only 4% of the sampled projects but 29% of the savings. It involves utility billing analysis to identify energy savings associated with an upgrade. Typically, 12 months of pre- and post-retrofit billing data are required for this approach. IPMVP Option D (Calibrated Simulation) accounted for only 1% of the sampled projects but 6% of the savings. It involves modeling the energy performance of the facility before and after the conservation measure is installed. The SWE supports this "value-of-information" technique of reserving expensive metering activities for projects that account for the largest share of savings.

Figure F-2 and Figure F-3 depict how the different M&V methods were used in specific program groups. Figure F-2 depicts the frequency of each type of M&V performed by the evaluation contractor in only the Commercial, Government, and Non-Profit Program Group and the associated verified kWh for each M&V approach. The distribution is similar to that shown in Figure F-1, indicating again that the more expensive methods (i.e., Options B, C, and D) were reserved for a small number of projects, each of which contributed a relatively large amount of savings.

Figure F-2: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Commercial Programs (Including GNI)

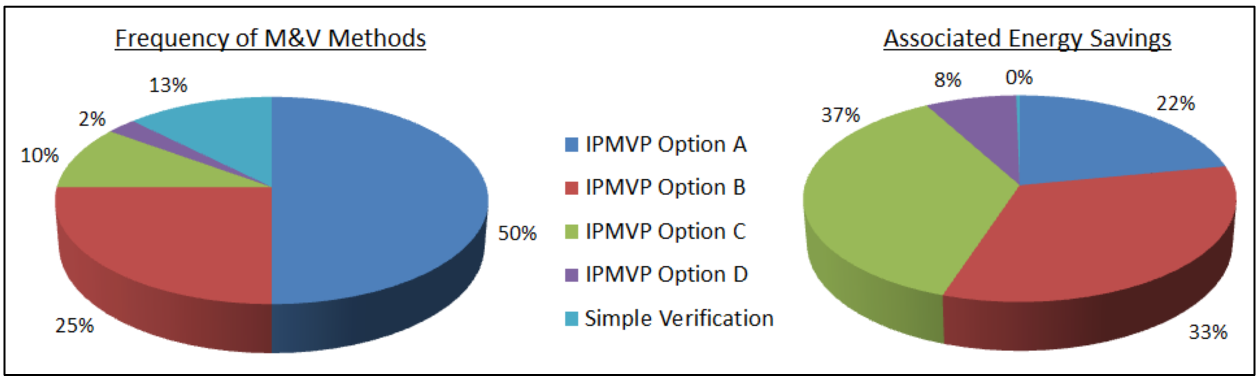
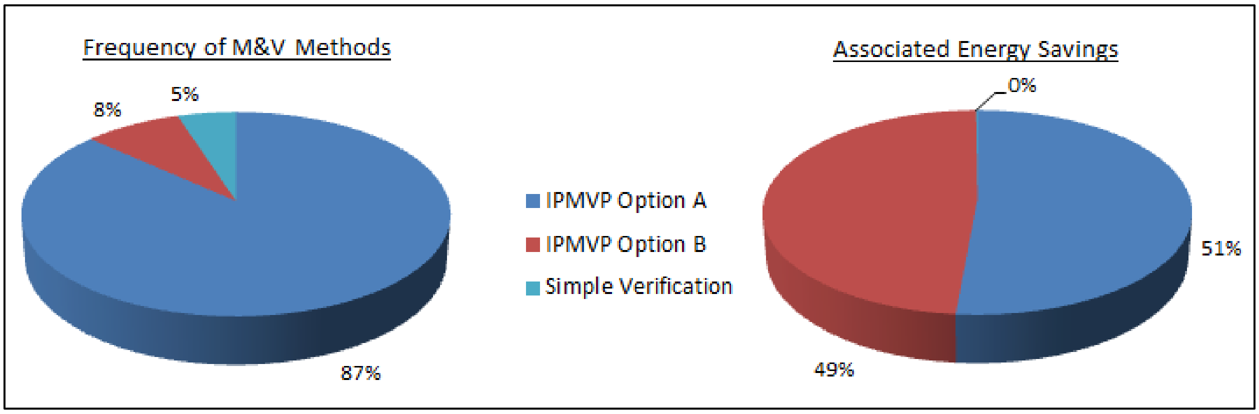


Figure F-3 depicts the frequency of each type of M&V performed by the evaluation contractor in only the Industrial Program Group and the associated verified kWh for each M&V approach. Note that only three different methods of M&V were used for this sector as compared with five in the Commercial, Government, and Non-Profit Program Group.

Figure F-3: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Industrial Programs



A detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. However, the SWE found the completeness of site visit documentation to be insufficient in several instances. Table F-27 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for the site evaluation. Highlighting indicates sites where the SWE has some concern about the M&V activities performed.

Table F-27: IPMVP Methods and Verified Savings of Duquesne's PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Portfolio Energy Savings	Verified Demand Savings (kW)	% of Portfolio Demand Savings	Method
Commercial	8000006714.33.01	8,056,223	7.52%	619.00	1.53%	IPMVP Option C
Commercial	9000008674.20.04	1,607,291	1.50%	224.68	0.56%	IPMVP Option B
Commercial	2000661379.36.01	524,874	0.49%	24.20	0.06%	IPMVP Option B
Commercial	7000006709.17.02	1,893,597	1.77%	387.02	0.96%	IPMVP Option A
Industrial	6000636680.23.03	420,288	1.19%	45.64	0.07%	IPMVP Option B
Industrial	2000010473.25.01	315,231	0.89%	36.00	0.06%	IPMVP Option A
Industrial	2000007883.23.03	1,331	< 0.01%	0.37	< 0.01%	IPMVP Option A

Project number 9000008674.20.04 generated 1.6 million kWh in savings, which accounted for 1.50% of the PY4 energy savings achieved in the Commercial Programs Group. The project received incentives for the installation of 24 VFDs. The evaluation contractor successfully metered (9) of the installed VFDs with either a current or power logger. Additional on-site verification was performed by the evaluation contractor on logger drop-off and pick-up visits, which included motor nameplate data, VFD frequency readings, and motor operation schedules as verified by the site contact. Accompanying Excel calculations provided matched logger data and photographs of equipment tags. The evaluation contractor also provided three years of utility bill analysis but deemed it insufficient as the combined savings across the three analyzed meters only supported half of the ex-ante savings. The SWE agrees with the evaluator's decision to use IPMVP Option B given the inconclusive utility bill analysis, and found the supporting documentation and calculations provided to be robust and detailed.

Project number 7000006709.17.02 produced 1.9 million kWh in savings, which accounted for 1.77% of the PY4 energy savings attributed to the Commercial Programs Group. The project received incentives for the lighting portion of a large new construction retail site. The CSP submitted Appendix C[565] of the 2011 TRM with its application. The evaluator documented several discrepancies in both equipment type and quantity between application and on-site verification. The site contact was able to clarify the inconsistencies by providing detailed descriptions, including fixture type, control type, and hours of use (HOU) for all fixtures as that are logged within the building automation system. The evaluator used this information to come up with a weighted hours of use to be applied to the whole building. Despite the detailed information provided on site, the evaluator chose to calculate the ex-post savings using the Building Area Method, citing an inability to obtain square footages of individual spaces to match the HOU described per space. The whole building square footage input into the calculations was taken from the application supplied by the CSP. As the evaluator already found numerous discrepancies between the CSP application and the site visit, the SWE questions the use of this square footage value. Line item 2 of the evaluator's site-specific monitoring and verification plan (SSMVP) specifically states that the evaluator will collect the square footage of both the entire building and each space where fixtures were installed. It is unclear why this was not completed on either scale. The SWE believes the evaluator should have been able to either obtain proper drawings indicating square footages, or measure the site at the time of inspection to produce a more accurate verified savings estimate for the project.

At 8 million kWh and 619 kW saved, project number 8000006714.33.01 represents 7.52% of the energy savings and 1.53% of the demand savings achieved by the Commercial Programs Group in PY4. Per the supplied SSMVP, the evaluator intended to procure the following trend data at 15-minute intervals over a three-week period from the site:

- Outside air temperature
- Speed for each affected VFD
- Chilled water temperature
- Chiller load or power

These data were unable to be secured. The evaluator's report states that at the time of evaluation, sub-metering had not yet been installed and facility staff were unable to provide requested data in a timely manner. As an alternative method, the evaluator obtained billing data from the EDC in order to perform a regression analysis. The final analysis submitted contains numerous cells that are highlighted as having inadequate supporting data, and several other cells with errors in the outputs. Ultimately, the evaluator

[565] Appendix C is the "Lighting Inventory Tool" which is to be used for retrofit lighting projects.

could not confidently verify the savings for this project due to limited data and time constraints. For a project contributing over 7% of the program's verified savings, the SWE would expect the EDC and CSP to have begun project coordination far enough in advance that these verification details could have been obtained. The calculated energy realization rate for the Office Building – Large – EE Program was 99%. The calculated realization rate of this project was 80%. Had the realization rate of this project been calculated at 60%, the realization rate for the program would have dropped down to 95%. The SWE recommends that Duquesne make a more concerted effort to partner with customers having projects of this magnitude earlier on in the project's planning phase so that savings can be accurately captured after the project's completion.

In the PY3 annual report, the SWE recommended increasing the number of sampled projects evaluated using IPMVP Option B, or deploying data loggers on a greater portion of sampled projects evaluated using IPMVP Option A. While it appears that Duquesne and its evaluation contractor took this into consideration, the completeness and validity of on-site data provided are questionable in several instances. Overall, the SWE recommends that Duquesne continue its Phase I approach of choosing levels of rigor and selecting M&V methods, but requests that the evaluation team get involved earlier in the process for large projects to ensure sufficient data is collected to calculate verified savings for complex projects.

F.4.2 PECO

This section contains details on the SWE's audit of PECO's PY4 non-residential programs.

F.4.2.1 Site Inspection Findings

Table F-28 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of PECO non-residential project installations. Details about the SWE site inspection process can be found Section B.2.2.6.2.

The PECO PY4 site inspection findings are categorized into three types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.
- TRM findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

Table F-28: PECO PY4 Non-Residential Site Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-401	Motors, VFDs, EMS, ASHP	RA	Project savings were overstated because savings were included for the EMS, though the EMS functions used by the facility are required by code.	Pro	The evaluator correctly removed EMS savings in the verified savings analysis. The SWE recommended to PECO that for future projects the implementer should determine whether the EMS functions are required by code prior to reporting project savings.
			There were inconsistencies between assumptions used in the evaluator's VFD and high-efficiency motor calculations.	Eval	The evaluation team stated that, for any future projects in which the ex-post savings are calculated using a custom approach, the EFLH and CF values will be used consistently throughout the analysis.
PECO-402	Lighting	RA	The number of lighting fixtures controlled with occupancy sensors was overstated by the implementer.	Pro	PECO will emphasize with implementers the importance of accurately documenting measures as installed.
PECO-403	Lighting	RA	Fixture controls were incorrectly reported for some of the fixtures.	Pro	The evaluator corrected the fixture controls error in the verified savings analysis.
			There were fixtures added shortly after project completion to provide the same amount of illumination as the old fixtures (project was not a one-for-one replacement). The SWE recommended that the baseline fixture count should be adjusted downward since the incented fixtures provided the same illumination level as a smaller quantity of baseline fixtures than was reported.	Eval/TRM	The evaluator did not adjust the baseline fixture count because the total fixture count found on-site differed by less than 5 percent from what was reported. The TRM states that “widget counts within 5% of the application numbers can be considered within reasonable error without requiring realization rate adjustment” (Section 1.11.4 of 2012 TRM) and therefore the evaluator’s approach is acceptable. However, Section 4.1.2.5.2 of the 2011 Audit Plan states, “if the evaluation adjusted kW (connected load) for any usage group in the sample is within +/-5% of the claimed kW, the project savings should be accepted at the claimed value, else, the calculations should be revised and recalculated by the EDC evaluators.” Consistency is needed in future versions of the TRM and Audit Plan regarding whether the 5% error band should be at the project or usage group level.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-404	VFDs, EMS	RA	There were some minor inconsistencies in the evaluator's savings analysis and minor discrepancies with the site contact's interview results.	Eval	The evaluation team is taking additional quality control steps in PY5 to ensure internal agreement between the site contact report and the analysis.
PECO-405	CHP	RA	There were cell formula errors that sum parasitic load, to the pivot table that calculates demand impact and to the steam enthalpy value used to calculate natural gas cost offset for TRC purposes.	Eval	None needed. Impact of spreadsheet error was negligible.
PECO-406	Lighting	RA	Evaluator hours of use did not reflect a typical operating year of the facility.	Eval	The SWE recommended that the hours of use be adjusted to represent a typical operating year. The evaluator agreed and stated that it would be taken into account for future evaluations.
PECO-407	VFDs	RA	Implementer misused the TRM Appendix D tool to calculate VFD savings.	Pro/ TRM	The confusion of the TRM Appendix D motor and VFD tool has been eliminated in the 2013 TRM with the introduction of separate calculators for VFD and motor savings.
PECO-408	Lighting	RA	Facility lighting hours of use were variable among different spaces and were inconsistent between the application, interview hours, and observations during site inspection.	Pro	The SWE recommended that for future projects where there is high variability and inconsistency in hours, metering should be performed. The evaluator concurred with the SWE's recommendation.
PECO-409	Retro-commissioning and ventilation upgrade	RA	An ongoing upgrade to the HVAC system caused the evaluator to have to abandon plans for on-site measurements. This project and the HVAC system upgrade project have related impacts.	Pro	The evaluator recommended to PECO that this project and the HVAC system upgrade project be considered together using a 2010 baseline for both projects. When the HVAC project is reported, the savings credited to that project should be the savings of the two projects considered together less the ex-post savings of the retrocommissioning and ventilation upgrade project. The SWE concurs with the evaluator's recommendation.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-410	Lighting	IND	Facility lighting hours of use were significantly greater than the TRM deemed hours of use.	Pro	The SWE recommended that PECO have implementers carefully document facility lighting hours of use and use the schedules for the ex-ante savings analysis, particularly when the hours depart significantly from the TRM deemed value for the appropriate building type. PECO's evaluator concurred with the SWE's recommendation.
PECO-411	Lighting	IND	Reported fixture quantities, controls, and space cooling did not match site inspection findings.	Pro	The SWE recommended that PECO stress with implementers the importance of accurate project documentation. PECO's evaluator concurred with the SWE's recommendation.

F.4.2.2 Review of Savings Database

PECO reported savings impacts from four non-residential programs in PY4: Smart Equipment Incentives C&I, Smart Equipment Incentives GNP, Smart Construction Incentives C&I, and Smart Construction Incentives GNP. The retrofit, multi-tenant and appliance recycling portions of the Smart Equipment Incentives program are reported separately, and both the SEI and SCI programs are separated by sector for reporting and evaluation. There were no participants or savings reported for the Appliance Recycling Program for the GNP sector. The gross reported energy savings of the four non-residential programs was 192,507 MWh, and the gross reported demand savings was 30 MW. Table F-29 shows the reported number of participants, energy savings (MWh) and demand savings (MW) from each reporting category in PY4 based on PECO's PY4 annual report. Demand impact figures were adjusted to reflect a peak LLF of 10.0% for C&I programs and 10.5% for GNP programs prior to reporting, to account for transmission and distribution (T&D) losses.

Table F-29: PECO Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Smart Equipment Incentives - C&I Retrofit	659	98,746	17.3
Smart Equipment Incentives - C&I Multi-tenant	44	506	0.1
Smart Equipment Incentives - C&I Appliance Recycling	14	77	0.0
Smart Equipment Incentives - GNP Retrofit	273	74,041	9.4
Smart Equipment Incentives - GNP Multi-tenant	8	11	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	57	8,323	1.5
Smart Construction Incentives - GNP	44	10,803	1.9
Totals	**1,099**	**192,507**	**30.2**

Following each quarter in PY4, PECO submitted program tracking data to the SWE for review. The SWE combined these quarterly data extracts and compared them with the values shown in Table F-29. Table F-30 provides the participant count, energy savings, and demand savings by program according to the PECO database extract. The SWE applied a peak LLF of 10.0% for C&I programs and 10.5% for GNP programs to demand impacts to facilitate a comparison with reported figures.

Table F-30: PECO Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Smart Equipment Incentives - C&I Retrofit	659	98,746	15.6
Smart Equipment Incentives - C&I Multi-tenant	44	506	0.1
Smart Equipment Incentives - C&I Appliance Recycling	14	77	0.0
Smart Equipment Incentives - GNP Retrofit	273	74,041	8.4
Smart Equipment Incentives - GNP Multi-tenant	8	11	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	55	8,274	1.0
Smart Construction Incentives - GNP	49	10,851	2.0
Totals	**1,099**	**192,508**	**27.1**

Table F-31 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$Reported\ Figure\ - Database\ Summary = Variance$$

Table F-31: PECO Non-Residential Program PY4 Discrepancies

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)[566]
Smart Equipment Incentives - C&I Retrofit	0	0	0.0
Smart Equipment Incentives - C&I Multi-tenant	0	0	0.0
Smart Equipment Incentives - C&I Appliance Recycling	0	0	0.0
Smart Equipment Incentives - GNP Retrofit	0	0	0.0
Smart Equipment Incentives - GNP Multi-tenant	0	0	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	2	49	0.4
Smart Construction Incentives - GNP	-2	-48	-0.3
Totals	**0**	**-1**	**0.1**

Upon review the SWE found some minor differences in the participant counts and reported energy and demand savings in the report and the tracking data for some of the PECO's non-residential programs. For example, the SWE found that the reported participant count for the Smart Equipment Incentives (SEI) - C&I in PY4 was 44 lower than the participant count shown in the savings database for the same program. The SWE also found a large difference in the savings impacts in the PY4 report and the database extract for this program. The SWE followed-up with PECO's evaluator, who provided an explanation for these variations. The most current values provided by PECO are used in this report. In most cases the variations in participant counts and savings impacts were due to adjustments to projects that occurred following the close of a quarter or were due to the unverified combined heat and power (CHP) projects. The remaining discrepancies shown in the Smart Construction Incentives (SCI) programs are due to re-categorization of 2 projects between the C&I and GNI sectors.

Note that variances found do not indicate inadequate QA/QC or incorrect reported savings. The SWE understands that program tracking is a continuous process and that project details are subject to change after they are first reported to the SWE.

[566] Database demand impacts reflect a T&D loss factor of 10.0% for C&I programs and 10.5% for GNP programs.

F.4.2.3 Review of Project Files

During PY4, the SWE reviewed project documentation from PECO's Multi-tenant, SEI – Retrofit[567], and SEI - New Construction programs. Several projects were selected from each quarter within each program. For the most part, PECO's project documentation was complete and easy to follow and review. A few of the projects had subfolders placing the files into logical categories such as application materials, invoices, review verification, specification/cut sheets, and TRM calculators. This was especially helpful for the review of larger projects with multiple installed measures, but all projects could benefit from this filing system.

Multi-Tenant

The SWE reviewed nine of the projects submitted from the Multi-tenant program. Measures in this program typically follow a residential protocol in the TRM but are counted as non-residential savings because the savings occur in a master-metered apartment complex or housing project. Measures reviewed included air-source heat pumps, air conditioners, and refrigerators. Multi-tenant projects had the least robust documentation of the measures reviewed because the low per-unit savings and deemed or partially deemed savings protocols don't require extensive documentation. Project documentation typically included an application form and invoices for the products purchased. However, no savings calculation documentation was provided. This is most likely due to the straightforward deemed savings protocol specified in the TRM to calculate these savings and the prescriptive rebate level offered by the program.

The majority of the projects completed the Smart Home Rebates (residential) application form. However, two of the projects used the Smart Equipment Incentives: Multi-Unit Application for Individual Units. Although there were two different forms, the rebate amounts mostly matched between the two forms. One exception was for room air conditioners. Project PECO-11-91981 completed the Smart Equipment Incentives: Multi-Unit Application which had a deemed $50 rebate for room air conditioners. However, the other Smart Home Rebates applications had a deemed $25 rebate for room air conditioners. Due to the form that was filled out, it appears that an additional $25 was given to project PECO-11-91981 according to the application forms and program tracking data.

All of the projects reviewed contained the application form and the invoices for the products purchased. The quantity and model number provided in the application form matched those in the invoices provided. Ex-ante project savings were based on the following deemed values: 98 kWh and 0.059 kW for room air conditioners and 106 kWh and 0.0125 kW for refrigerators. All of the projects reviewed used these deemed values. These values also matched, for the most part, those in the 2012 PA TRM, where 98 kWh is the deemed value for a room air conditioner in Philadelphia. The 2012 PA TRM states a deemed value of 0.1018 kW demand savings for an ENERGY STAR room air conditioner. This differs from the deemed value reported by PECO of 0.059 kW. The 2012 PA TRM also states a savings of 106 kWh for

[567] SEI – Retrofit includes projects from both the C&I and GNI sectors

a top-mount freezer without ice door and 0.0125 kW demand savings, which matches the PECO-reported values.

There were two projects reviewed with air-source heat pumps, PECO-11-91953 with a savings of 1,293.4 kWh and PECO-12-91997 with a savings of 10,353.6 kWh. These measures follow a partially deemed savings protocol in the PA TRM, so an assessment was completed using the equation for high-efficiency air-source heat pumps found in Section 2.1 of the 2012 PA TRM. Since the baseline equipment was not well documented in the application, the TRM deemed baseline values were inputs for the TRM equations. The project tracking reported kWh savings of 1293.4 kWh for PECO-11-91953, which was equal to the savings calculated when using the 2012 PA TRM protocol.

Project PECO-12-91997 had a reported quantity of four units and a total project energy savings of 10,353.6 kWh in the program tracking data. The SWE replicated PECO's per-unit savings estimate of 2588 kWh using the 2012 PA TRM protocol and the equipment specifications. However, it is unclear why the project quantity stored in the program tracking data was four. The rebate application showed a single unit, and the submitted invoice was for a single heat pump. The rebate amount stored in the program tracking data corresponded to a single heat pump. The SWE recommends that PECO investigate this issue with the program implementer and make the necessary changes to ensure that ex-ante quantities and savings values are accurately stored in the program tracking data.

Smart Equipment Incentives – Retrofit (Includes C&I and GNI Sectors)

Three retrofit projects were chosen for document review for each of Q1 and Q2. Four retrofit projects were reviewed for Q3 and Q4. The majority of the projects reviewed contained the application, invoices, spec sheets, and savings calculators. Of the projects reviewed, only two did not have savings calculators: PECO-10-01153, which had an energy management system (EMS) installed, and PECO-11-03646, which had traffic lighting installed. The 2012 PA TRM did not include a protocol for EMS installation, so savings followed a custom protocol. LED traffic signals follow a deemed savings protocol in the PA TRM, so a calculator is not necessary. The savings listed in the application and the program tracking data both agreed with the deemed savings values in the TRM for the type of traffic lighting installed.

Of the retrofit projects reviewed, the majority of the retrofit installations were for LED or T-8 lighting upgrades, the installation of lighting controls, and HVAC improvements or upgrades. There were a few VFD installations and building envelope improvements. The program-tracking-reported kWh savings equaled the application savings for 21% of the projects reviewed, and the program-tracking-reported kW savings equaled the application savings for 29% of the projects reviewed. These low percentages could be due to changes in the project scope during installation or to applications being completed incorrectly by the applicant. After reviewing the provided savings calculators, the SWE found that only three of the reviewed projects provided different savings in the calculators than what was ultimately reported in the program tacking data.

Project PECO-11-03523 appears to be a school retrofit as well as remodeling or building additions. This project contained lighting installations and retrofits, a VFD installation for the kitchen exhaust fan, and an EMS installation for the refrigerators. A note in the documents states that there was an error in the program-tracking-reported savings of 229,238 kWh. This was due to a typo in lighting EFLH; the correct total kWh savings was 229,246 kWh. The calculators were a little difficult to follow for this application as there were several measures that received incentives. In the future, it would be helpful to combine all of the savings calculators into one form instead of several different forms with several different versions.

Project PECO-12-04151 contained lighting, air-source heat pumps, and air conditioners. The program-tracking-reported savings for this project was 18,106.5 kWh and 6.18 kW. After reviewing the application, this appears to be the savings for only the custom lighting project, but it does not include the other measures on the application. This project provided two savings calculators, one of which was a savings summary and the other a TRM-referenced lighting calculator. The savings summary provided an overview of the project savings which was reviewed by PECO. This document reported a total savings of 141,649.63 kWh and 23.52 kW, which included all of the lighting, controls and HVAC measures. The PECO review of these values is logical, and the values and assumptions seem reasonable. The other calculator included was a controls and lighting calculator which reported higher savings values than the previous calculator. There are also notes in the review stating that several of the original lighting plans were not installed, which could also have contributed to these higher values. Therefore this second lighting and controls calculator was neglected in the review process. Although no equations were provided, the savings summary that was reviewed by PECO seems to report the correct total project savings values of 141,649.63 kWh and 23.52 kW, which are much higher than the program-tracking-reported savings.

Project PECO-12-04169 was a lighting and controls project with a project-tracking-reported savings of 38,894.4 kWh. However, there is a note amending the change to 426,305.4 kWh, as the original project-tracking-reported savings was only for the controls and did not include the lighting portion of the retrofit. The amended kWh value is confirmed by the calculation sheet, which also included a demand savings of 44.225 kW for the fixture retrofit that was not reported in the project tracking data.

Smart Construction Incentives

A total of 10 SCI projects were reviewed. Four projects were reviewed for each of Q1 and Q2, and two projects were reviewed for Q3 and Q4. Of the projects reviewed, the majority contained applications, invoices, spec sheets, and savings calculators. There were two projects that did not contain savings calculators, PECO-11-03228 which contained lighting and a geothermal HVAC system, and PECO-11-01906 which contained a whole building remodel. Project PECO-11-03228 had a new HVAC system installed, so this could have used a deemed value, but no documentation was provided to confirm this assumption. PECO-11-01906 did not contain a savings calculator, but it appears that some modeling was completed post- and pre-remodel which resulted in the savings values. The modeling inputs seem correct from the documentation provided. Approximately 40% of the projects reviewed contained differing kWh savings calculations between the application and the program-tracking-reported values. This is most likely a result of the changes in plans between submittal and completion of the projects.

Of the projects reviewed that had savings calculators, one project had differing savings between the savings calculator values and the program-tracking-reported values. Project PECO-12-04243, which contained custom lighting, chillers, air conditioners, motors, and VFDs, had program-tracking-reported savings values of 116,303.2 kWh and 36.91 kW. However, the sum of all the calculators equaled a total savings of 154,483.2 kWh and 47.18 kW which is a bit higher than the program-tracking-reported savings values. This could be due to some custom lighting measures that do not appear to be included in the program-tracking-reported savings. It is unknown if the custom lighting measures were actually installed, resulting in the lack of the custom lighting measures in the program tracking data, but the calculators do seem to have calculated the savings correctly. Both the program-tracking-reported savings and the savings calculator values are still much lower than the estimated savings on the application of 236,014 kWh and 46.06 kW. This is most likely due to the motors having negative savings and some of the measures not having been installed once the project was underway.

F.4.2.4 Review of Sample Design

PECO's PY4 final annual report provides detailed information on the sample design for the PY4 gross impact evaluation of non-residential programs. PECO splits its non-residential EE programs into three groups for evaluation: Smart Equipment Incentives: Commercial and Industrial (SEI C&I) Program, Smart Equipment Incentives: Government, Non-Profit, Institutional (SEI -- GNP) Program, and Smart Construction Incentives Program.

F.4.2.4.1 Smart Equipment Incentives C&I Program

The SEI C&I Program has three subcomponents: retrofit projects, multi-tenant projects, and appliance-recycling projects. In PY4, the C&I multi-tenant and appliance recycling projects were not evaluated because their savings were a very small percentage of the overall program savings. The evaluation contractor designed the final C&I sample for the purpose of achieving the required 85%/15% confidence and precision at the program level. The SWE Team used a combination of project type and size to determine each project's appropriate stratum within the program. The PY4 SEI C&I retrofit projects used stratified ratio estimation similar to the method used in PY1 through PY3. Thirty projects were drawn from an annual population of 657 C&I retrofit projects, and the samples were selected each quarter in order to minimize the amount of time elapsed between project implementation and evaluation.

Based on the data from Q1, Q2, and pipeline data at the end of Q2, the strata boundaries were defined as follows:

- Stratum 1: The top 33% of reported kWh savings
- Stratum 2: The middle 33% of reported kWh savings
- Stratum 3: The lowest 33% of reported kWh savings

Due to the unique properties of EMS and CHP projects,[568] PECO's evaluation contractor placed these project types in their own strata. SWE thinks this strategy is appropriate. One C&I project that had a large savings discrepancy because of a spreadsheet error was also placed in its own stratum. The implementation team and PECO hoped that, by doing this, the verified savings for the rest of the projects would not be affected by the error. The SWE Team finds this approach problematic. If the sample is intended to be representative of the rest of the projects in the program, we should assume that a certain number of non-sampled projects also contained spreadsheet errors that were not discovered because the projects were not selected for evaluation. By separating this project, the error ratio for the program is falsely suppressed and the accuracy of the verified savings estimates is overstated. This should be avoided in the future, and the SWE recommends that in future program years PECO follow the sample design that approved by the SWE. The remaining projects were stratified into three groups – large, medium, and small - according to their ex-ante kWh savings. A coefficient of variation (Cv) value of 0.4 was used to calculate the required sample size, based on the error ratio observed in the PY3 evaluation of the SEI C&I Program.

As shown in Table F-32, PECO failed to meet the 15% relative precision requirement at the 85% confidence level for peak demand savings. The actual relative precision of the peak demand savings estimate was 16% at the 85% confidence level. The missed requirement was due, in part, to the low peak demand realization rate (0.80). Relative precision values increase when realization rates are low because the error bound is larger relative to the program savings. The missed requirement is also a function of PECO's evaluation contractor designing the sample to narrowly meet the audit plan requirements. Similar to the missed precision requirement for the SEI GNI Program in PY3, the PY4 sampling plan was based on optimistic assumptions that reported and verified savings estimates would be well aligned. The sample size proved insufficient when these sampling assumptions were violated for peak demand savings in the EMS stratum. The SWE encourages PECO to add additional sample points in PY5 to avoid a recurrence of this. The PY4 sampling strategy the SEI C&I Program is shown in Table F-32.

Table F-32: PECO Smart Equipment Incentives C&I Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand	Achieved Sample Size
C&I-Large	8	0.4	0.16	0.2	0.07	0.10	6
C&I-Medium	36	0.4	0.31	0.3	0.21	0.30	8
C&I-Small	596	0.4	0.29	0.4	0.24	0.40	9
C&I-CHP	1	0.5	0.00	0.0	0.00	0.00	1
C&I-EMS	16	0.4	0.44	2.4	0.43	0.70	6
Total	**657**				**0.11**	**0.16**	**30**

[568] EMS projects are likely to have a significantly different realization rate from other measures, and CHP projects are large in size and have a distinct nature

F.4.2.4.2 Smart Equipment Incentives GNI Program

Similar to the method used in PY1 through PY3, the PY4 sampling plan for the SEI GNI program used stratified ratio estimation. Since in PY3 PECO missed the 85%/15% confidence and precision requirement for this program, SWE required more conservative variability assumptions for the PY4 sampling plan. The assumed error ratio that PECO used for this program's PY4 sampling was above 0.5 for the three core strata. The final sample size for the PY4 evaluation was 36 GNI projects, from an annual population of 269 GNI retrofit projects. The projects were stratified into five groups: large, medium, small, CHP, and municipal lighting. In each of the four stages -- after Q2, after Q3, during Q4, and after Q4 -- samples were pulled and the sample design was reviewed and adjusted to make sure it would achieve the targeted confidence and precision level. Finally, samples were selected only from projects that represent the top 95% of overall program savings. The details of the GNI program sampling strategy for PY4 are in Table F-33:

Table F-33: PECO Smart Equipment Incentives: GNI Program Sample Plan for PY4

Stratum	Population	Assumed Eror Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand	Achieved Sample Size
GNI-Large	1	0.6	0.00	0.00	0.00	0.00	1
GNI-Medium	18	0.9	0.04	0.12	0.17	0.15	12
GNI-Small	229	0.7	0.00	0.00	0.48	0.12	13
GNI-CHP	4	0.5	0.00	0.00	0.00	0.00	4
GNI-Muni Lighting	17	0.4	0.00	0.00	0.01	0.00	6
Total	**269**				**0.12**	**0.05**	**36**

F.4.2.4.3 Smart Construction Incentives Program

New construction projects from the C&I and GNI sectors were combined into a single sample frame for impact evaluation by PECO's evaluation contractor because of the small size of the program. The evaluation team used an approach of considering both project size (gross reported kWh) and project type for stratified sampling. Five strata were defined:

- Non-whole building high
- Non-whole building medium
- Non-whole building low
- Whole building high
- Whole building low

Whole-building projects claim modeled savings for all building systems from a code reference building, with the exception of process equipment. The MWh boundaries for the strata are shown in Table F-34.

Table F-34: Strata Boundaries for PY4 SCI Sampling

Stratum	Stratum Boundaries
Non-Whole Building High	>750 MWh
Non-Whole Building Medium	200-750 MWh
Non-Whole Building Low	<200 MWh
Whole Building High	>750 MWh
Whole Building Low	<750 MWh

The targeted confidence and precision are 85%/10% at the program level. The evaluation contractor conducted desk reviews of all the sampled projects, and site visits of all the non-whole building high and medium and whole building high strata projects except one site in the non-whole building medium stratum that could not be reached. The PY4 sampling strategy for this program is shown in Table F-35.

Table F-35: PECO Smart Construction Incentives Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Non-whole building high	2	0.5	85/15	2	2
Non-whole building medium	10	0.5	85/15	5	5*
Non-whole building low	73	0.5	85/15	7	7
Whole building high	2	0.5	85/15	2	2
Whole building low	14	0.5	85/15	6	6
Total	**101**		**85/15**	**22**	**22**
*One site did not respond to a request for on-site visit, so desk review results for this site were used instead.					

The observed error ratios and relative precision levels for SCI projects from both the C&I and GNI sectors are shown in Table F-36. The sampling uncertainty for the SCI program was significantly better than the allowable levels set forth in the audit plan.

Table F-36: Smart Construction Incentives Program Evaluation Results for PY4

Stratum	Observed Error Ratio Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand
C&I Non-Whole Building Medium	0.23	0.32	23.5%	1.9%
C&I Non-Whole Building Low	0.05	0.18	2.3%	4.6%
C&I Whole Building High	0.0	0.00	0.0%	0.0%
C&I Whole Building Low	0.02	0.39	0.0%	21.7%
GNI-Strata 1	0.19	0.69	0.00	0.02
GNI-Strata 2	0.41	0.40	0.74	0.2
GNI-Strata 3	0.06	0.20	0.07	0.4
GNI-Whole-Building 1	0.00	0.00	0.00	0.0
GNI-Whole-Building 2	0.03	0.28	0.01	0.2
Program Total			**3.1%**	**4.0%**

F.4.2.5 Review of Verified Savings Analysis

Table F-37 summarizes the data resulting from the M&V activities conducted by the PECO evaluation contractor.

Table F-37: Realization Rates and Precisions for PECO's PY4 Non-Residential C&I EE Programs from Annual Report

Program	Realization Rate (Energy)	Relative Precision (Energy)	Realization Rate (Demand)	Relative Precision (Demand)
Smart Equipment Incentives - C&I[1]	86%	10%	80%	20%
Smart Equipment Incentives – GNI[2]	95%	12%	110%	4%
Smart Construction Incentives	102%	6%	120%	2%
TOTAL PORTFOLIO[3,4]	**82%**	**6%**	**100%**	**3%**

[1] Values shown are inclusive of retrofit, multi-tenant, and appliance recycling strata
[2] Values shown are inclusive of retrofit, multi-tenant, appliance recycling, and new construction strata
[3] Individual program relative precisions are given at an 85% confidence interval, whereas the total portfolio relative precisions are given at a 90% confidence interval.
[4] Total portfolio realization rates include all programs – residential and non-residential.

Realization rates for energy savings from PECO's non-residential programs range from 86% (SEI C&I) to 102% (SCI). Realization rates for demand reductions range from 80% (SEI C&I) to 120% (SCI).

While the SWE notes the relative improvement from PY3 in reducing the margin of error for programs, the SEI C&I demand relative precision still exceeded the targeted 15%. The SWE strongly recommends that the evaluation contractor increase the sample size in the future to ensure that this issue is mitigated.

During PY4, PECO performed a variety of evaluation activities in order to verify its reported savings. Evaluation activities were to be performed in accordance with PECO's EM&V plan issued January 9, 2013. The plan included intended activities for fully deemed, partially deemed, and custom measures in accordance with the TRM.

The impacts for fully deemed measures are provided in the TRM or in an approved interim TRM measure protocol. Therefore, PECO's evaluation approach for fully deemed measures followed the basic level of rigor path: verifying quantities and that the measure installed matched the program and TRM-required specifications through review of project documentation.

For partially deemed measures, the measure type and overall impact of the measure were used to determine whether a basic or enhanced level of rigor was followed. For basic level of rigor, a physical on-site inspection was typically performed for each measure. This included verifying the measure's type and correct installation, operational assumptions, and installation quantity. Partially deemed measures where an enhanced level of rigor was used for verification followed one of the four IPMVP Options (A, B, C, or D).

Likewise, custom measures were also evaluated using an enhanced level of rigor and followed one of the four IPMVP Options. However, evaluating each custom measure additionally required an SSMVP to be developed and followed.

Figure F-4 depicts the frequency of each type of M&V performed by the evaluation contractor in the C&I and GNI programs and also displays the associated evaluated kWh for each M&V approach.

Figure F-4: Frequency and Associated Verified Savings by M&V Method for PECO's PY4 C&I and GNI Programs

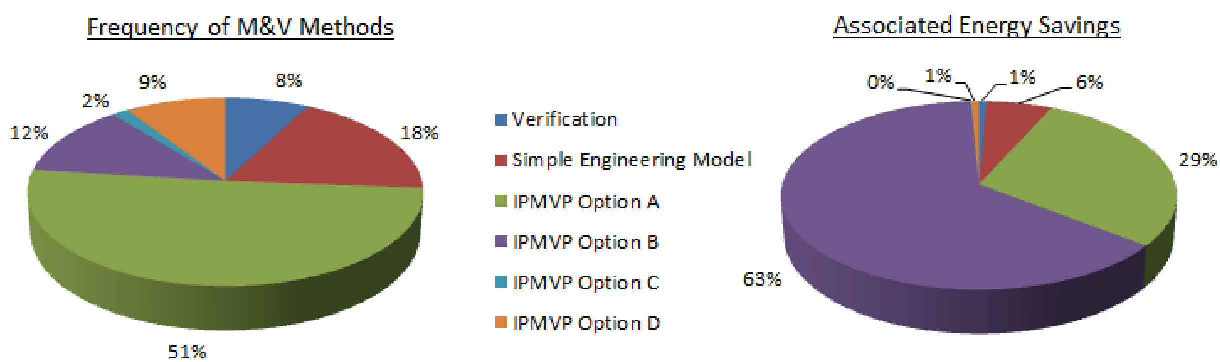
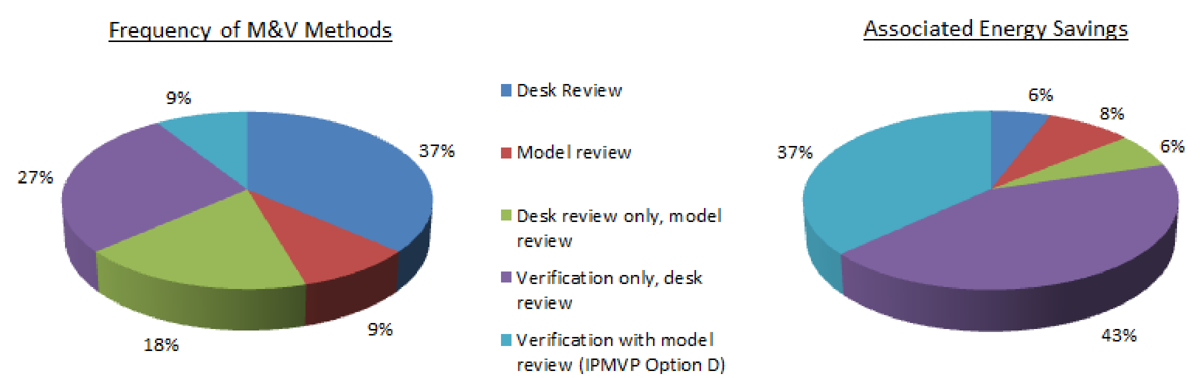


Figure F-4 indicates that roughly one-quarter of the sampled measures in the C&I and GNI programs (17 measures of 65 total) were evaluated using a basic level of rigor. However, the representative savings for each M&V type indicate that approximately 7% of the total evaluated savings were based on basic level of rigor approaches. This suggests that the use of basic rigor was appropriately used predominately for measures with smaller savings.

Due to the nature of the measures in the SCI Program and their associated evaluation efforts being dissimilar from those in the SEI C&I and GNI programs, the SCI program evaluation was reviewed separately.

Figure F-5 shows the relative frequency of each M&V approach used in the SCI program. The "model review" involved "comparing model inputs to parameters verified on-site and making adjustments to modeled savings if needed." The evaluation team received energy model outputs for all whole building projects, and executable modeling files for some. In cases where an executable modeling file was available, the evaluation team used an IPMVP Option D approach by verifying the existing model's inputs, metering and/or calibrating on available billing data, then making changes to the model as necessary. Since the evaluator verifies the projects after the fact, the evaluator sometimes has the unique opportunity to calibrate the energy models to actual utility bills for the facility in instances where sufficient data is available and expected typical building operation conditions exist.

Figure F-5: M&V Approaches Used in PECO's PY4 SCI Program Evaluation



It appears that roughly half the energy savings were verified through "Desk review" or "Verification only, desk review," which implies a basic level of rigor. Specifically, the projects falling under "Verification only, desk review" account for 27% of the sampled projects yet represent 43% of the verified energy savings. This indicates that some projects with larger than average energy savings were evaluated with a basic level of rigor. However, the SWE also notes the evaluator's use of "verification with model review". After discussing the "verification with model review" process with the evaluator and reviewing a sample project using this methodology, the SWE feels that this process is equivalent to the intent of IPMVP Option D, as discussed in the previous paragraph. Therefore, 9% of the sampled projects were verified at a high level of rigor and accounted for 37% of the sample's associated verified savings, implying that a high of level of rigor was appropriately applied to larger impact projects.

The SWE requested a subset of the evaluator's sample for review. By and large, the SWE agrees with the level of rigor and calculation methodology used. Table F-39 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for site evaluation.

Table F-38: IPMVP Methods and Verified Savings of PECO's PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Program Energy Savings	Verified Demand Savings (kW)	% of Program Demand Savings	Method
SEI C&I	PECO-11-03437	52,630	0.08%	30	0.3%	IPMVP Option C
SEI C&I	PECO-12-03961	2,192,407	3.40%	276	2.5%	IPMVP Option B
SEI C&I	PECO-10-01393	434,810	0.67%	121	1.1%	IPMVP Option D
SEI GNI	PECO-10-01385	32,454,576	41.71%	3081	28.0%	IPMVP Option B
SEI GNI	PECO-12-04133	2,348,133	3.02%	184	1.6%	IPMVP Option A
SCI	PECO-11-03345	2,893,203	4.48%	475	0.0%	IPMVP Option D

*From the PECO PY4annual report, savings per program: C&I = 64,530 MWh and 11.0 MW; GNI = 77,893 MWh and 11.8 MW; SCI = 8,494 MWh and 1.80 MW

Project number PECO-10-01385 involved the installation of a large CHP plant. The SWE agrees with the evaluation contractor's general savings calculation approach - using on-site verification of equipment, leveraging trend data from the customer's supervisory control and data acquisition (SCADA) system, and employing the same savings algorithms as was used by the implementation CSP. The SWE found the project's calculation spreadsheets and corresponding project report to be clearly and completely written. Further, the SWE was pleased that the Evaluation contractor leveraged a longer metering period to determine more accurate hours of use estimates, as well as investigated and modeled the plant's dependence on outdoor air temperatures.

Project number PECO-10-01393 entailed the installation of 1,491 programmable thermostats with occupancy sensors in a hotel. On-site activities included verifying different set points according to guest-room settings such as rented occupied, rented unoccupied, and unrented hibernating using data loggers and guest check-in status of nine guest rooms. While the evaluation approach is well documented (eQUEST model inputs, building characteristics, assumptions of variables), the final project report does not include any comparison or reference to the implementation CSP's approach and only states that "detailed calculations for these savings values are not included in the project files". With realization rates of 87% for energy and only 57% for demand, the SWE would have expected the evaluation contractor to work with PECO and the implementation CSP to investigate the large discrepancies in findings. If the approach used by the implementation CSP included using IPMVP Option D as well, the SWE recommends that the evaluation contractor review the inputs to the implementation CSP's model also.

Project PECO-11-03437 included an EMS and white roof installation. On-site activities included verifying the installation of both the new roof and EMS. However, on-site activities also revealed the installation of higher efficiency lighting and rooftop HVAC units. The evaluation contractor's analysis took these auxiliary measures into account by ensuring that the bill analysis was done post-lighting retrofit and also by individually calculating and then subtracting the savings gained by the higher rooftop unit (RTU) efficiencies. There also was an attempt to disaggregate the savings from the white roof and the EMS. The approach called for estimating the savings from the roof using the Department of Energy's (DOE's) Cool Roof Calculator, then subtracting those savings from the aggregate. However, as the evaluator stated in the project report, the calculator has a known validation issue for PECO's climate zone. While the SWE generally agrees with the evaluation contractor's approach of leaving the white roof and EMS savings in aggregate (as only project level savings are needed), the SWE encourages using more robust analyses at the individual measure-type level to more thoroughly support savings claims. In this case, perhaps another means of calculating the savings from the white roof could have been used in lieu of the DOE calculator.

The SWE generally agreed with the methodology and level of rigor used on the reviewed projects and the portfolio sample as a whole. However, there were some instances where there didn't appear to be sufficient documentation. For example, individual project reports sometimes lacked a clear explanation for very high or very low realization rates, or the annual report did not address the discrepancy between the realization rates reported in it and in the data request documents. However, these instances occurred infrequently, and overall the SWE was pleased with the evaluation contractor's inclusion of most key evaluation details in the annual report and the project files reviewed.

F.4.3 PPL

This section contains details on the SWE's audit of PPL's PY4 non-residential programs.

F.4.3.1 Site Inspection Findings

Table F-39 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of PPL non-residential project installations. Details about the SWE site inspection process can be found in Appendix B, section B.2.2.6.2.

The PPL PY4 site inspection findings are categorized into two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table F-39: PPL PY4 Non-Residential Site Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PPL-401	Lighting	RA	The number of fixtures controlled with occupancy sensors was incorrectly reported.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.
PPL-402	Lighting	RA	The evaluator did not obtain sufficient detail regarding lighting schedules to support the use of interview results.	Eval	The evaluator will emphasize with inspectors the importance of obtaining detailed schedules during inspections, particularly when interview results are used for the verified savings analysis.
PPL-403	Lighting	RA	The evaluator's original verified savings analysis did not account for two fixtures that were found t obe uninstalled during the site inspection.	Eval	The evaluator revised the verified savings to remove the savings associated with the two fixtures that were not installed.
			Baseline bulb count and fixture wattage were incorrect for a portion of the project.	Pro	The evaluator's verified savings analysis corrected the bulb count and fixture wattage to match those in the site contact's report.
PPL-404	Lighting	RA	Evaluator did not inquire about space conditioning or baseline fixture types.	Eval	The evaluator will emphasize with site inspectors the importance of asking about baseline fixture types, space conditioning, and other pertinent project details during future site inspections.
PPL-405	Lighting	RA	For a portion of the project, the evaluator failed to ask about baseline fixture type and counts. In addition, the evaluator did not inquire about lighting hours of use during the site inspection.	Eval	The evaluator will emphasize with site inspectors the importance of asking about all pertinent project details, including hours of use, baseline fixture types, and de-lamping during future site inspections.
PPL-406	Lighting	RA	The implementer chose the incorrect facility type (and associated lighting hours) from the TRM to characterize the facility.	Pro	The evaluator and SWE concurred that the incorrect facility type was selected by the implementer and that the verified savings reflects the appropriate building type and lighting hours of use.
			Several areas that were reported to be air conditioned were found not to be during the site inspection.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.
PPL-407	Lighting	RA	The implementer incorrectly reported space conditioning and fixture wattage for several spaces.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
			The evaluator did not adjust pre-installation fixture quantities in spaces where fewer fixtures than listed were observed.	Eval	The evaluator agreed and modified the verified savings analysis to reflect the reduced fixture quantities.
PPL-408	Lighting	RA	The evaluator used the incorrect lighting schedule to estimate hours of use for an area of the facility.	Eval	The evaluator agreed that the incorrect lighting schedule had been used.
PPL-409	Lighting	RA	The project documentation did not represent the as-installed fixture quantities and controls observed by the SWE and evaluator.	Pro	The evaluator and SWE both recommend that PPL emphasize with implementers the importance of accurate project documentation.
PPL-410	Lighting	RA	The site was in the middle of a tenant change within the first year of project savings. The evaluator performed logging at the time of site inspection to estimate hours of use, but did not use logging results because the evaluator's report stated "it was decided after the visit that facility operation at the time of the visit was not representative of the lifetime savings of the project." The evaluator used logging results from the implementer, performed six months earlier, to determine hours of use. The SWE believed these hours of use were not representative of the lifetime savings for the project and recommended TRM hours be used.	Eval	The SWE and evaluator differed on the lighting hours to represent the project impact. If future projects arise with this same issue, the SWE will provide guidance on treatment of such projects.
PPL-411	Lighting	RA	The evaluator did not inquire about permanent fixture removal during the site inspection.	Eval	The evaluator will stress with site inspectors the importance of inquiring about all key project details.
PPL-412	Lighting	IND	There were several instances where the on-site fixture quantities and fixtures types did not match the reported fixture types and quantities.	Pro	PPL will emphasize with implementers the importance of accurate and detailed documentation of project details.
PPL-413	Lighting	IND	The implementer did not use usage groups for this project as required by the TRM for projects with an impact of greater than 20 kW.	Pro	The SWE recommended using usage groups because the facility had a project impact of greater than 20 kW and distinct areas with different operating schedules.
PPL-414	VFDs	IND	All equipment was installed and operating as reported.	N/A	The SWE had no recommendations based on its review of this project.

F.4.3.2 Review of Savings Database

PPL listed five programs under the non-residential umbrella, which includes the small C&I, large C&I, and GNI sectors. Energy and demand savings were reported for all five programs during PY4. PPL's programs are designed to be cross-cutting, allowing customers from all rate classes to participate in them. Because the PY4 annual report format does not include sector-level insight, the SWE did not separate the participation and impacts of the non-residential portions of PPL's Appliance Recycling program from the participation and impacts of the residential portion. The Efficient Equipment Incentive program includes three subgroups; C&I Lighting – New Construction, C&I Lighting Retrofit, and EE Non-Lighting. Table F-40 shows the reported number of participants, energy savings, and demand savings from each reporting category in PY4 based on PPL's PY4 annual report. The Efficient Equipment Incentive program accounted for 76% of the gross reported energy savings and 83% of the gross peak demand savings from non-residential customers in PY4. The HVAC Tune-up and Renewable Energy programs contributed to a small portion of the total portfolio savings.

Table F-40: Annual Report Summary for PPL Non-Residential PY4 Programs

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	15,267	25,260	4.1
Custom Incentive *	112 projects paid in PY4 (some could have initiated before PY4) 83 new projects created in PY4	73,758	7.8
Efficient Equipment Incentive (lighting and non-lighting)	27,833	316,877	59.0
Renewable Energy	116	860	0.3
HVAC Tune-up	274	364	0.1
Total	**43,573**	**417,119**	**71.3**

*In the Custom Incentive Program, two metrics are used to count participants because of the time it takes to complete projects.

PPL provided a series of databases capturing all PY4 activity to the SWE Team for review. Table F-41 provides the participant count, energy savings, and demand savings by program according to the PPL database extracts.

Table F-41: Tracking System Summary for PPL Non-Residential PY4 Programs

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	15,267	24,561	4.1
Custom Incentive	83 new projects initiated in PY4	73,758	7.8
Efficient Equipment Incentive (lighting and non-lighting)	27,833	316,877	59.0
Renewable Energy	116	860	0.3
HVAC Tune-up	274	364	0.1
Total	**43,573**	**416,420**	**71.3**

Table F-42 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Variance}$$

Table F-42: Discrepancies Between PPL's Tracking System and PY4 Annual Report

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	0	699	0.0
Custom Incentive	0	0	0
Efficient Equipment Incentive (lighting and non-lighting)	0	0	0
Renewable Energy	0	0	0.0
HVAC Tune-up	0	0	0.0
Total	**0**	**699**	**0**

The SWE compared the figures in Table F-40 to the program tracking data that PPL submitted for each quarter of PY4. The SWE found a minor difference in the energy savings for the Appliance Recycling program, but all other fields were in perfect agreement. Note that variances do not necessarily indicate inadequate QA/QC or incorrect reported savings. This variation is often the result of program implementers or evaluators discovering a mistake or obtaining additional information about a project after the close of the quarter and modifying the record in the program tracking system. The SWE understands that program tracking is a continuous process, and historical corrections are expected and encouraged. PPL's evaluator also clarified that the definition of the participant can vary by program and that there is a difference between the "work package approval date" and "installation date." PPL uses the work package approval date to assign participant counts to specific quarters. Given the volume of rebates processed by PPL in PY4 and the complexity of the Act 129 tracking and reporting requirements, the SWE believes PPL's EEMIS tracking system is performing quite well.

Based on its audit findings, the SWE Team recommends that PPL and its evaluator continue to perform periodic comparisons between the values reported in the quarterly and annual reports and those listed in tracking data extracts. This comparison will help ensure that the participant counts and savings impacts shown in the filed reports continue a high level of agreement with those in the database.

F.4.3.3 Review of Project Files

The SWE review of non-residential projects completed by PPL customers during PY4 was done using project documentation files uploaded quarterly to the SWE SharePoint site. These files included project-level savings calculation worksheets, specification sheets for equipment installed, invoices, customer incentive agreements, and post-inspection forms. The documentation provided was comprehensive, detailed, and organized and allowed for complete review of all uploaded projects.

Twenty projects were reviewed to assess the consistency of the program tracking database and the overall completeness of documentation for each project. The20 projects included 10 C&I Lighting Retrofit projects, 5 Custom Incentives projects, 3 EE Non-Lighting projects, 1 HVAC Tune-Up project, and 1 Renewable Energy project. Overall the documentation for the reviewed projects was quite good and consistent with the database, though there were some omissions on a specific basis. Table F-43 summarizes the discrepancies that were found in the reviewed projects between the project documentation and the program tracking database. The discrepancies are further detailed in the paragraphs below.

Table F-43: Summary of Discrepancies between PY4 Project Documentation and Program Tracking Database

Unique ID	Program	Reported kWh/yr	Reported kW	Rebate Amount
PPL-10-03744	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-LTO-12-0269	C&I Lighting Retrofit	Discrepancy	Discrepancy	Consistent
PPLDI-12-7293	C&I Lighting Retrofit	Discrepancy	Discrepancy	Consistent
PPLLTO-CC15-12-7066	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-7053	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPL-10-05365	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLLTO-MS20-10-04873	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLLTO-MS20-10-04729	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-4649	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-8738	C&I Lighting Retrofit	Consistent	Consistent	Consistent
233	Custom Incentives	Consistent	Consistent	Consistent
263	Custom Incentives	Consistent	Consistent	Consistent
363	Custom Incentives	Consistent	Consistent	Consistent
344	Custom Incentives	Consistent	Consistent	Consistent
373	Custom Incentives	Consistent	Consistent	Consistent
PPL-10-04831	EE Non-Lighting	Consistent	Consistent	Consistent
PPL-10-04798	EE Non-Lighting	Consistent	Discrepancy	Consistent
PPL-10-04615	EE Non-Lighting	Consistent	Consistent	Consistent
668964	HVAC Tune-Up Program	Consistent	Consistent	Consistent
64740653	Renewable Energy Program	Discrepancy	Discrepancy	Consistent
	Total Consistent	**17**	**16**	**20**
	Total Discrepancy	**3**	**4**	**0**

<u>C&I Lighting Retrofit Program</u>

Two projects (PPLDI-LTO-12-0269 and PPLDI-12-7293) had project documentation that disagreed with the tracking database in energy and demand savings. The first of these projects, a lighting retrofit and controls project, had an energy savings of 283,483.6 kWh/yr and a demand reduction of 44.19 kW in the program tracking database. This value was also listed in the TRM calculator. However, in the program application, post-installation inspection report, project completion form, and notification of payment, the energy savings was listed as 147,651.6 kWh/yr and the demand reduction of 52.35 kW. The cause for this discrepancy was a difference in the operating hours that were used to calculate the savings., According to the TRM calculation sheet, the EFLH was 4,290 based on it being categorized as a Manufacturing – Light Industrial facility, whereas the actual operating hours of the lighting ranged from

48 to 50 hours per week (less than 2,600 hours per year). While the energy savings and demand reduction in the project forms, other than the TRM calculator, are more accurate, the TRM calculation is correct based on the rules of the program.

For the second of the two projects, which involved a retrofit to seven exit lights, the same discrepancy was found between the program documents (2,140.32 kWh/yr and 0.25 kW) and the TRM calculator (1,198.58 kWh/yr and 0.29 kW). The cause for this discrepancy was also a difference in the operating hours that were used to calculate the savings. According to the TRM calculation sheet, the EFLH was 4,368 based on it being categorized as a Retail – Single-story Large facility, whereas the actual operating hours of the lighting were 24 hours/day (8,760 hours per year). While the energy savings and demand reduction in the project forms, other than the TRM calculator, are more accurate, the TRM calculation is correct based on the rules of the program. The observed differences between the TRM default EFLH and the actual site operating conditions highlight the need to move to more customer-specific data collection in Phase II of Act 129.

EE Non-Lighting Program

One project (PPL-10-04798) showed a difference in the reported demand savings in the submitted project information and the tracking database. The project took place at a community college and included a retrofit of HVAC fans and chiller pumps. The demand reduction was 8.94 kW in the program tracking database and in the TRM calculator as well, but in the application summary the demand reduction was 7.96 kW It is is unclear why 8.94 kW was found in the program tracking database. The SWE assumes it is a data-entry issue.

Renewable Energy Program

The one renewable energy project that was reviewed (64740653) did not include information on the reported energy or demand reduction. This project had information on the expected tonnage for the ground-source heat pump as well as the actual tons and the EER, but there was no summary of the expected level of generation capacity in terms of kWh/yr or kW. Based on the size and efficiency of the equipment, the savings estimates correspond to an EFLH of only approximately 450, which appears too low for a unit responsible for both heating and cooling.

Additional Discrepancies in Project Documents

Table F-44 summarizes the three types of PPL project documents that were either provided, not provided, or found to be incomplete. As can be noted in the table, nearly half of these documents were not provided by the EDC. While these can likely be considered nonessential documents, it will be important to emphasize more thorough provisioning of these documents in future program years.

Table F-44: Summary of PY4 Provision of Confirmation, Equipment Specs, and Invoices

Unique ID	Program	Installation Confirmation	Equipment Specs	Invoices
PPL-10-03744	C&I Lighting Retrofit	Provided	Provided	Provided
PPLDI-LTO-12-0269	C&I Lighting Retrofit	Provided	Not Provided	Provided
PPLDI-12-7293	C&I Lighting Retrofit	No notes	Not Provided	Not Provided
PPLLTO-CC15-12-7066	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
PPLDI-12-7053	C&I Lighting Retrofit	Provided	Provided	Not Provided
PPL-10-05365	C&I Lighting Retrofit	No notes	Provided	Provided
PPLLTO-MS20-10-04873	C&I Lighting Retrofit	No notes	Not Provided	Provided
PPLLTO-MS20-10-04729	C&I Lighting Retrofit	Provided	Provided	Provided
PPLDI-12-4649	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
PPLDI-12-8738	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
233	Custom Incentives	Provided	Provided	Provided
263	Custom Incentives	No notes	Provided	Provided
363	Custom Incentives	Provided	Not Provided	Not Provided
344	Custom Incentives	No notes	Provided	Not Provided
373	Custom Incentives	Provided	Provided	Provided
PPL-10-04831	EE Non-Lighting	No notes	Provided	Provided
PPL-10-04798	EE Non-Lighting	No notes	Incomplete	Provided
PPL-10-04615	EE Non-Lighting	Provided	Provided	Not Provided
668964	HVAC Tune-Up Program	No notes	Provided	Provided
64740653	Renewable Energy Program	No notes	Not Provided	Provided
	Total Provided	11	11	12
	Total Not Provided	9	9	8

Overall the forms uploaded were well organized, easy to work with, and provided all the information required to complete a thorough review of the selected projects. The issues highlighted above were only observed on a small number of projects, and the project-specific inconsistencies were minimal for the size of the overall programs. The inconsistencies reported are minor database oversights and data-entry errors, which are expected given the volume of projects processed by PPL. The remaining projects reviewed showed consistency between the database and project-specific files. The SWE believes the uploaded documents provided sufficient insight into the savings calculations and documentation processes used by PPL and believes the associated reported savings estimates are valid.

F.4.3.4 Review of Sample Design

PPL's PY4 final annual report provides detailed information about the sample design and selection for the PY4 gross impact evaluation of non-residential programs. The sampling plan for PY4 continually aligns with and exceeds the requirements of the SWE annual sampling guidelines for Act 129 programs, including:

1. 90%/10% confidence and precision (C/P) at the portfolio level for non-residential programs
2. 85%/1%5 C/P for each program in the portfolio
3. GNI and low-income sector populations treated as independent program populations and sampled at 85%/15% C/P if the energy savings contribution to the respective sector-level portfolios is more than 20%
4. All C/P levels are minimum requirements, and EDC evaluators are encouraged to exceed them.

The initial sample design for each program in PY4 was based on PY3 participation, realization rates, and error ratios/coefficients of variation. The target numbers of sample points were established using conservative assumptions so that even if the PY4 results were more variable than PY3, PPL would still meet the required precision levels. PPL's evaluation contractor also conducted a quarterly review of the measure mix and distribution of measures by sector and made adjustments where necessary. In PY4Q4, the final verification of samples was conducted considering participation from the full program year.

Four PPL non-residential programs reported savings in PY4: the Efficient Equipment Incentive Program (includes lighting and non-lighting strata), the Renewable Energy Program, the HVAC Tune-Up Program, and the Custom Incentive Program.

F.4.3.4.1 Efficient Equipment Incentive Program

The non-residential Efficient Equipment Incentive Program evaluation group included lighting, non-lighting, and direct discount programs. Because of the large variation in unit ex-ante savings across measures from over 13,000 participants in this evaluation group in PY3, PPL's evaluation contractor stratified the program into large, medium, and small strata, based on total measure ex-ante energy savings (see Table F-45). Lighting measures were treated as the large stratum since they comprise the largest measure group. The medium stratum included the adjustable speed drive (ASD) and variable speed drive (VSD) measure groups, and the small stratum included HVAC measures, office equipment, and miscellaneous measures. The large (lighting) stratum received some additional sub-stratification as well. The medium and small strata targeted 15% precision at 85% confidence, while the large stratum targeted 10% precision at 90% confidence.

Table F-45: PPL PY4 Efficient Equipment Incentive Program Non-Residential Sector Strata

Stratum	Stratum Definition	Substratum	Measure Groups
Large	Top 80%	Direct Discount	Lighting
		Large Lighting	
		Medium Lighting	
		Small Lighting	
Medium	Next 10%		VSD, ASD, and refrigeration
Small	Last 10%		All others: HVAC, appliances, office equipment, insulation, other

Because participation in PY4 was anticipated to be similar to that in PY3, the proposed PY4 sampling plan was based on cumulative PY3 participation. The PY4 sampling plan was based on the final number of measures installed in PY3, along with respective ex-post verified savings and variability assumptions. By checking the quantities of measures rebated and the respective contribution of reported energy savings (kWh) to the total sector's savings, PPL's evaluation contractor determined there was no need to change the strata definitions or target number of sample points in each stratum. In the non-lighting samples, the site visits for the small stratum were originally planned to be nested within the medium stratum; however, it was not possible to reach the small stratum quota with this strategy. Therefore, the PPL's evaluation contractor conducted additional record reviews for the small measures to meet the quota. No site visits were conducted for the measures installed by participants only in the small stratum.

After receiving all records for PY4 at the end of the program year, PPL's evaluation contractor adjusted the original sampling plan for the medium and small strata to address the following issues.

1) *Different realization rates were calculated from motors and VSD samples installed in different years.*

The savings of many sampled motors and VSD projects that had been installed in 2010 and 2011 were calculated according to the methodology from the 2010 and 2011 TRMs, and the savings of the motors and VSD projects installed in PY4 were calculated according to the 2012 TRM methodology. Twelve VSD projects (medium stratum) and six motors projects (small stratum) were added to the records review sample by PPL's evaluation contractor, so that separate realization rates for 2010-2011 and 2012 could be calculated.

2) *New measures were processed after Q4 changed the target sample distribution.*

PPL's evaluation contractor drew an additional 11 measures from the medium stratum and an additional 13 measures from the small stratum. The samples were randomly chosen to reflect the underrepresented measures (including insulation, evaporator fans, [ASHPs], [DX AC], and chillers) in the original sample plan.

3) *The commercial insulation measures were originally part of the non-residential small stratum, but the realization rates for the initial sampled projects were not representative of all insulation projects or of the other measures in the commercial small stratum.*

PPL's evaluation contractor separated these measures into their own stratum because savings and realization rates were highly variable for insulation measures. The SWE reviewed these adjustments to the PY4 sampling plan and felt each was an appropriate response to the circumstances.

The PY4 stratification plan within the large stratum was based on the number of non-residential lighting projects installed in PY3 and their distribution between direct discount and standard (referring to prescriptive rebates) delivery paths observed in PY4Q1. The kWh error ratio of 0.4 was used for calculating the sample size for this stratum. The 0.4 value was rounded up from the observed PY3 error ratio of 0.34. A stratified sampling approach was used to separate the lighting stratum into four substrata: direct discount, standard large, standard medium, and standard small. Sample sizes for each substratum were based on its contribution to total reported kWh savings. According to the information provided in PPL's final annual report, new construction was added as a fifth substratum to the lighting stratum, with 10 samples for site visits and records review. One sample point was added in the direct discount stratum, 10 sample points were added in the standard small stratum, and 4 sample points were reduced from the standard large stratum. Details of the targeted sample sizes and completed sample sizes for the non-residential Efficient Equipment Incentive Program projects are shown in Table F-46.

Table F-46: PPL PY4 Efficient Equipment Incentive Program Nonresidential Projects Sample Plan

Stratum	Substratum	PY4 Sampling Rigor & Cv	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	Direct Discount	90/10, Cv=0.4	24	25	Site Visits & Records Review
	Standard Large		12	8	
	Standard Medium		8	8	
	Standard Small		8	18	
	New Construction		-	10	
Medium	-	85/15 at program level, 90/10 at sector level; assumed Cv or proportion in sample design: 0.5	20	43	Records Review
			20	21	Site Visits
Small	-		20	39	Records Review
			20	1	Site Visits

The observed error ratios and the relative precision for each stratum of PY4 non-residential Efficient Equipment Incentive Program projects are shown in Table F-47.

Table F-47: PPL Efficient Equipment Incentive Program Nonresidential Sector Evaluation Results

Stratum	Observed Error Ratio for Energy	Relative Precision for Energy	Observed Error Ratio for Demand	Relative Precision for Demand
Non-residential Large (Lighting)	0.19	4.54%	0.17	1.00%
Non-residential Medium	0.86	21.15%	0.75	18.47%
Non-residential Medium, Small (Motors/VSDs from 2010 and 2011)	0.31	6.98%	0.67	15.19%
Non-residential Small (Insulation)	N/A*	N/A*	N/A*	N/A*
Non-residential Small	2.38	48.59%	2.1	42.74%
*This stratum did not include sampling. Cv and Precision are not meaningful.				

F.4.3.4.2 Renewable Energy Program

In PY4, the Renewable Energy Program was only available to the GNI sector for a few remaining projects in progress. All projects were included in the sample for records review, and five projects received site visits by PPL's evaluation contractor.

F.4.3.4.3 HVAC Tune-Up Program

The HVAC Tune-Up Program used a census approach that covered PY4 program participants. All measures were included in the desk review and analysis. This program's evaluation did not include sampling, thus C_v and precision are not meaningful.

F.4.3.4.4 Custom Incentive Program

Projects in the Custom Incentives Program were defined as large or small projects for the purpose of verification. A census of the 41 projects in the large stratum in PY4 was included in the impact evaluation sample and was verified. A sample of 8 projects was selected from 71 total projects in the small stratum in PY4 and was verified. The error ratio is reported instead of coefficient of variation because the realization rate (for the small stratum) was calculated using ratio estimation, and the error ratio is used in sample planning. For the large stratum, the observed error ratio was 0.39 for energy, which is only for the 10 projects for which PPL paid the incentive prior to verification. There is no sampling uncertainty for the large stratum because a census of completed projects was verified. For the small stratum, the observed error ratio was 0.27 and the relative precision was 13.6% for energy. The program total observed error ratio was 0.33 for energy and 0.16 for demand. The program total relative precision was 6.2% for energy and 3.0% for demand.

F.4.3.5 Review of Verified Savings Analysis

Table F-48 summarizes the data resulting from the M&V activities conducted by the PPL evaluation contractor.

Table F-48: PPL PY4 Non-Residential Energy Efficiency Programs - Realization Rates and Relative Precisions for Energy and Demand Savings

Program	Realization Rate (Energy)	Relative Precision (Energy)	Realization Rate (Demand)	Relative Precision (Demand)
Custom Incentive	98%	6.2%	102%	3%
Efficient Equipment Incentive[1]	97%	4.2%	91%	3.2%
HVAC Tune-Up	100%	N/A[2]	100%	N/A[2]
Renewable Energy	72%	9.8%	78%	14.9%
Total Portfolio[3]	**98%**	**1.9%**	**90%**	**1.8%**

[1] Values shown in this table for this program include both residential and non-residential sectors.
[2] This program did not include sampling, therefore relative precision is not applicable.
[3] Total portfolio realization rates include all programs – residential and non-residential.

During PY4, PPL performed a variety of evaluation activities in order to verify its reported savings. Evaluation activities were to be performed in accordance with each program's QA/QC and EM&V plan submitted by PPL in May 2012. The plans specified data collection and reviewing activities, including EEMIS data and other required data included with the rebate application forms, billing data, participant surveys, on-site visits, and metering for some lighting and most custom projects.

The level of rigor used to evaluate projects sampled in each program generally followed the program's corresponding QA/QC and EM&V plan. The HVAC Tune-Up, Renewable Energy, and non-lighting portion of the Efficient Equipment Incentive programs only used a basic level of rigor in their evaluation efforts, opting to use simple on-site verification and/or desk reviews for their entire samples. This was likely due to the programs' relatively low contribution to the portfolio savings, as shown in Figure F-6. Further, it appears that the other programs – Custom Incentive and the lighting portion of Efficient Equipment Incentive – follow the same trend, where the level of rigor used in each program is proportionate to the program's savings contribution to the overall portfolio (see Figure F-7). Overall, the SWE feels that this is a valid approach for using limited EM&V funds toward the highest impact projects. However, the SWE still suggests that the evaluation contractor review the use of high rigor evaluation approaches in programs with smaller, yet still significant, savings.

Figure F-6: PY4 Evaluation Sample Verified kWh Savings by Program (rounded to the nearest percent)

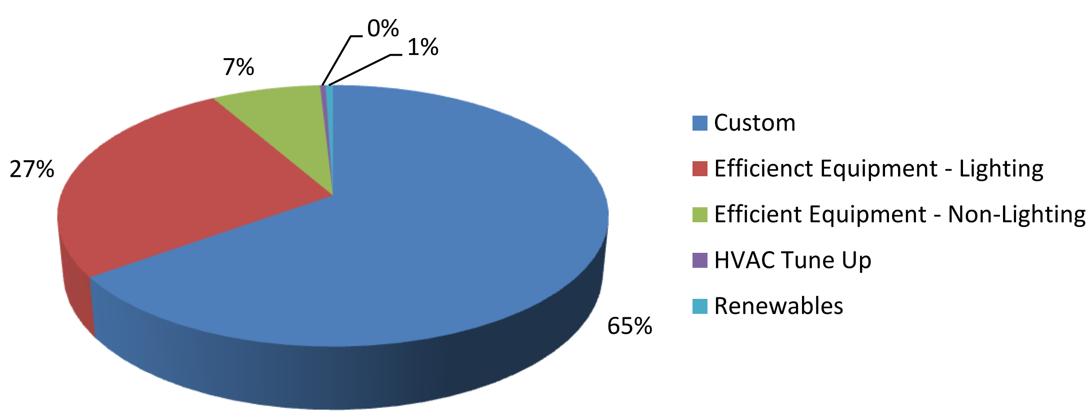


Figure F-7: Level of Rigor Use by Project Count in PPL Non-Residential Programs

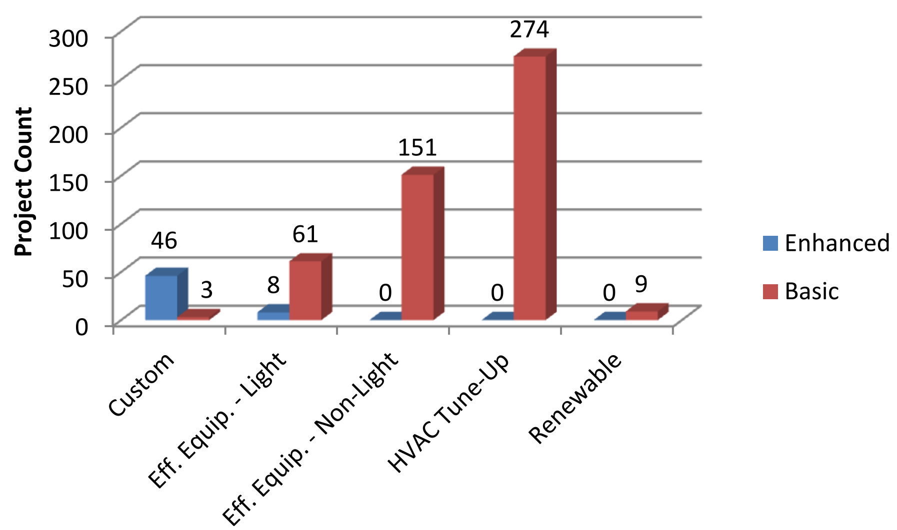


Figure F-8 depicts the frequency of each type of M&V performed by the evaluation contractor across the non-residential programs and the associated energy savings (kWh) for each M&V approach.

Figure F-8: PY4 M&V Approaches Used in PPL's Non-Residential Projects

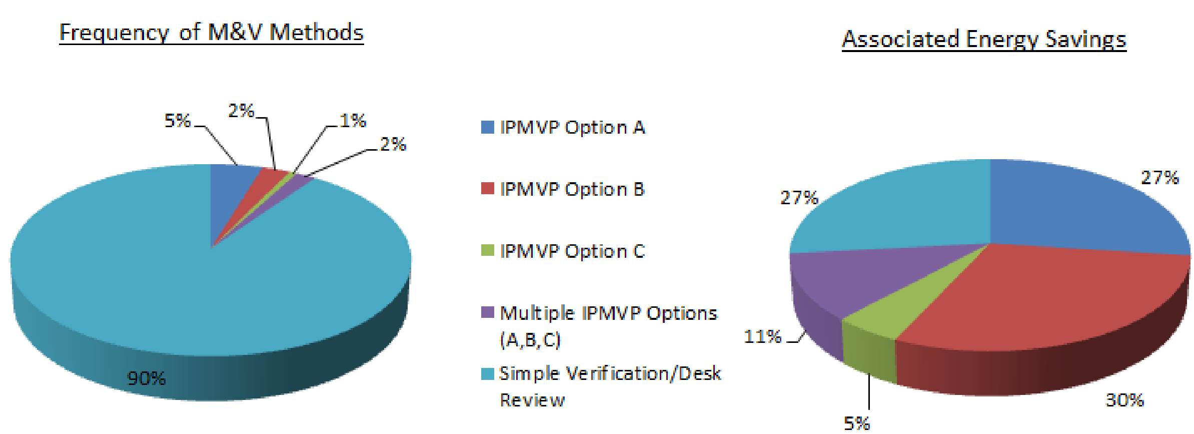


Figure F-8 indicates that 73% of verified energy savings were verified using enhanced levels of rigor, therefore reinforcing what was stated previously: it appears that the evaluation contractor correctly applied enhanced levels of rigor on projects with the highest impact. However, over one-quarter of the energy savings was still verified using a basic level of rigor. The SWE suggests that the evaluation contractor increase the quantity of projects verified at an enhanced level of rigor. This would result in both lowering the proportion of savings verified using a basic level of rigor and helping better understand savings from programs the currently do not have any projects that were verified at an enhanced level of rigor (see Figure F-7).

The SWE requested a subset of projects in the evaluator's sample for review. By and large, the SWE agreed with the level of rigor and calculation methodology used. Table F-49 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for site evaluation.

Table F-49: IPMVP Methods and Verified Savings of PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Program Energy Savings	Verified Demand Savings (kW)	% of Program Demand Savings	Method
Custom	212	3,407,005	5.4%	454	6.7%	IPMVP Options B & C
Custom	233	1,164,004	1.8%	86	1.3%	IPMVP Option B
Eff. Equip. – Lighting	PPL-10-05158	6,061,995	11.7%	645	8.6%	Simple Verification
Eff. Equip. – Lighting	PPLLTO-T12-10-04205	2,212,185	4.3%	323	4.3%	IPMVP Option A
Eff. Equip. – Non-lighting	PPLLTO-VSD-10-04442	195,194	2.7%	91	12.7%	Simple Verification (Desk Review)
Eff. Equip. – Non-lighting	PPLLTO-MS20-10-05785	170,443	2.3%	15	2.1%	Simple Verification (Desk Review)
Eff. Equip. – Non-lighting	PPL-10-05554	6,416	0.1%	11	1.5%	Simple Verification (Desk Review)

Project 212 included removing two transformers and adding VFDs on two 600HP motors. The savings calculation from removing the two transformers was relatively straightforward and was based on simple verification and determining no-load losses and additional oil circulation pumps and cooling fans used by the removed transformers. The VFDs were measured using the facility's existing meters, with the evaluator noting a correlation between tons of material processed and fan use. Using these as a proxy and three months of post-retrofit metering data, the VFD savings were calculated. The SWE feels that this method is a valid approach but still may take into account variances in other loads fed by the meters. The most robust process would be to meter the power draw to the VFDs directly, as outlined in the project's SSMVP. The project's verification report stated that directly metering the VFDs was not possible due to the equipment being connected to high voltage (2300 V) lines. The SSMVP took this safety issue into account and stated that the metering was to be performed using a current transducer (CT) on a secondary circuit or, if a secondary circuit was unavailable, directly from measuring the input to the VSD and after the step-down transformer (480 V). However, the verification report did not cite a reason why direct measurement was not done, only that it had not been done.

Project PPL-10-05158 involved retrofitting metal halide fixtures with high-bay T8 lighting. The evaluation contractor verified fixture types and counts installed on site and used the light metering data from the implementation CSP to verify the savings. The evaluation contractor used information from a customer interview to determine that the facility operates 24 hours/day on weekdays and 18 hours/day on weekends, with three shut-down days per year, which yields approximately 8,062 operating hours/year. However, 7 lighting loggers were installed for 25 consecutive days and showed that the lights were on very close to 100% of the time. The evaluation contractor then revised the estimated hours of use based on extrapolating the light metering data and a customer interview indicating the facility is shut down 5 days per year, arriving at 8,638 operating hours/year. The SWE agrees with this methodology and encourages the use of logged data over interview data, when available.

Project PPLLTO-VSD-10-04442 involved adding VFDs to motors serving chilled water pumps, condensing water pumps, and a cooling tower fan. The ex-ante savings notes the installation of eight VFDs, whereas the invoices indicate seven VFDs were installed. During the on-site visit, the evaluation contractor noted the installation of only seven VFDs and remarked that this more closely matched the invoices than the ex-ante savings estimate. However, the evaluation contractor's calculations appeared to still count savings from eight VFDs, and showed a verified quantity of eight VFDs for this particular project. No documentation from the evaluation contractor's further explaining the discrepancy between the calculation and the remark was found in the project file submitted to the SWE. The SWE highly recommends that the evaluation contractor pay closer attention to calculation inputs. Moreover, the SWE suggests that the evaluation contractor increase the level of documentation (e.g., on-site photos, checklists, notes, etc.) supplied for each project file. This would likely mitigate the discrepancy issues and allow for a quicker and more robust review. Further, the SWE notes the size of this project. While the 2011 TRM (applicable to this project based on the installation date) does not specify a minimum kWh savings that would trigger an enhanced level of rigor to be performed, the SWE would have expected the evaluation contractor to consider using enhanced rigor to evaluate this project given its size, and to document the reason for choosing not to pursue an enhanced level of rigor -- especially since this project was evaluated during PY4, when the evaluation contractor could reference the current TRM (2012 TRM), which used a 50,000 kWh savings minimum threshold to trigger a mandatory metering study.

Generally, the SWE agreed with evaluation contractor's savings calculation methodologies when sufficient documentation was present in the project file for the SWE to review. Many of the reviewed project files lacked detailed documentation explaining alternative calculations or deviations from the ex-ante savings calculations. The SWE recommends that the evaluation contractor be more detailed in documenting and more systematic in recording the evaluation work and corresponding outcomes.

F.4.4 Met-Ed

This section contains details on the SWE's audit of Met-Ed's PY4 non-residential programs. The sections "Site Inspection Findings" and "Review of Project Files" (Sections F.4.4.3 and F.4.4.3 respectively) also include information from Penelec, Penn Power, and West Penn Power. This is because all four FirstEnergy companies presented audit information for these two sections to the SWE in aggregate.

F.4.4.1 Site Inspection Findings (Met-Ed, Penelec, Penn Power, and West Penn Power)

Table F-50 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of FirstEnergy non-residential project installations. Details about the SWE site inspection process can be found in Appendix B, section B.2.2.6.2.

The FirstEnergy PY4 site inspection findings are categorized into three types

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.
- TRM findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

Table F-50: FirstEnergy PY4 Non-Residential Site-Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
FE-401	Lighting	RA	The evaluator did not adjust the fixture counts for a small number of uninstalled fixtures and instead applied a discount rate to the savings to account for delayed installation.	Eval	The evaluator revised the savings to account for the uninstalled fixtures. The SWE recommended that savings for the delayed fixtures begin in PY5 since it was highly likely the fixtures were going to be installed imminently. However, applying a discount rate is not appropriate since Phase I compliance is based on measures that are installed and operational by May 31, 2013.
			None of the versions of the Appendix C in the project file matched the reported savings for this project.	Pro	The SWE recommended to FirstEnergy that for future projects the contents of project files should be clearly labeled and the version of the Appendix C supporting the reported savings should be provided.
FE-402	Lighting	RA	The evaluator did not conduct a census of the installed fixtures. The SWE judged that the quantity of fixtures included in the project was not prohibitive to obtaining an exact fixture count. Also, there was uncertainty in the project scope that could have been clarified via a census.	Eval	The evaluator agreed with the SWE and will be more diligent in future projects that are similar.
FE-403	Lighting	RA	The evaluator installed two light loggers to monitor fixtures controlled by occupancy sensors and assumed that if one logger indicated that the lights were on, then all lights affected by the project were assumed to be on. The SWE noted that one logger was installed in a high-use location and the other in a low-use location and thus the evaluator's assumption may not be valid.	Eval	The evaluator revised the logger data analysis to calculate hours of use for each logger separately (high- and low-use) and then averaged the results to more accurately represent the average hours of use of for all fixtures affected by the project.
			Reported fixture counts did not agree with site inspection findings.	Pro	The evaluator corrected the fixture count discrepancies in verified savings analysis.
FE-404	Lighting	RA	Some of the evaluator's fixture types and counts did not agree with the site inspection findings, and the lighting hours of use in the evaluator's analysis differed from the hours posted on the facility's website.	Eval	The evaluator corrected the fixture types and counts to agree with the site inspection findings and the hours of use to agree with the posted hours.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
			Reported fixture counts and fixture types did not agree with site visit findings for a portion of the project.	Pro	The SWE recommends that FirstEnergy emphasize with implementers the importance of documenting accurate project details.
FE-405	Lighting	RA	The evaluator assumed that rebated lamps were sold by the customer with merchandise and thus assumed residential lighting hours of use. Based on the SWE's interview with the site contact, the SWE does not believe the rebated lamps were sold.	Eval	The evaluator revised the hours of use to be consistent with the SWE's interview with the site contact.
FE-406	VFDs	RA	Ex-ante savings analysis was not included in the project file.	Pro	The SWE requested that the implementer's savings analysis be included as part of all future project files.
			The implementer's engineering analysis was presumed by the evaluator and SWE to be inappropriate for the application of the VFDs. The result was that the reported savings was significantly overstated.	Pro	The evaluator corrected the implementer's assumptions and calculation to reflect the application of the VFDs included in this project. The evaluator and SWE agreed on the verified savings impact.
FE-407	Lighting	RA	The project documentation did not include any supporting calculations or assumptions to support lighting hours of use that differed from the TRM hours.	Pro	The SWE recommended that FirstEnergy emphasize with implementers that all hours of use estimates should be documented in a transparent manner (i.e., detailed lighting schedules).
			The evaluator did not inquire about lighting hours of use in all spaces or attempt to quantify the number of fixtures that were on occupancy dimming controls prior to the project.	Eval	For future projects the evaluator will emphasize with inspectors the importance of obtaining detailed lighting schedules for all spaces.
			Lighting controls were not accounted for in peak demand reduction calculations.	TRM	The 2014 TRM incorporates this finding and allows for peak demand reduction impacts of lighting controls to be accounted for.
FE-408	Lighting	RA	The implementer did not use TRM fixture codes for any fixtures but rather listed all fixtures as custom.	Pro	The SWE recommended that the implementer use TRM fixture codes for fixtures that are in the TRM.
			The project documentation did not provide accurate support for fixture wattages and ballast types.	Pro	The SWE recommended that the implementer provide better project documentation.
			The implementer and evaluator both incorrectly characterized space cooling for the warehouse areas of the facility.	Pro/Eval	The evaluator concurred and adjusted the space cooling of the warehouse areas to match on-site findings.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
FE-409	Lighting	RA	The implementer labeled fixture types as custom when TRM fixture codes existed and used the incorrect wattages for some custom fixtures.	Pro	The SWE recommended that the implementer use TRM fixture codes for fixtures that are in the TRM and provide better project documentation.
			The implementer reported what the evaluator and SWE agreed was an unrealistic quantity of fixtures as removed and not replaced and provided no documentation to support this removal.	Pro	The SWE recommended that the implementer provide better project documentation.
FE-410	Lighting	IND	Hours of use assumptions and calculations were not documented in the project file. Also, specification sheets were not provided to support all custom fixture codes.	Pro	First Energy has recently implemented a practice of having applicants provide signed letters that document hours of use assumptions, particularly for large projects.
FE-411	Lighting	IND	The implementer did not use an hour of use estimate that accurately reflected the lighting schedule of the facility.	Pro	The SWE recommended that the implementer use hours of use estimates that accurately reflect the lighting schedule of the facility.
FE-412	VFDs, HVAC controls, vending machine controls	IND	The prescriptive portion of the project (which was a minor contributor to total project savings) was not reported using TRM protocols.	Pro	The SWE recommended that implementerd use TRM protocols for measures included in the TRM. The calculations should be transparent and any departures from the TRM based on project-specific data should be clearly identified and documented..

F.4.4.2 Review of Savings Database

Met-Ed lists five programs in its non-residential portfolio. It defines programs within that portfolio primarily by customer sector. All five programs achieved energy and demand savings during PY4. The reported gross energy savings from non-residential programs was 88,130 MWh, and the reported gross demand savings was 33.49 MW. The number of participants, gross reported energy impact, and gross reported demand impact for PY4 are shown in Table F-51.

Table F-51: Met-Ed Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	401	25,538	7.23
Large C&I Performance Contracting/Equipment	94	38,087	18.30
Non-Profit	11	455	0.10
Remaining Government/Non-Profit	358	24,043	7.86
Streetlighting	1	7	0.00
Total	**865**	**88,130**	**33.49**

FirstEnergy provided the SWE Team a database of project activity for each of its operating companies. This database contained the key reporting metrics for each project reporting savings for each quarter. It also contained detail on the types of EE equipment installed at each site to generate savings. The SWE Team identified each of the distinct participants and the energy and demand impacts associated with that participant for each Met-Ed non-residential program. Table F-52 shows the total participant counts, energy savings, and demand savings by program from Met-Ed's non-residential projects in the FirstEnergy savings database.

Table F-52: Met-Ed Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	401	25,538	6.20
Large C&I Performance Contracting/Equipment	94	38,087	15.70
Non-Profit	11	455	0.09
Remaining Government/Non-Profit	358	24,043	6.74
Streetlighting	1	7	0.00
Total	**865**	**88,130**	**28.72**

Table F-53 shows the variances between the reported figures and the information contained in the FirstEnergy tracking database. All variances are reported as follows:

$$\textit{Reported Figure} - \textit{Database Summary} = \textit{Variance}$$

Table F-53: Met-Ed Non-Residential Program Discrepancies

Program	Participants	MWh	MW
Small C&I Performance Contracting/Equipment	0	0	1.03
Large C&I Performance Contracting/Equipment	0	0	2.60
Non-Profit	0	0	0.01
Remaining Government/Non-Profit	0	0	1.12
Streetlighting	0	0	0.00
Total	**0**	**0**	**4.77**

The total number of non-residential participants and total energy impacts (MWh) in the database summary match perfectly with the figures reported in Met-Ed's PY4 annual report for all the programs. The reported demand impacts were 4.77 MW higher than the impacts shown in the savings database. The SWE confirmed with the EDC evaluation contractor that this variance in peak demand is a function of the application of line losses in the reported figures, but not in the program tracking data. Based on its audit findings, the SWE Team commends FirstEnergy for the zero variance between tracked and reported energy savings and participant counts for Met-Ed's non-residential programs.

F.4.4.3 Review of Project Files (Met-Ed, Penelec, Penn Power, and West Penn Power)

FirstEnergy provided the SWE Team with project files for 112 individual C&I projects completed during PY4. A sample of four projects from each of the operating companies -- Met Ed, Penelec, Penn Power, and West Penn Power -- was reviewed. The majority of the reviewed projects consisted of retrofits to lighting, motors, controls, and other. Some of the other projects included photovoltaic panel installation and streetlighting retrofits.

The majority of the projects reviewed contained the appropriate documentation, including applications, invoices, equipment spec sheets, and savings calculations. However, some improvements can be made to the documents provided to contribute to consistency and ease of review. The savings calculation documents can be improved by adding dates or consistent revisions to the file name or within the document so it is clear which the most current savings values are. An invoice or a copy of the rebate check mailed to participants would clarify the final rebate amount allotted to each applicant, as it appears this number often changed from the start to the end of project processing. Inclusion of a post-application form would also ease the documentation review process, as several projects have multiple iterations between inception and completion.

Incomplete Documentation

The two streetlighting projects reviewed provided the least documentation for evaluation. The three documents provided in both projects were an application, master request detail, and rebate inventory. It was assumed that the lack of a calculation sheet was due to the straightforward nature of the TRM savings protocol for streetlighting.

Several other projects were missing savings calculation sheets, including, MD39112, SLB36625, NSLB90739, and CI70764. This made the review of the savings values difficult to follow, as the application in these cases also did not have any savings values associated. Therefore the reported values could not be confirmed, except for NSLB90739 and CI70764 which both had savings values in the application forms. Unfortunately, the savings values listed in the application for NSLB90739 did not match with the reported values. There was little supporting documentation to support either of the values found. However, in the case of CI70764 the application value did match the reported value. For the remaining projects with more complete documentation, two documents were reviewed to confirm the reported values, the application, and the savings calculations worksheet.

kWh Inconsistencies

The gross reported kWh values in the program tracking system and submitted to the SWE matched the calculation sheet values for 70% of the projects reviewed. Of the projects reviewed, 40% had a matching value for all three documents: reported values, application, and calculation sheet. The three projects with inconsistent values between the reported kWh values and the calculation sheet values were NSLB73318, CI66397, and MD36686. Lighting project NSLB73318 had a reported savings of 31,080 kWh and a calculated savings of 25,682 kWh. According to the invoice, 36 2-lamp T8 fixtures, one LED exit sign, three refrigerator CFL lamps, and five additional T8s were installed at this facility. After reviewing the calculation sheet and invoices, it appeared that six more 2 x 32W T8 fixtures were installed than was initially proposed, resulting in the higher reported savings value than what was initially used in the calculation documents. This could be clarified by including the final calculation sheet for this project. Custom project CI66397 installed a 240.27 kW photovoltaic system. This project had a very small difference between the reported gross kWh of 304,935 kWh, and the calculated kWh value in the supporting documentation of 304,973 kWh. It appears that the calculations were based on the SAIC review of the project and could be the result of rounding error.

Motors and drives project MD36686 had almost double the kWh savings in the calculation sheet than what was reported by Penelec in the program tracking data. From the calculation sheet, it appeared that the actual installed equipment had lower cubic feet per minute (CFM) and average kW values than initially proposed. It appears that both the old compressor and the new compressor were monitored for a period of time and that those numbers were used in the saving calculations. It is unclear why the data gathered through M&V activities was not used instead of the specs of the proposed equipment. It is possible that the post-install data collected would be leveraged by the evaluation contractor if the project was selected in the Penelec evaluation sample. The proposed compressor specifications were

257 CFM with an average power draw of 48.8 kW, but the actual installed equipment had 96 CFM and 15.4 average kW. This savings value calculated using the post-install monitored data was 350,862 kWh compared with the gross reported value 142,595 kWh.

kW Inconsistencies

In general, the application kW savings and the calculation sheet savings values matched or very nearly matched, but those confirmed numbers did not match the reported values. The cases in which the reported values and the calculation sheet values differed greatly were NSLB82063, NSLB82055, NSLB73318, NSLB66271, NSLB54815, NSLB61060, and MD36686. Project NSLB82063 had a typo as there were no reported kW savings but a savings of 3.14 kW was determined through the calculation sheet. Lighting project NSLB73318 had a gross reported peak demand impact of 5.08 kW, but a calculated kW of 3.19 in the supporting documentation. This discrepancy is most likely due to six more fixtures being installed than initially proposed, as was stated above under "kWh Inconsistencies." This could be clarified by including the final calculation sheet with the FirstEnergy file export. Lighting projects NSLB82055, NSLB66271, NSLB54815, and NSLB61060 all reported the demand savings as opposed to the change in connected load savings; however, the calculation sheets support the reported values. This can be clarified by consistently reporting either the demand savings or the connected load savings. As mentioned above under "kWh Inconsistencies," the motors and drives project MD36686 had more savings associated in the calculation sheet than what was reported by Penelec due to the lower average kW and CFM in the actual equipment installed than the proposed equipment. This resulted in a higher kW savings value of 56.3 kW compared with the reported kW savings value of 22.9 kW.

Incentive Inconsistencies

There were no reported incentive values available to the SWE Team, so the application form and savings calculation sheet were compared to confirm the incentive amount. Once again, to improve on this analysis a scanned copy of the final check or an invoice would be a good confirmation of the final incentive allocated to the applicant. Of the projects reviewed, the calculation sheet and the application incentive matched for 50% of the projects. This could be due to errors in the participant filling out the application form correctly or revisions to the incentive calculations once the projects were completed and final data entered.

F.4.4.4 Review of Sample Design

Met-Ed's PY4 final annual report provides detailed information about the sample design for the PY4 gross impact evaluation of non-residential programs. Met-Ed's evaluation contractor used a stratified sampling technique for each of the non-residential programs and targeted precision of 15% at the 85% confidence level for each program annually. At the end of Q2, Q3, and Q4, tracking data were reviewed by the evaluation contractor to draw a sample population for that quarter. The sample population was separated by operating companies and programs first, and then was stratified by technology at the measure level according to the realization rates, variability of realization rates, modes, and rebated savings. The evaluator used a minimum Cv value of 0.4 for each stratum based on PY2 and PY3 evaluation results.

In the PY4 non-residential sample plan, each program contained multiple strata and the C_V values were equal to or greater than 0.4. The achieved sample sizes, by program, for the sample draw were: 14 for Large C&I, 30 for Small C&I, 20 for Governmental/Remaining Non-Profit, 1 for Street Lighting, and 5 for Governmental/Non-Profit. Table F-54 shows detailed Information for Met-Ed's PY4 non-residential sample plan. More strata were used in Met-Ed's sample plan than are listed in this table. Table F-54 contains information only for those strata that had participants in PY4. The +/- 15% sampling error requirement was achieved for each program's energy savings estimate, but several programs failed to meet the requirement for the demand savings estimate.

Table F-54: Met-Ed PY4 Non-Residential Programs Sample Plan

Program	Stratum	Stratum Boundaries (kWh)	Participants	Observed Cv for Energy	Observed Cv for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample
Small Commercial/Industrial Equipment Program	NSL0	100,000	269	0.4	0.4	18%	18%	10
	NSL1	500,000	30	0.4	0.4	21%	21%	6
	NSL2	-	5	0.4	0.4	21%	21%	3
	SLB0	100,000	3	0.6	0.6	68%	68%	1
	Prescriptive0	499,999	44	1.6	1.6	221%	221%	1
	Custom0	499,999	29	0.4	0.4	27%	27%	4
	PV0	500,000	15	0.3	0.3	24%	24%	2
	PV1	2,000,000	2	0.3	0.3	0%	0%	2
	SAL0	99,999	4	0.4	0.4	50%	50%	1
Program Total			**401**			**9%**	**16%**	**30**
Large Commercial/Industrial Equipment Program	NSL0	1,500,000	61	0.4	0.4	32%	32%	3
	NSL1	5,555,555	1	0.4	0.4	0%	0%	1
	Prescriptive0	100,000	3	1.6	1.6	182%	182%	1
	Custom0	500,000	18	0.4	0.4	38%	38%	2
	Custom2		1	0.4	0.4	0%	0%	1
	PV0	1,000,000	4	0.3	0.3	31%	31%	1
	PV1	3,000,000	2	0.3	0.3	25%	25%	1
	PV2		4	0.3	0.3	0%	0%	4
Program Total			**94**			**10%**	**10%**	**14**
Governmental/Non-Profit Program	NSL0	500,000	7	0.4	0.4	53%	53%	1
	NSL1		3	0.4	0.4	0%	0%	3
	SLB0	500,000	1	0.6	0.6	0%	0%	1
Program Total			**11**			**10%**	**7%**	**5**
Governmental/Remaining Non-Profit Program	NSL0	100,000	191	0.4	0.4	28%	28%	4
	NSL1	600,000	32	0.4	0.4	27%	27%	4
	NSL2		2	0.4	0.4	0%	0%	2
	Prescriptive0	100,000	48	1.6	1.6	221%	221%	1
	Custom0	285,000	28	0.4	0.4	57%	57%	1
	Custom1	500,000	1	0.4	0.4	0%	0%	1
	Custom2		1	0.4	0.4	0%	0%	1
	PV0	500,000	2	0.3	0.3	25%	25%	1
	PV1	750,000	4	0.3	0.3	18%	18%	2
	SAL0	10,000	27	0.4	0.4	39%	39%	2
	SAL1	100,000	14	0.4	0.4	56%	56%	1
Program Total			**350**			**13%**	**30%**	**20**
Governmental/Non-Profit Street Lighting Program	SAL0	10,000	1	0.4	-	0%	-	1
Program Total			**1**			**0%**		**1**

F.4.4.5 Review of Verified Savings Analysis

Met-Ed's PY4 M&V activities for non-residential programs involved selecting a sample of 71 projects for verification. The sample was broken down by measure type into six strata each of which was further broken down by project size (kWh) into three substrata. Ex-ante energy savings thresholds were established to delineate the substrata. Figure F-9 shows the sampling breakdown by stratum, and Figure F-10 shows it by program.

Figure F-9: PY4 Non-Residential Sample Breakdown by Stratum

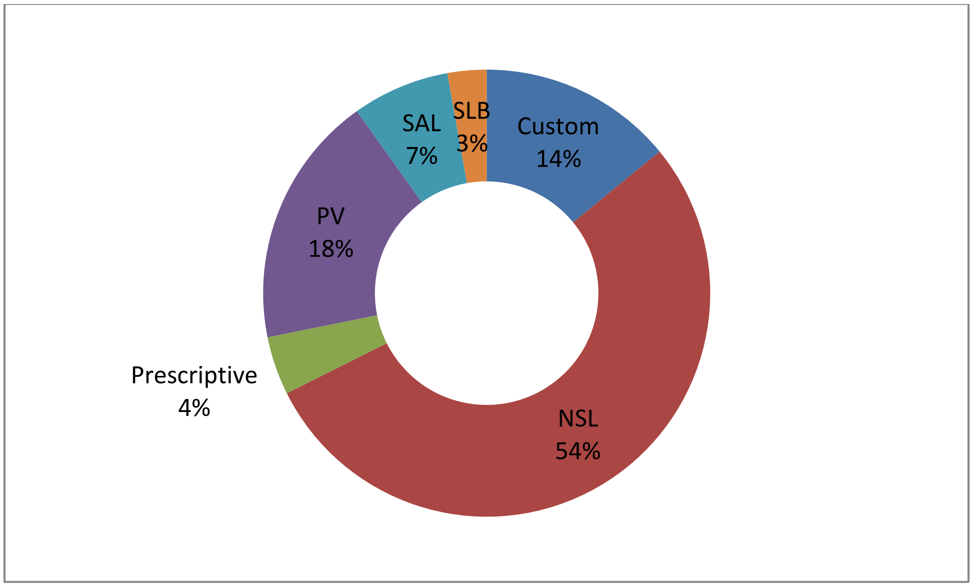
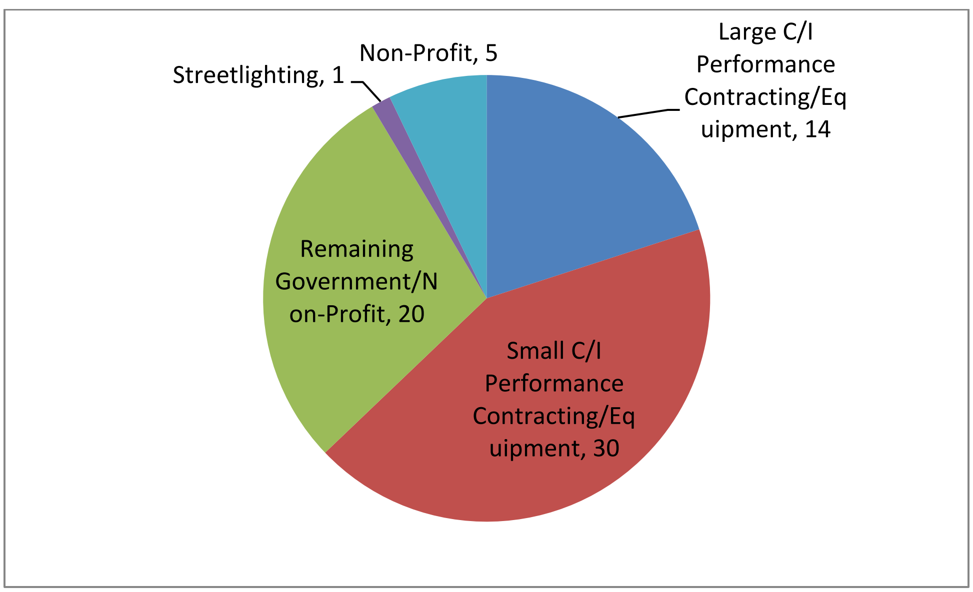


Figure F-10: PY4 Non-Residential Sample Breakdown by Program



Forty-six of the 71 sampled projects involved a visit to the project site, and of those 46, 15 involved deploying data logging instruments. Figure F-11 shows the breakdown of sampled projects by M&V technique.

Figure F-11: PY4 Non-Residential Sample Breakdown of M&V Technique by Project Count

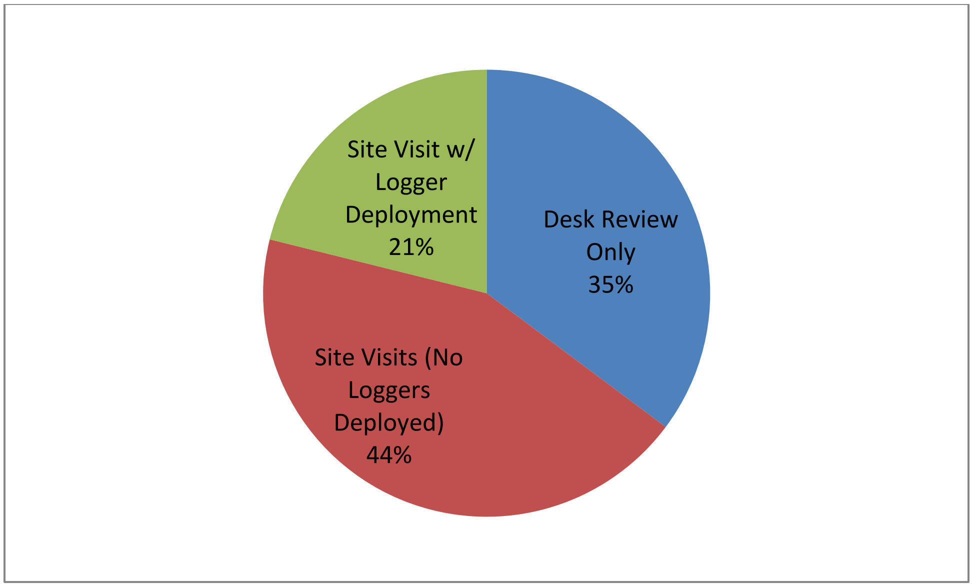
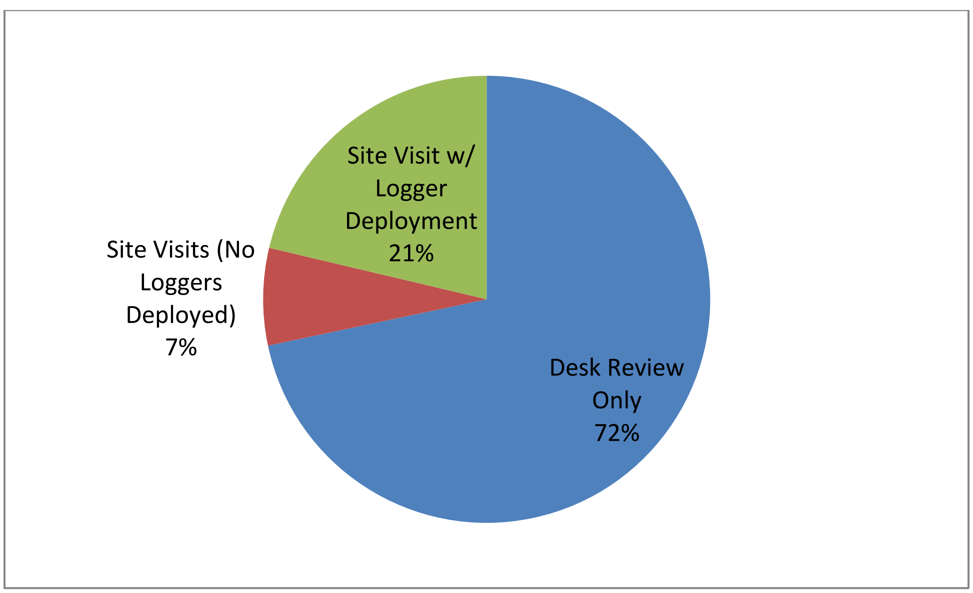


Figure F-12 shows the breakdown of the ex-post energy savings associated with those sampled projects by M&V technique.

Figure F-12: Sample Breakdown of M&V Technique by ex-post kWh



The vast majority of logger deployments, 14 of 15, were used for projects in the non-standard lighting (NSL) stratum, representing 7.5 GWh of verified energy savings. The remaining one logger deployment was used for a project in the largest custom substratum.

A detailed view of the sampling and verified savings results for each stratum is shown in Table F-55.

Table F-55: Met-Ed PY4 Sampling and Savings Detail

Stratum/ Substratum	Sample Points	Site Visits	Logger Installs	Sum of Ex-Ante kWh	Sum of Ex-Ante kW	Sum of Ex-Post kWh	Sum of Ex-Post kW	kWh RR	kW RR
Custom0	7	2	0	513,869	115	369,409	30	0.72	0.26
Custom1	1	1	0	259,534	27	259,534	27	1.00	1.00
Custom2	2	1	1	3,099,408	225	1,514,554	204	0.49	0.91
NSL0	19	16	2	594,511	117	497,596	100	0.84	0.86
NSL1	14	13	9	4,206,224	730	3,548,028	649	0.84	0.89
NSL2	5	5	3	8,608,321	1,108	6,888,799	991	0.80	0.89
Prescriptive0	3	1	0	12,659	9	10,166	8	0.80	0.86
Prescriptive1	0	0	0	-	-	-	-		
Prescriptive2	0	0	0	-	-	-	-		
PV0	4	0	0	772,455	512	851,544	250	1.10	0.49
PV1	5	0	0	4,727,151	2,986	4,967,641	1,315	1.05	0.44
PV2	4	0	0	14,990,426	10,460	17,162,127	5,100	1.14	0.49
SAL0	4	4	0	20,747	1	20,880	1	1.01	0.99
SAL1	1	1	0	13,022	1	13,101	1	1.01	1.01
SAL2	0	0	0	-	-	-	-		
SLB0	2	2	0	11,310	2	12,864	4	1.14	1.77
SLB1	0	0	0	-	-	-	-		
SLB2	0	0	0	-	-	-	-		
TOTAL	***71***	***46***	***15***	***37,829,637***	***16,293***	***36,116,242***	***8,680***		
Weighted Average								***0.95***	***0.53***

Table F-56 shows the program-level realization rates and the relative precision (given at 85% confidence levels) for each of Met-Ed's non-residential programs in PY4.

Table F-56: Met-Ed PY4 Program-Level Realization Rates and Relative Precision

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Large C/I Performance Contracting/Equipment	90%	14%	54%	11%
Small C/I Performance Contracting/Equipment	90%	9%	67%	10%
Remaining Government/Non-Profit	96%	13%	76%	20%
Streetlighting	100%	0%	100%	0%
Non-Profit	98%	10%	89%	7%

For its non-residential portfolio, Met-Ed depicts a near-1 realization rate for kWh savings but just over 0.5 for kW reductions. Several characteristics of the M&V results affected these values. As Table F-55 showed, the energy savings realization rates among the custom, NSL, and prescriptive strata came in moderately lower than 1 in most cases. The portfolio-level energy realization rate was bolstered by greater than 1 realization rates among the photovoltaic (PV), Streetlighting (SAL), and Standard Lighting for Business (SLB) strata. The largest substratum of PV projects resulted in an energy realization rate of 1.14.

Met-Ed's demand savings realization rate at the portfolio level was, by contrast, adversely affected by the findings in the PV strata. Each of the three PV substrata netted sub-0.5 realization rates for kW savings.

Figure F-13 and Figure F-14 show the relationship between ex-ante and ex-post savings for kWh and kW, respectively, for projects sampled from Met-Ed's PY4 non-residential programs.

Figure F-13: Comparison of Med-Ed Ex-Post and Ex-Ante Energy Savings

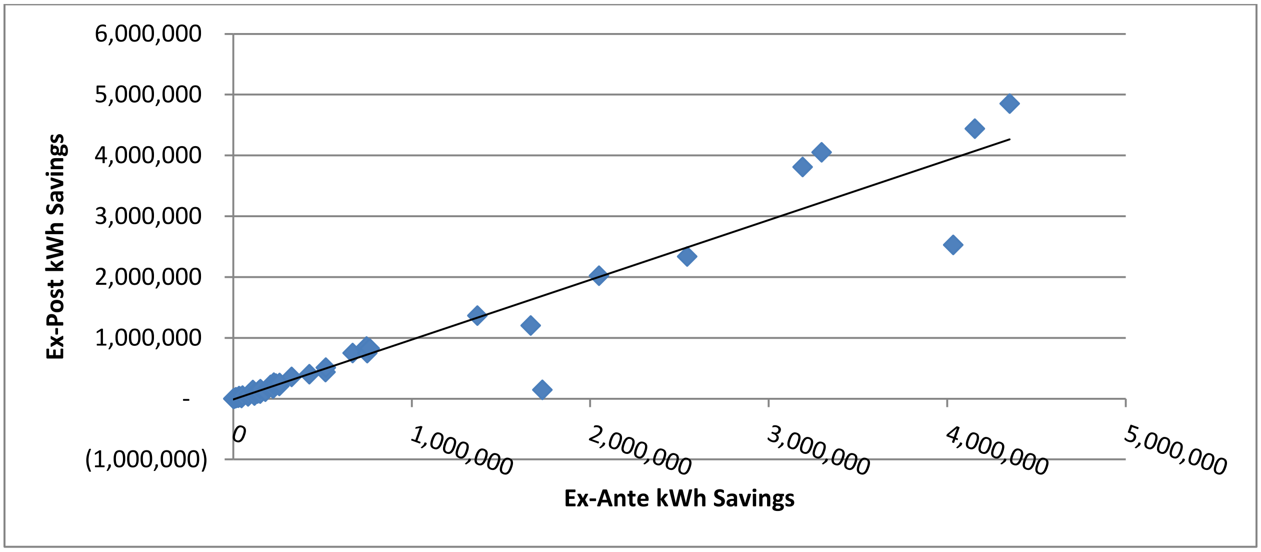
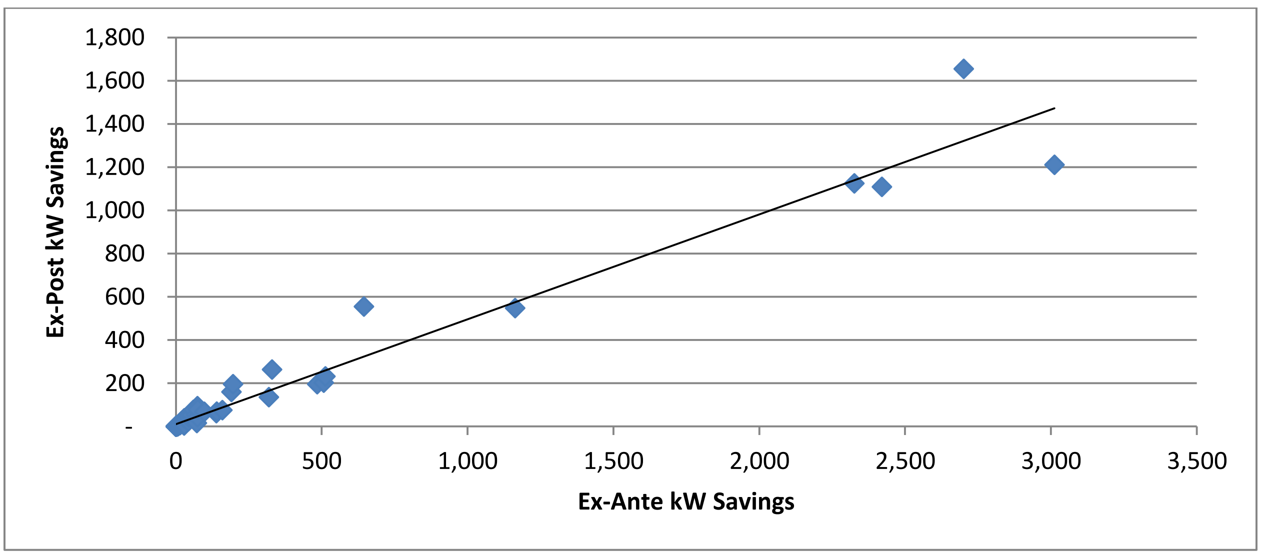


Figure F-14: Comparison of Med-Ed Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of Met-Ed sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Table F-57 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-57: IPMVP Methods and Verified Savings of Met-Ed PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Method
Large C&I	3010	4,442,115	1,211.0	IPMVP Option D
Small C&I	3021	1,011	0.7	IPMVP Option D
Remaining Gov/NP	3022	34,877	2.8	IPMVP Option A
Large C&I	3025	2,340,161	263.7	IPMVP Option A
Small C&I	3050	4,053,467	1,125.0	IPMVP Option D

Project 3010 represented 4.4 million kWh in energy savings and 1.2 MW in demand savings. The project involved construction of a 3.1 MW solar PV system at a food co-op in Harrisburg. The evaluation contractor performed a desk review of the project, completing a simulation using the National Renewable Energy Laboratory's System Advisor Model (SAM) tool. The modeling tool uses specific inputs for module and inverter type, as well as string size and array configuration, to develop detailed hourly estimates of energy production. While the SWE would have expected to see one of the more extensive M&V methods used for a project of such significant savings, the SWE believes there is enough evidence to support the use of IPMVP Option D given the relative accuracy of the SAM tool for predicting PV system energy production. However, larger PV projects like this one could be considered in the future as candidates for on-site inspection to verify inputs into the SAM tool such as module quantity, angle and azimuth, and string and array size. It is important to note that verified results for each evaluated project were informed by actual generation records obtained by the EDC evaluator.

Project 3021 involved replacing three HVAC rooftop units (RTUs): one unit at 12.5 tons and two units at 10 tons. The project netted a verified 1,011 kWh in energy savings and 0.7 kW in demand savings. The evaluation contractor performed a desk review for this project, using AHRI specifications and product invoices, as well as other inputs specific to the project site, which was a chain drug store. The evaluation contractor provided a spreadsheet with two simple formulas for each type of RTU. The results of the analysis provided differ only slightly in kWh savings from what was reported. The analysis showed 1,020 kWh savings, whereas the M&V tracking database showed 1,011 kWh savings. The SWE recommends a more robust analysis spreadsheet, providing more detail. Additionally, the evaluation contractor should ensure that the savings values match between the project analysis file and what is reported and tracked in the M&V tracking database.

Project 3022 accounted for 34,877 kWh in energy savings and 2.8 kW in demand savings. The project involved installing several VFDs on different types of equipment, including two condenser water pumps and two energy recovery ventilation units. The evaluation contractor performed a site visit to verify equipment specs and operating schedules, although no data logging took place. The verified characteristics were then used as inputs into a spreadsheet model to determined verified energy and demand savings. The savings from the spreadsheet model matched the M&V tracking database entries.

Project 3025 involved a comprehensive lighting retrofit at a paper company in Spring Grove. The retrofit netted a verified energy savings of 2.3 million kWh and a demand reduction of 264 kW. Lighting types replaced included several types of high intensity discharge (HID) fixtures, a variety of incandescent lamps, and several different configurations of T12 linear fluorescent fixtures. These fixtures were mainly replaced by T8 linear fluorescent fixtures of various configurations. The evaluation contractor performed a site visit to verify the types and quantities of installed fixtures and to deploy seven data loggers. These data loggers measured the lighting schedules in several disparate locations within the facility for nearly two months. The results were used to estimate annual operating hours for each location, and for the associated lighting. The SWE, however, could not locate an analysis spreadsheet that made use of these annual hours of use calculations to generate the final verified kWh and kW savings values.

Project 3050 was a large-scale solar PV project, similar to project 3010. This project accounted for verified energy savings of over 4 million kWh and demand savings of over 1.1 MW. The project was reviewed in much the same way as project 3010 by running the SAM tool with inputs specific to the project. The tilt of the PV arrays for this project, however, was estimated using a photograph of the system. The evaluation contractor estimated the tilt to be 45 degrees based on this image. While this is one of many inputs into the SAM tool, variations in this input can have an appreciable effect on the outcome. The SWE recommends a more rigorous attempt to verify such inputs, such as contacting a site representative to measure the angle if a site visit is not possible.

F.4.5 Penelec

This section contains details on the SWE’s audit of Penelec’s PY4 non-residential programs.. The site inspection findings and review of project details for Penelec are discussed above in this appendix, in sections F.4.4.3 and F.4.4.3 respectively.

F.4.5.1 Review of Savings Database

Table F-26 shows the realization rates and relative precision values for verified energy and demand savings in each of Duquesne's non-residential EE programs for PY4, based on activities completed by Duquesne's evaluation contractor.

Table F-58: Duquesne Energy and Demand Realization Rates for Non-Residential EE Programs in PY4

Program	Energy Realization Rate	Relative Precision (Energy)[569]	Demand Realization Rate	Relative Precision (Demand)[570]
Commercial Sector Umbrella	99%	9.3%	104%	7.9%
Commercial Sector Umbrella (Upstream Lighting)	99%	9.3%	104%	7.9%
Healthcare	99%	9.3%	104%	7.9%
Industrial Sector Umbrella	102%	7.1%	100%	0.1%
Chemical Products	102%	7.1%	100%	0.1%
Mixed Industrial	102%	7.1%	100%	0.1%
Office Building - Large	99%	9.3%	104%	7.9%
Office Building - Small	99%	9.3%	104%	7.9%
Primary Metals	102%	7.1%	100%	0.1%
Public Agency/Non-Profit	102%	8.6%	102%	1.7%
Retail Stores - Small	99%	9.3%	104%	7.9%
Retail Stores - Large	99%	9.3%	104%	7.9%

The realization rate is a factor that compares the gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities. The general calculation for a realization rate is as follows.

$$\frac{\sum Verified\ Savings\ Estimates}{\sum Reported\ Savings\ Estimates} = Realization\ Rate$$

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants, or on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the evaluation team was able to verify all reported savings. A realization rate of less than 100% indicates that the gross savings were an overestimate, and a realization rate of more than 100% indicates that gross savings were an underestimate. In most cases, EDC evaluation contractors used a stratification approach in their sample designs, which are described in the previous section. Realization rates for energy savings from Duquesne's C&I programs range from 99% to 102%. Realization rates for demand reductions from these programs range from 100% to 104%.

[569] Relative precisions given at 90% confidence level.
[570] ibid.

In order to calculate these realization rates, Duquesne's evaluation contractor performed a variety of activities to verify Duquesne's reported savings. Evaluation activities were to be performed in accordance with Duquesne's evaluation, measurement, and verification (EM&V) plan issued July 15, 2010 as follows:

- Projects with rebates less than $2,000: Basic Level of Rigor
  Included document review with as-needed phone interviews of applicable parties
- Projects with rebates greater than $2,000: Enhanced Level of Rigor
  Included basic level of rigor plus on-site verification of key project parameters

Figure F-1 depicts the frequency of each type of M&V performed by the evaluation contractor in the C&I program groups and the associated verified energy savings for each M&V approach.[571] The figure indicates that the more expensive M&V methods (i.e., Options B, C, and D) were reserved for a small number of projects but accounted for a large share of program savings.

Figure F-15: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 C&I Programs

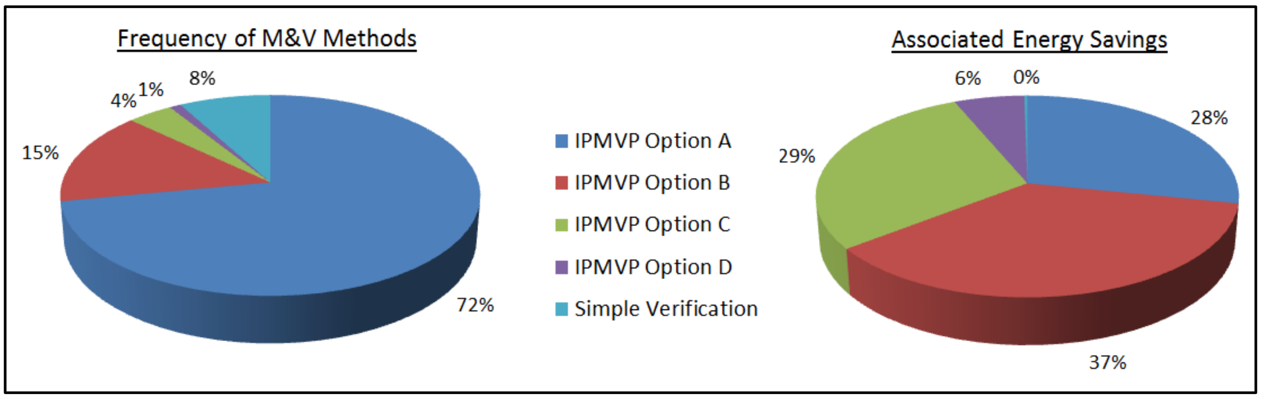


Figure F-1 indicates that 8% of the sampled measures in the C&I program groups (8 measures of 100 sampled) were evaluated using only a basic level of rigor ("Simple Verification"). The associated verified kWh savings for these eight measures accounts for less than 1% of the total verified savings (101,634 kWh out of 39,364,847 kWh total). This suggests that the use of basic rigor was appropriately used predominately for measures with smaller savings. Likewise, enhanced levels of rigor were used for 92% of the sampled measures, accounting for almost 100% of the savings achieved, proving that the use of enhanced rigor was appropriately used predominately for measures with larger savings.

Delving further into the enhanced levels of rigor for the C&I program groups, it is apparent that 72% of projects sampled were evaluated using IPMVP Option A (Partial Measure Retrofit Isolation). This approach uses a combination of measurement of key parameters of the retrofitted equipment, and the use of stipulated values for other parameters. IPMVP Option B (Retrofit Isolation: All Parameter Measurement) was used for 15% of projects sampled. This option involves more robust measurement of

[571] IPMVP methodologies are briefly defined in the Glossary.

the retrofitted system's energy usage, typically using short-term data logging. IPMVP Option C (Whole Facility Billing Analysis) accounted for only 4% of the sampled projects but 29% of the savings. It involves utility billing analysis to identify energy savings associated with an upgrade. Typically, 12 months of pre- and post-retrofit billing data are required for this approach. IPMVP Option D (Calibrated Simulation) accounted for only 1% of the sampled projects but 6% of the savings. It involves modeling the energy performance of the facility before and after the conservation measure is installed. The SWE supports this "value-of-information" technique of reserving expensive metering activities for projects that account for the largest share of savings.

Figure F-2 and Figure F-3 depict how the different M&V methods were used in specific program groups. Figure F-2 depicts the frequency of each type of M&V performed by the evaluation contractor in only the Commercial, Government, and Non-Profit Program Group and the associated verified kWh for each M&V approach. The distribution is similar to that shown in Figure F-1, indicating again that the more expensive methods (i.e., Options B, C, and D) were reserved for a small number of projects, each of which contributed a relatively large amount of savings.

Figure F-16: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Commercial Programs (Including GNI)

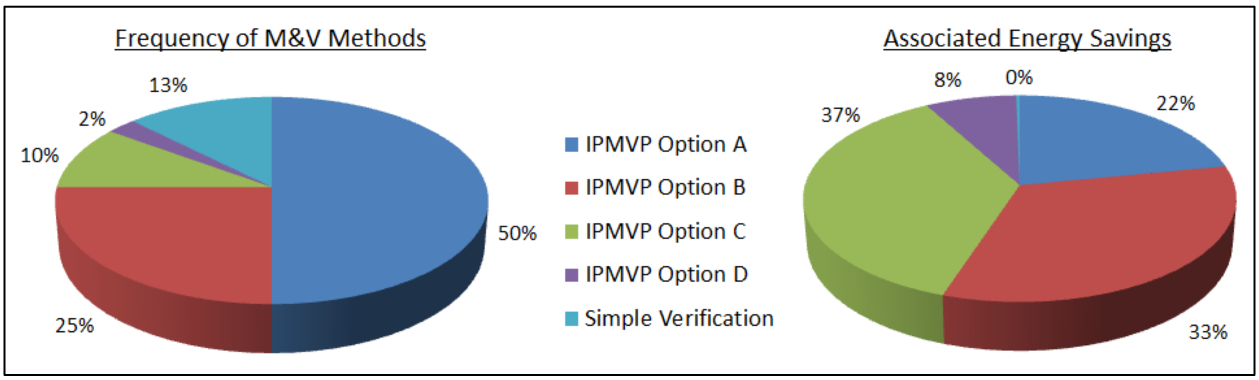
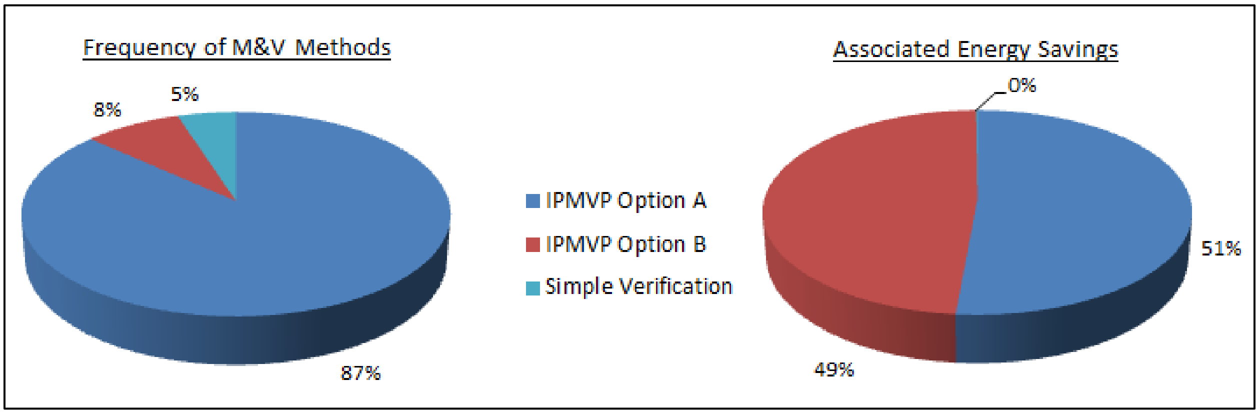


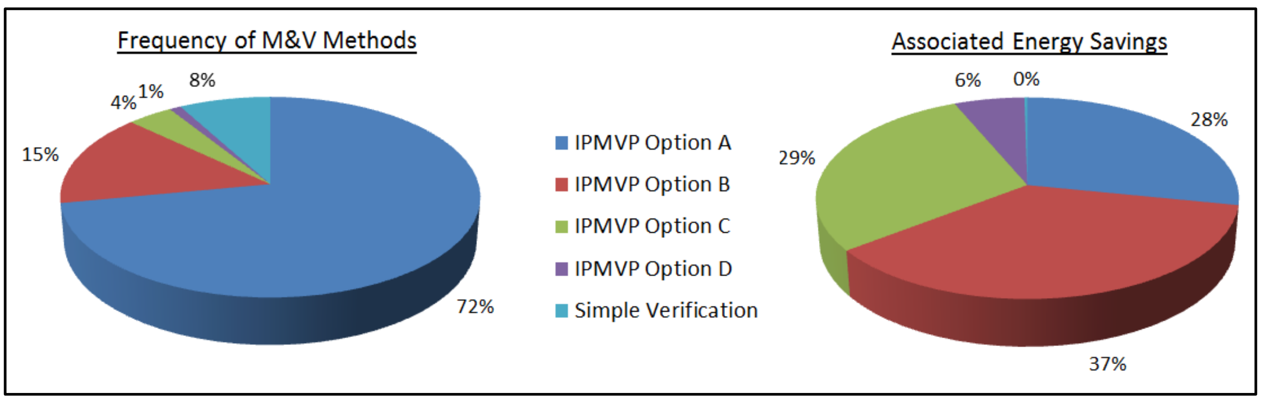
Figure F-3 depicts the frequency of each type of M&V performed by the evaluation contractor in only the Industrial Program Group and the associated verified kWh for each M&V approach. Note that only three different methods of M&V were used for this sector as compared with five in the Commercial, Government, and Non-Profit Program Group.

Figure F-17: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Industrial Programs



A detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. However, the SWE found the completeness of site visit documentation to be insufficient in several instances. Figure F-1 depicts the frequency of each type of M&V performed by the evaluation contractor in the C&I program groups and the associated verified energy savings for each M&V approach. The figure indicates that the more expensive M&V methods (i.e., Options B, C, and D) were reserved for a small number of projects but accounted for a large share of program savings.

Figure F-1: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 C&I Programs



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Delving further into the enhanced levels of rigor for the C&I program groups, it is apparent that 72% of projects sampled were evaluated using IPMVP Option A (Partial Measure Retrofit Isolation). This approach uses a combination of measurement of key parameters of the retrofitted equipment, and the use of stipulated values for other parameters. IPMVP Option B (Retrofit Isolation: All Parameter Measurement) was used for 15% of projects sampled. This option involves more robust measurement of the retrofitted system's energy usage, typically using short-term data logging. IPMVP Option C (Whole Facility Billing Analysis) accounted for only 4% of the sampled projects but 29% of the savings. It involves utility billing analysis to identify energy savings associated with an upgrade. Typically, 12 months of pre- and post-retrofit billing data are required for this approach. IPMVP Option D (Calibrated Simulation) accounted for only 1% of the sampled projects but 6% of the savings. It involves modeling the energy performance of the facility before and after the conservation measure is installed. The SWE supports this "value-of-information" technique of reserving expensive metering activities for projects that account for the largest share of savings.

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Figure F-2: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Commercial Programs (Including GNI)

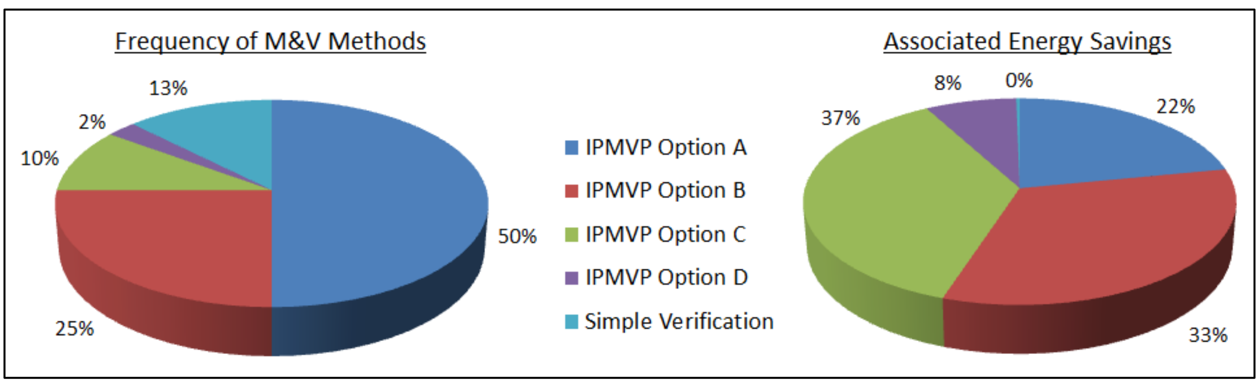
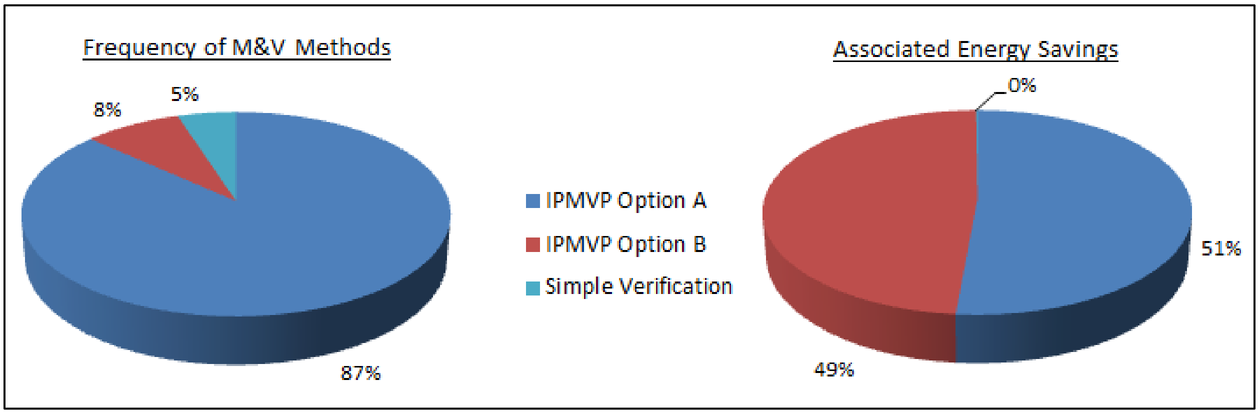


Figure F-3 depicts the frequency of each type of M&V performed by the evaluation contractor in only the Industrial Program Group and the associated verified kWh for each M&V approach. Note that only three different methods of M&V were used for this sector as compared with five in the Commercial, Government, and Non-Profit Program Group.

Figure F-3: Frequency and Associated Verified Savings by M&V Method for Duquesne's PY4 Industrial Programs



A detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. However, the SWE found the completeness of site visit documentation to be insufficient in several instances. Table F-27 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for the site evaluation. Highlighting indicates sites where the SWE has some concern about the M&V activities performed.

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Table F-59: IPMVP Methods and Verified Savings of Duquesne's PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Portfolio Energy Savings	Verified Demand Savings (kW)	% of Portfolio Demand Savings	Method
Commercial	8000006714.33.01	8,056,223	7.52%	619.00	1.53%	IPMVP Option C
Commercial	9000008674.20.04	1,607,291	1.50%	224.68	0.56%	IPMVP Option B
Commercial	2000661379.36.01	524,874	0.49%	24.20	0.06%	IPMVP Option B
Commercial	7000006709.17.02	1,893,597	1.77%	387.02	0.96%	IPMVP Option A
Industrial	6000636680.23.03	420,288	1.19%	45.64	0.07%	IPMVP Option B
Industrial	2000010473.25.01	315,231	0.89%	36.00	0.06%	IPMVP Option A
Industrial	2000007883.23.03	1,331	< 0.01%	0.37	< 0.01%	IPMVP Option A

Project number 9000008674.20.04 generated 1.6 million kWh in savings, which accounted for 1.50% of the PY4 energy savings achieved in the Commercial Programs Group. The project received incentives for the installation of 24 VFDs. The evaluation contractor successfully metered (9) of the installed VFDs with either a current or power logger. Additional on-site verification was performed by the evaluation contractor on logger drop-off and pick-up visits, which included motor nameplate data, VFD frequency readings, and motor operation schedules as verified by the site contact. Accompanying Excel calculations provided matched logger data and photographs of equipment tags. The evaluation contractor also provided three years of utility bill analysis but deemed it insufficient as the combined savings across the three analyzed meters only supported half of the ex-ante savings. The SWE agrees with the evaluator's decision to use IPMVP Option B given the inconclusive utility bill analysis, and found the supporting documentation and calculations provided to be robust and detailed.

Project number 7000006709.17.02 produced 1.9 million kWh in savings, which accounted for 1.77% of the PY4 energy savings attributed to the Commercial Programs Group. The project received incentives for the lighting portion of a large new construction retail site. The CSP submitted Appendix C[572] of the 2011 TRM with its application. The evaluator documented several discrepancies in both equipment type and quantity between application and on-site verification. The site contact was able to clarify the inconsistencies by providing detailed descriptions, including fixture type, control type, and hours of use (HOU) for all fixtures as that are logged within the building automation system. The evaluator used this information to come up with a weighted hours of use to be applied to the whole building. Despite the detailed information provided on site, the evaluator chose to calculate the ex-post savings using the Building Area Method, citing an inability to obtain square footages of individual spaces to match the HOU described per space. The whole building square footage input into the calculations was taken from the application supplied by the CSP. As the evaluator already found numerous discrepancies between the CSP application and the site visit, the SWE questions the use of this square footage value. Line item 2 of the evaluator's site-specific monitoring and verification plan (SSMVP) specifically states that the evaluator will collect the square footage of both the entire building and each space where fixtures were installed. It is unclear why this was not completed on either scale. The SWE believes the evaluator should have been able to either obtain proper drawings indicating square footages, or measure the site at the time of inspection to produce a more accurate verified savings estimate for the project.

At 8 million kWh and 619 kW saved, project number 8000006714.33.01 represents 7.52% of the energy savings and 1.53% of the demand savings achieved by the Commercial Programs Group in PY4. Per the supplied SSMVP, the evaluator intended to procure the following trend data at 15-minute intervals over a three-week period from the site:

- Outside air temperature
- Speed for each affected VFD
- Chilled water temperature
- Chiller load or power

These data were unable to be secured. The evaluator's report states that at the time of evaluation, sub-metering had not yet been installed and facility staff were unable to provide requested data in a timely

[572] Appendix C is the "Lighting Inventory Tool" which is to be used for retrofit lighting projects.

manner. As an alternative method, the evaluator obtained billing data from the EDC in order to perform a regression analysis. The final analysis submitted contains numerous cells that are highlighted as having inadequate supporting data, and several other cells with errors in the outputs. Ultimately, the evaluator could not confidently verify the savings for this project due to limited data and time constraints. For a project contributing over 7% of the program's verified savings, the SWE would expect the EDC and CSP to have begun project coordination far enough in advance that these verification details could have been obtained. The calculated energy realization rate for the Office Building – Large – EE Program was 99%. The calculated realization rate of this project was 80%. Had the realization rate of this project been calculated at 60%, the realization rate for the program would have dropped down to 95%. The SWE recommends that Duquesne make a more concerted effort to partner with customers having projects of this magnitude earlier on in the project's planning phase so that savings can be accurately captured after the project's completion.

In the PY3 annual report, the SWE recommended increasing the number of sampled projects evaluated using IPMVP Option B, or deploying data loggers on a greater portion of sampled projects evaluated using IPMVP Option A. While it appears that Duquesne and its evaluation contractor took this into consideration, the completeness and validity of on-site data provided are questionable in several instances. Overall, the SWE recommends that Duquesne continue its Phase I approach of choosing levels of rigor and selecting M&V methods, but requests that the evaluation team get involved earlier in the process for large projects to ensure sufficient data is collected to calculate verified savings for complex projects.

F.4.6 PECO

This section contains details on the SWE's audit of PECO's PY4 non-residential programs.

F.4.6.1 Site Inspection Findings

Table F-28 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of PECO non-residential project installations. Details about the SWE site inspection process can be found Section B.2.2.6.2.

The PECO PY4 site inspection findings are categorized into three types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.
- TRM findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

Table F-60: PECO PY4 Non-Residential Site Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-401	Motors, VFDs, EMS, ASHP	RA	Project savings were overstated because savings were included for the EMS, though the EMS functions used by the facility are required by code.	Pro	The evaluator correctly removed EMS savings in the verified savings analysis. The SWE recommended to PECO that for future projects the implementer should determine whether the EMS functions are required by code prior to reporting project savings.
			There were inconsistencies between assumptions used in the evaluator's VFD and high-efficiency motor calculations.	Eval	The evaluation team stated that, for any future projects in which the ex-post savings are calculated using a custom approach, the EFLH and CF values will be used consistently throughout the analysis.
PECO-402	Lighting	RA	The number of lighting fixtures controlled with occupancy sensors was overstated by the implementer.	Pro	PECO will emphasize with implementers the importance of accurately documenting measures as installed.
PECO-403	Lighting	RA	Fixture controls were incorrectly reported for some of the fixtures.	Pro	The evaluator corrected the fixture controls error in the verified savings analysis.
			There were fixtures added shortly after project completion to provide the same amount of illumination as the old fixtures (project was not a one-for-one replacement). The SWE recommended that the baseline fixture count should be adjusted downward since the incented fixtures provided the same illumination level as a smaller quantity of baseline fixtures than was reported.	Eval/TRM	The evaluator did not adjust the baseline fixture count because the total fixture count found on-site differed by less than 5 percent from what was reported. The TRM states that “widget counts within 5% of the application numbers can be considered within reasonable error without requiring realization rate adjustment” (Section 1.11.4 of 2012 TRM) and therefore the evaluator’s approach is acceptable. However, Section 4.1.2.5.2 of the 2011 Audit Plan states, “if the evaluation adjusted kW (connected load) for any usage group in the sample is within +/-5% of the claimed kW, the project savings should be accepted at the claimed value, else, the calculations should be revised and recalculated by the EDC evaluators.” Consistency is needed in future versions of the TRM and Audit Plan regarding whether the 5% error band should be at the project or usage group level.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-404	VFDs, EMS	RA	There were some minor inconsistencies in the evaluator's savings analysis and minor discrepancies with the site contact's interview results.	Eval	The evaluation team is taking additional quality control steps in PY5 to ensure internal agreement between the site contact report and the analysis.
PECO-405	CHP	RA	There were cell formula errors that sum parasitic load, to the pivot table that calculates demand impact and to the steam enthalpy value used to calculate natural gas cost offset for TRC purposes.	Eval	None needed. Impact of spreadsheet error was negligible.
PECO-406	Lighting	RA	Evaluator hours of use did not reflect a typical operating year of the facility.	Eval	The SWE recommended that the hours of use be adjusted to represent a typical operating year. The evaluator agreed and stated that it would be taken into account for future evaluations.
PECO-407	VFDs	RA	Implementer misused the TRM Appendix D tool to calculate VFD savings.	Pro/ TRM	The confusion of the TRM Appendix D motor and VFD tool has been eliminated in the 2013 TRM with the introduction of separate calculators for VFD and motor savings.
PECO-408	Lighting	RA	Facility lighting hours of use were variable among different spaces and were inconsistent between the application, interview hours, and observations during site inspection.	Pro	The SWE recommended that for future projects where there is high variability and inconsistency in hours, metering should be performed. The evaluator concurred with the SWE's recommendation.
PECO-409	Retro-commissioning and ventilation upgrade	RA	An ongoing upgrade to the HVAC system caused the evaluator to have to abandon plans for on-site measurements. This project and the HVAC system upgrade project have related impacts.	Pro	The evaluator recommended to PECO that this project and the HVAC system upgrade project be considered together using a 2010 baseline for both projects. When the HVAC project is reported, the savings credited to that project should be the savings of the two projects considered together less the ex-post savings of the retrocommissioning and ventilation upgrade project. The SWE concurs with the evaluator's recommendation.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PECO-410	Lighting	IND	Facility lighting hours of use were significantly greater than the TRM deemed hours of use.	Pro	The SWE recommended that PECO have implementers carefully document facility lighting hours of use and use the schedules for the ex-ante savings analysis, particularly when the hours depart significantly from the TRM deemed value for the appropriate building type. PECO's evaluator concurred with the SWE's recommendation.
PECO-411	Lighting	IND	Reported fixture quantities, controls, and space cooling did not match site inspection findings.	Pro	The SWE recommended that PECO stress with implementers the importance of accurate project documentation. PECO's evaluator concurred with the SWE's recommendation.

F.4.6.2 Review of Savings Database

PECO reported savings impacts from four non-residential programs in PY4: Smart Equipment Incentives C&I, Smart Equipment Incentives GNP, Smart Construction Incentives C&I, and Smart Construction Incentives GNP. The retrofit, multi-tenant and appliance recycling portions of the Smart Equipment Incentives program are reported separately, and both the SEI and SCI programs are separated by sector for reporting and evaluation. There were no participants or savings reported for the Appliance Recycling Program for the GNP sector. The gross reported energy savings of the four non-residential programs was 192,507 MWh, and the gross reported demand savings was 30 MW. Table F-29 shows the reported number of participants, energy savings (MWh) and demand savings (MW) from each reporting category in PY4 based on PECO's PY4 annual report. Demand impact figures were adjusted to reflect a peak LLF of 10.0% for C&I programs and 10.5% for GNP programs prior to reporting, to account for transmission and distribution (T&D) losses.

Table F-61: PECO Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Smart Equipment Incentives - C&I Retrofit	659	98,746	17.3
Smart Equipment Incentives - C&I Multi-tenant	44	506	0.1
Smart Equipment Incentives - C&I Appliance Recycling	14	77	0.0
Smart Equipment Incentives - GNP Retrofit	273	74,041	9.4
Smart Equipment Incentives - GNP Multi-tenant	8	11	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	57	8,323	1.5
Smart Construction Incentives - GNP	44	10,803	1.9
Totals	**1,099**	**192,507**	**30.2**

Following each quarter in PY4, PECO submitted program tracking data to the SWE for review. The SWE combined these quarterly data extracts and compared them with the values shown in Table F-29. Table F-30 provides the participant count, energy savings, and demand savings by program according to the PECO database extract. The SWE applied a peak LLF of 10.0% for C&I programs and 10.5% for GNP programs to demand impacts to facilitate a comparison with reported figures.

Table F-62: PECO Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Smart Equipment Incentives - C&I Retrofit	659	98,746	15.6
Smart Equipment Incentives - C&I Multi-tenant	44	506	0.1
Smart Equipment Incentives - C&I Appliance Recycling	14	77	0.0
Smart Equipment Incentives - GNP Retrofit	273	74,041	8.4
Smart Equipment Incentives - GNP Multi-tenant	8	11	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	55	8,274	1.0
Smart Construction Incentives - GNP	49	10,851	2.0
Totals	**1,099**	**192,508**	**27.1**

Table F-31 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$Reported\ Figure\ - Database\ Summary = Variance$$

Table F-63: PECO Non-Residential Program PY4 Discrepancies

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)[573]
Smart Equipment Incentives - C&I Retrofit	0	0	0.0
Smart Equipment Incentives - C&I Multi-tenant	0	0	0.0
Smart Equipment Incentives - C&I Appliance Recycling	0	0	0.0
Smart Equipment Incentives - GNP Retrofit	0	0	0.0
Smart Equipment Incentives - GNP Multi-tenant	0	0	0.0
Smart Equipment Incentives - GNP Appliance Recycling	0	0	0.0
Smart Construction Incentives - C&I	2	49	0.4
Smart Construction Incentives - GNP	-2	-48	-0.3
Totals	**0**	**-1**	**0.1**

Upon review the SWE found some minor differences in the participant counts and reported energy and demand savings in the report and the tracking data for some of the PECO's non-residential programs. For example, the SWE found that the reported participant count for the Smart Equipment Incentives (SEI) - C&I in PY4 was 44 lower than the participant count shown in the savings database for the same program. The SWE also found a large difference in the savings impacts in the PY4 report and the database extract for this program. The SWE followed-up with PECO's evaluator, who provided an explanation for these variations. The most current values provided by PECO are used in this report. In most cases the variations in participant counts and savings impacts were due to adjustments to projects that occurred following the close of a quarter or were due to the unverified combined heat and power (CHP) projects. The remaining discrepancies shown in the Smart Construction Incentives (SCI) programs are due to re-categorization of 2 projects between the C&I and GNI sectors.

Note that variances found do not indicate inadequate QA/QC or incorrect reported savings. The SWE understands that program tracking is a continuous process and that project details are subject to change after they are first reported to the SWE.

[573] Database demand impacts reflect a T&D loss factor of 10.0% for C&I programs and 10.5% for GNP programs.

F.4.6.3 Review of Project Files

During PY4, the SWE reviewed project documentation from PECO's Multi-tenant, SEI – Retrofit[574], and SEI - New Construction programs. Several projects were selected from each quarter within each program. For the most part, PECO's project documentation was complete and easy to follow and review. A few of the projects had subfolders placing the files into logical categories such as application materials, invoices, review verification, specification/cut sheets, and TRM calculators. This was especially helpful for the review of larger projects with multiple installed measures, but all projects could benefit from this filing system.

Multi-Tenant

The SWE reviewed nine of the projects submitted from the Multi-tenant program. Measures in this program typically follow a residential protocol in the TRM but are counted as non-residential savings because the savings occur in a master-metered apartment complex or housing project. Measures reviewed included air-source heat pumps, air conditioners, and refrigerators. Multi-tenant projects had the least robust documentation of the measures reviewed because the low per-unit savings and deemed or partially deemed savings protocols don't require extensive documentation. Project documentation typically included an application form and invoices for the products purchased. However, no savings calculation documentation was provided. This is most likely due to the straightforward deemed savings protocol specified in the TRM to calculate these savings and the prescriptive rebate level offered by the program.

The majority of the projects completed the Smart Home Rebates (residential) application form. However, two of the projects used the Smart Equipment Incentives: Multi-Unit Application for Individual Units. Although there were two different forms, the rebate amounts mostly matched between the two forms. One exception was for room air conditioners. Project PECO-11-91981 completed the Smart Equipment Incentives: Multi-Unit Application which had a deemed $50 rebate for room air conditioners. However, the other Smart Home Rebates applications had a deemed $25 rebate for room air conditioners. Due to the form that was filled out, it appears that an additional $25 was given to project PECO-11-91981 according to the application forms and program tracking data.

All of the projects reviewed contained the application form and the invoices for the products purchased. The quantity and model number provided in the application form matched those in the invoices provided. Ex-ante project savings were based on the following deemed values: 98 kWh and 0.059 kW for room air conditioners and 106 kWh and 0.0125 kW for refrigerators. All of the projects reviewed used these deemed values. These values also matched, for the most part, those in the 2012 PA TRM, where 98 kWh is the deemed value for a room air conditioner in Philadelphia. The 2012 PA TRM states a deemed value of 0.1018 kW demand savings for an ENERGY STAR room air conditioner. This differs from the deemed value reported by PECO of 0.059 kW. The 2012 PA TRM also states a savings of 106 kWh for

[574] SEI – Retrofit includes projects from both the C&I and GNI sectors

a top-mount freezer without ice door and 0.0125 kW demand savings, which matches the PECO-reported values.

There were two projects reviewed with air-source heat pumps, PECO-11-91953 with a savings of 1,293.4 kWh and PECO-12-91997 with a savings of 10,353.6 kWh. These measures follow a partially deemed savings protocol in the PA TRM, so an assessment was completed using the equation for high-efficiency air-source heat pumps found in Section 2.1 of the 2012 PA TRM. Since the baseline equipment was not well documented in the application, the TRM deemed baseline values were inputs for the TRM equations. The project tracking reported kWh savings of 1293.4 kWh for PECO-11-91953, which was equal to the savings calculated when using the 2012 PA TRM protocol.

Project PECO-12-91997 had a reported quantity of four units and a total project energy savings of 10,353.6 kWh in the program tracking data. The SWE replicated PECO's per-unit savings estimate of 2588 kWh using the 2012 PA TRM protocol and the equipment specifications. However, it is unclear why the project quantity stored in the program tracking data was four. The rebate application showed a single unit, and the submitted invoice was for a single heat pump. The rebate amount stored in the program tracking data corresponded to a single heat pump. The SWE recommends that PECO investigate this issue with the program implementer and make the necessary changes to ensure that ex-ante quantities and savings values are accurately stored in the program tracking data.

Smart Equipment Incentives – Retrofit (Includes C&I and GNI Sectors)

Three retrofit projects were chosen for document review for each of Q1 and Q2. Four retrofit projects were reviewed for Q3 and Q4. The majority of the projects reviewed contained the application, invoices, spec sheets, and savings calculators. Of the projects reviewed, only two did not have savings calculators: PECO-10-01153, which had an energy management system (EMS) installed, and PECO-11-03646, which had traffic lighting installed. The 2012 PA TRM did not include a protocol for EMS installation, so savings followed a custom protocol. LED traffic signals follow a deemed savings protocol in the PA TRM, so a calculator is not necessary. The savings listed in the application and the program tracking data both agreed with the deemed savings values in the TRM for the type of traffic lighting installed.

Of the retrofit projects reviewed, the majority of the retrofit installations were for LED or T-8 lighting upgrades, the installation of lighting controls, and HVAC improvements or upgrades. There were a few VFD installations and building envelope improvements. The program-tracking-reported kWh savings equaled the application savings for 21% of the projects reviewed, and the program-tracking-reported kW savings equaled the application savings for 29% of the projects reviewed. These low percentages could be due to changes in the project scope during installation or to applications being completed incorrectly by the applicant. After reviewing the provided savings calculators, the SWE found that only three of the reviewed projects provided different savings in the calculators than what was ultimately reported in the program tacking data.

Project PECO-11-03523 appears to be a school retrofit as well as remodeling or building additions. This project contained lighting installations and retrofits, a VFD installation for the kitchen exhaust fan, and an EMS installation for the refrigerators. A note in the documents states that there was an error in the program-tracking-reported savings of 229,238 kWh. This was due to a typo in lighting EFLH; the correct total kWh savings was 229,246 kWh. The calculators were a little difficult to follow for this application as there were several measures that received incentives. In the future, it would be helpful to combine all of the savings calculators into one form instead of several different forms with several different versions.

Project PECO-12-04151 contained lighting, air-source heat pumps, and air conditioners. The program-tracking-reported savings for this project was 18,106.5 kWh and 6.18 kW. After reviewing the application, this appears to be the savings for only the custom lighting project, but it does not include the other measures on the application. This project provided two savings calculators, one of which was a savings summary and the other a TRM-referenced lighting calculator. The savings summary provided an overview of the project savings which was reviewed by PECO. This document reported a total savings of 141,649.63 kWh and 23.52 kW, which included all of the lighting, controls and HVAC measures. The PECO review of these values is logical, and the values and assumptions seem reasonable. The other calculator included was a controls and lighting calculator which reported higher savings values than the previous calculator. There are also notes in the review stating that several of the original lighting plans were not installed, which could also have contributed to these higher values. Therefore this second lighting and controls calculator was neglected in the review process. Although no equations were provided, the savings summary that was reviewed by PECO seems to report the correct total project savings values of 141,649.63 kWh and 23.52 kW, which are much higher than the program-tracking-reported savings.

Project PECO-12-04169 was a lighting and controls project with a project-tracking-reported savings of 38,894.4 kWh. However, there is a note amending the change to 426,305.4 kWh, as the original project-tracking-reported savings was only for the controls and did not include the lighting portion of the retrofit. The amended kWh value is confirmed by the calculation sheet, which also included a demand savings of 44.225 kW for the fixture retrofit that was not reported in the project tracking data.

Smart Construction Incentives

A total of 10 SCI projects were reviewed. Four projects were reviewed for each of Q1 and Q2, and two projects were reviewed for Q3 and Q4. Of the projects reviewed, the majority contained applications, invoices, spec sheets, and savings calculators. There were two projects that did not contain savings calculators, PECO-11-03228 which contained lighting and a geothermal HVAC system, and PECO-11-01906 which contained a whole building remodel. Project PECO-11-03228 had a new HVAC system installed, so this could have used a deemed value, but no documentation was provided to confirm this assumption. PECO-11-01906 did not contain a savings calculator, but it appears that some modeling was completed post- and pre-remodel which resulted in the savings values. The modeling inputs seem correct from the documentation provided. Approximately 40% of the projects reviewed contained differing kWh savings calculations between the application and the program-tracking-reported values. This is most likely a result of the changes in plans between submittal and completion of the projects.

Of the projects reviewed that had savings calculators, one project had differing savings between the savings calculator values and the program-tracking-reported values. Project PECO-12-04243, which contained custom lighting, chillers, air conditioners, motors, and VFDs, had program-tracking-reported savings values of 116,303.2 kWh and 36.91 kW. However, the sum of all the calculators equaled a total savings of 154,483.2 kWh and 47.18 kW which is a bit higher than the program-tracking-reported savings values. This could be due to some custom lighting measures that do not appear to be included in the program-tracking-reported savings. It is unknown if the custom lighting measures were actually installed, resulting in the lack of the custom lighting measures in the program tracking data, but the calculators do seem to have calculated the savings correctly. Both the program-tracking-reported savings and the savings calculator values are still much lower than the estimated savings on the application of 236,014 kWh and 46.06 kW. This is most likely due to the motors having negative savings and some of the measures not having been installed once the project was underway.

F.4.6.4 Review of Sample Design

PECO's PY4 final annual report provides detailed information on the sample design for the PY4 gross impact evaluation of non-residential programs. PECO splits its non-residential EE programs into three groups for evaluation: Smart Equipment Incentives: Commercial and Industrial (SEI C&I) Program, Smart Equipment Incentives: Government, Non-Profit, Institutional (SEI -- GNP) Program, and Smart Construction Incentives Program.

F.4.6.4.1 Smart Equipment Incentives C&I Program

The SEI C&I Program has three subcomponents: retrofit projects, multi-tenant projects, and appliance-recycling projects. In PY4, the C&I multi-tenant and appliance recycling projects were not evaluated because their savings were a very small percentage of the overall program savings. The evaluation contractor designed the final C&I sample for the purpose of achieving the required 85%/15% confidence and precision at the program level. The SWE Team used a combination of project type and size to determine each project's appropriate stratum within the program. The PY4 SEI C&I retrofit projects used stratified ratio estimation similar to the method used in PY1 through PY3. Thirty projects were drawn from an annual population of 657 C&I retrofit projects, and the samples were selected each quarter in order to minimize the amount of time elapsed between project implementation and evaluation.

Based on the data from Q1, Q2, and pipeline data at the end of Q2, the strata boundaries were defined as follows:

- Stratum 1: The top 33% of reported kWh savings
- Stratum 2: The middle 33% of reported kWh savings
- Stratum 3: The lowest 33% of reported kWh savings

Due to the unique properties of EMS and CHP projects,[575] PECO's evaluation contractor placed these project types in their own strata. SWE thinks this strategy is appropriate. One C&I project that had a large savings discrepancy because of a spreadsheet error was also placed in its own stratum. The implementation team and PECO hoped that, by doing this, the verified savings for the rest of the projects would not be affected by the error. The SWE Team finds this approach problematic. If the sample is intended to be representative of the rest of the projects in the program, we should assume that a certain number of non-sampled projects also contained spreadsheet errors that were not discovered because the projects were not selected for evaluation. By separating this project, the error ratio for the program is falsely suppressed and the accuracy of the verified savings estimates is overstated. This should be avoided in the future, and the SWE recommends that in future program years PECO follow the sample design that approved by the SWE. The remaining projects were stratified into three groups – large, medium, and small - according to their ex-ante kWh savings. A coefficient of variation (Cv) value of 0.4 was used to calculate the required sample size, based on the error ratio observed in the PY3 evaluation of the SEI C&I Program.

As shown in Table F-32, PECO failed to meet the 15% relative precision requirement at the 85% confidence level for peak demand savings. The actual relative precision of the peak demand savings estimate was 16% at the 85% confidence level. The missed requirement was due, in part, to the low peak demand realization rate (0.80). Relative precision values increase when realization rates are low because the error bound is larger relative to the program savings. The missed requirement is also a function of PECO's evaluation contractor designing the sample to narrowly meet the audit plan requirements. Similar to the missed precision requirement for the SEI GNI Program in PY3, the PY4 sampling plan was based on optimistic assumptions that reported and verified savings estimates would be well aligned. The sample size proved insufficient when these sampling assumptions were violated for peak demand savings in the EMS stratum. The SWE encourages PECO to add additional sample points in PY5 to avoid a recurrence of this. The PY4 sampling strategy the SEI C&I Program is shown in Table F-32.

Table F-64: PECO Smart Equipment Incentives C&I Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand	Achieved Sample Size
C&I-Large	8	0.4	0.16	0.2	0.07	0.10	6
C&I-Medium	36	0.4	0.31	0.3	0.21	0.30	8
C&I-Small	596	0.4	0.29	0.4	0.24	0.40	9
C&I-CHP	1	0.5	0.00	0.0	0.00	0.00	1
C&I-EMS	16	0.4	0.44	2.4	0.43	0.70	6
Total	**657**				**0.11**	**0.16**	**30**

[575] EMS projects are likely to have a significantly different realization rate from other measures, and CHP projects are large in size and have a distinct nature

F.4.6.4.2 Smart Equipment Incentives GNI Program

Similar to the method used in PY1 through PY3, the PY4 sampling plan for the SEI GNI program used stratified ratio estimation. Since in PY3 PECO missed the 85%/15% confidence and precision requirement for this program, SWE required more conservative variability assumptions for the PY4 sampling plan. The assumed error ratio that PECO used for this program's PY4 sampling was above 0.5 for the three core strata. The final sample size for the PY4 evaluation was 36 GNI projects, from an annual population of 269 GNI retrofit projects. The projects were stratified into five groups: large, medium, small, CHP, and municipal lighting. In each of the four stages -- after Q2, after Q3, during Q4, and after Q4 -- samples were pulled and the sample design was reviewed and adjusted to make sure it would achieve the targeted confidence and precision level. Finally, samples were selected only from projects that represent the top 95% of overall program savings. The details of the GNI program sampling strategy for PY4 are in Table F-33:

Table F-65: PECO Smart Equipment Incentives: GNI Program Sample Plan for PY4

Stratum	Population	Assumed Eror Ratio (Cv) in Sample Design	Observed Error Ratio for Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand	Achieved Sample Size
GNI-Large	1	0.6	0.00	0.00	0.00	0.00	1
GNI-Medium	18	0.9	0.04	0.12	0.17	0.15	12
GNI-Small	229	0.7	0.00	0.00	0.48	0.12	13
GNI-CHP	4	0.5	0.00	0.00	0.00	0.00	4
GNI-Muni Lighting	17	0.4	0.00	0.00	0.01	0.00	6
Total	**269**				**0.12**	**0.05**	**36**

F.4.6.4.3 Smart Construction Incentives Program

New construction projects from the C&I and GNI sectors were combined into a single sample frame for impact evaluation by PECO's evaluation contractor because of the small size of the program. The evaluation team used an approach of considering both project size (gross reported kWh) and project type for stratified sampling. Five strata were defined:

- Non-whole building high
- Non-whole building medium
- Non-whole building low
- Whole building high
- Whole building low

Whole-building projects claim modeled savings for all building systems from a code reference building, with the exception of process equipment. The MWh boundaries for the strata are shown in Table F-34.

Table F-66: Strata Boundaries for PY4 SCI Sampling

Stratum	Stratum Boundaries
Non-Whole Building High	>750 MWh
Non-Whole Building Medium	200-750 MWh
Non-Whole Building Low	<200 MWh
Whole Building High	>750 MWh
Whole Building Low	<750 MWh

The targeted confidence and precision are 85%/10% at the program level. The evaluation contractor conducted desk reviews of all the sampled projects, and site visits of all the non-whole building high and medium and whole building high strata projects except one site in the non-whole building medium stratum that could not be reached. The PY4 sampling strategy for this program is shown in Table F-35.

Table F-67: PECO Smart Construction Incentives Program Sample Plan for PY4

Stratum	Population	Assumed Error Ratio (Cv) in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Non-whole building high	2	0.5	85/15	2	2
Non-whole building medium	10	0.5	85/15	5	5*
Non-whole building low	73	0.5	85/15	7	7
Whole building high	2	0.5	85/15	2	2
Whole building low	14	0.5	85/15	6	6
Total	**101**		**85/15**	**22**	**22**
*One site did not respond to a request for on-site visit, so desk review results for this site were used instead.					

The observed error ratios and relative precision levels for SCI projects from both the C&I and GNI sectors are shown in Table F-36. The sampling uncertainty for the SCI program was significantly better than the allowable levels set forth in the audit plan.

Table F-68: Smart Construction Incentives Program Evaluation Results for PY4

Stratum	Observed Error Ratio Energy	Observed Error Ratio for Demand	Relative Precision at 85% Confidence for Energy	Relative Precision at 85% Confidence for Demand
C&I Non-Whole Building Medium	0.23	0.32	23.5%	1.9%
C&I Non-Whole Building Low	0.05	0.18	2.3%	4.6%
C&I Whole Building High	0.0	0.00	0.0%	0.0%
C&I Whole Building Low	0.02	0.39	0.0%	21.7%
GNI-Strata 1	0.19	0.69	0.00	0.02
GNI-Strata 2	0.41	0.40	0.74	0.2
GNI-Strata 3	0.06	0.20	0.07	0.4
GNI-Whole-Building 1	0.00	0.00	0.00	0.0
GNI-Whole-Building 2	0.03	0.28	0.01	0.2
Program Total			**3.1%**	**4.0%**

F.4.6.5 Review of Verified Savings Analysis

Table F-37 summarizes the data resulting from the M&V activities conducted by the PECO evaluation contractor.

Table F-69: Realization Rates and Precisions for PECO's PY4 Non-Residential C&I EE Programs from Annual Report

Program	Realization Rate (Energy)	Relative Precision (Energy)	Realization Rate (Demand)	Relative Precision (Demand)
Smart Equipment Incentives - C&I[1]	86%	10%	80%	20%
Smart Equipment Incentives – GNI[2]	95%	12%	110%	4%
Smart Construction Incentives	102%	6%	120%	2%
TOTAL PORTFOLIO[3,4]	**82%**	**6%**	**100%**	**3%**

[1] Values shown are inclusive of retrofit, multi-tenant, and appliance recycling strata
[2] Values shown are inclusive of retrofit, multi-tenant, appliance recycling, and new construction strata
[3] Individual program relative precisions are given at an 85% confidence interval, whereas the total portfolio relative precisions are given at a 90% confidence interval.
[4] Total portfolio realization rates include all programs – residential and non-residential.

Realization rates for energy savings from PECO's non-residential programs range from 86% (SEI C&I) to 102% (SCI). Realization rates for demand reductions range from 80% (SEI C&I) to 120% (SCI).

While the SWE notes the relative improvement from PY3 in reducing the margin of error for programs, the SEI C&I demand relative precision still exceeded the targeted 15%. The SWE strongly recommends that the evaluation contractor increase the sample size in the future to ensure that this issue is mitigated.

During PY4, PECO performed a variety of evaluation activities in order to verify its reported savings. Evaluation activities were to be performed in accordance with PECO's EM&V plan issued January 9, 2013. The plan included intended activities for fully deemed, partially deemed, and custom measures in accordance with the TRM.

The impacts for fully deemed measures are provided in the TRM or in an approved interim TRM measure protocol. Therefore, PECO's evaluation approach for fully deemed measures followed the basic level of rigor path: verifying quantities and that the measure installed matched the program and TRM-required specifications through review of project documentation.

For partially deemed measures, the measure type and overall impact of the measure were used to determine whether a basic or enhanced level of rigor was followed. For basic level of rigor, a physical on-site inspection was typically performed for each measure. This included verifying the measure's type and correct installation, operational assumptions, and installation quantity. Partially deemed measures where an enhanced level of rigor was used for verification followed one of the four IPMVP Options (A, B, C, or D).

Likewise, custom measures were also evaluated using an enhanced level of rigor and followed one of the four IPMVP Options. However, evaluating each custom measure additionally required an SSMVP to be developed and followed.

Figure F-4 depicts the frequency of each type of M&V performed by the evaluation contractor in the C&I and GNI programs and also displays the associated evaluated kWh for each M&V approach.

Figure F-18: Frequency and Associated Verified Savings by M&V Method for PECO's PY4 C&I and GNI Programs

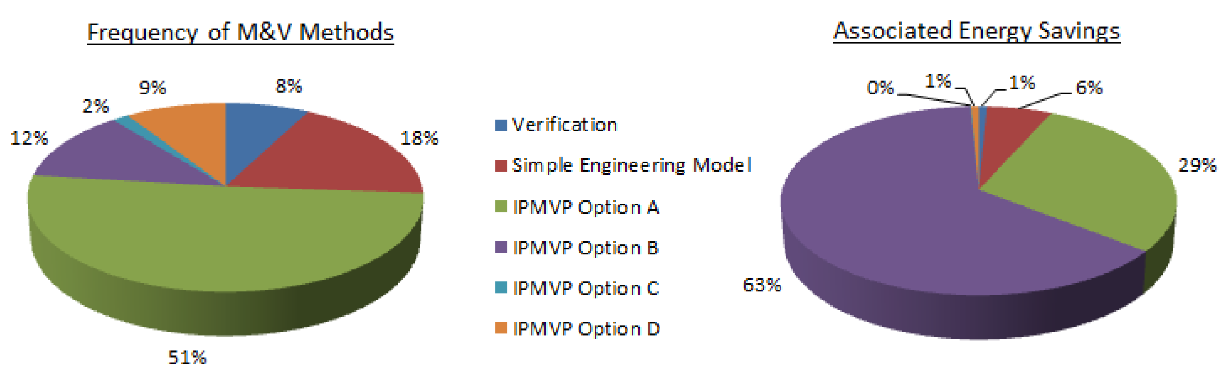
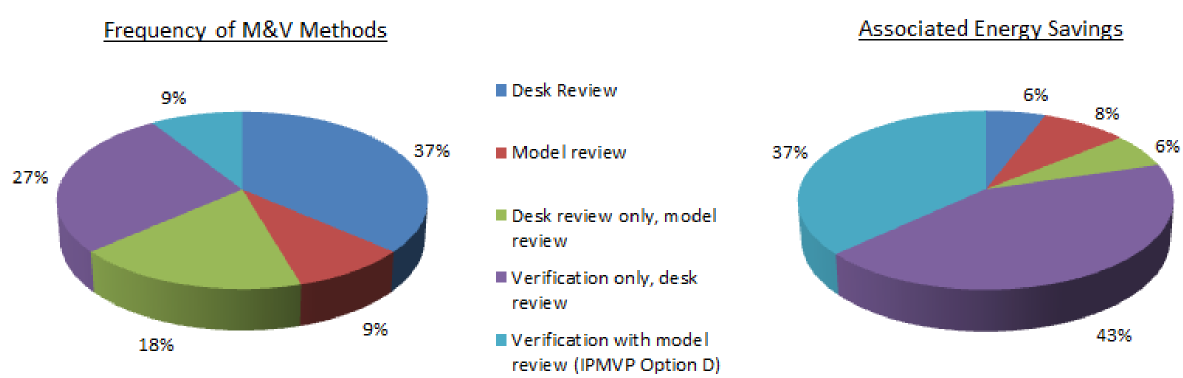


Figure F-4 indicates that roughly one-quarter of the sampled measures in the C&I and GNI programs (17 measures of 65 total) were evaluated using a basic level of rigor. However, the representative savings for each M&V type indicate that approximately 7% of the total evaluated savings were based on basic level of rigor approaches. This suggests that the use of basic rigor was appropriately used predominately for measures with smaller savings.

Due to the nature of the measures in the SCI Program and their associated evaluation efforts being dissimilar from those in the SEI C&I and GNI programs, the SCI program evaluation was reviewed separately.

Figure F-5 shows the relative frequency of each M&V approach used in the SCI program. The "model review" involved "comparing model inputs to parameters verified on-site and making adjustments to modeled savings if needed." The evaluation team received energy model outputs for all whole building projects, and executable modeling files for some. In cases where an executable modeling file was available, the evaluation team used an IPMVP Option D approach by verifying the existing model's inputs, metering and/or calibrating on available billing data, then making changes to the model as necessary. Since the evaluator verifies the projects after the fact, the evaluator sometimes has the unique opportunity to calibrate the energy models to actual utility bills for the facility in instances where sufficient data is available and expected typical building operation conditions exist.

Figure F-19: M&V Approaches Used in PECO's PY4 SCI Program Evaluation



It appears that roughly half the energy savings were verified through "Desk review" or "Verification only, desk review," which implies a basic level of rigor. Specifically, the projects falling under "Verification only, desk review" account for 27% of the sampled projects yet represent 43% of the verified energy savings. This indicates that some projects with larger than average energy savings were evaluated with a basic level of rigor. However, the SWE also notes the evaluator's use of "verification with model review". After discussing the "verification with model review" process with the evaluator and reviewing a sample project using this methodology, the SWE feels that this process is equivalent to the intent of IPMVP Option D, as discussed in the previous paragraph. Therefore, 9% of the sampled projects were verified at a high level of rigor and accounted for 37% of the sample's associated verified savings, implying that a high of level of rigor was appropriately applied to larger impact projects.

The SWE requested a subset of the evaluator's sample for review. By and large, the SWE agrees with the level of rigor and calculation methodology used. Table F-39 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for site evaluation.

Table F-70: IPMVP Methods and Verified Savings of PECO's PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Program Energy Savings	Verified Demand Savings (kW)	% of Program Demand Savings	Method
SEI C&I	PECO-11-03437	52,630	0.08%	30	0.3%	IPMVP Option C
SEI C&I	PECO-12-03961	2,192,407	3.40%	276	2.5%	IPMVP Option B
SEI C&I	PECO-10-01393	434,810	0.67%	121	1.1%	IPMVP Option D
SEI GNI	PECO-10-01385	32,454,576	41.71%	3081	28.0%	IPMVP Option B
SEI GNI	PECO-12-04133	2,348,133	3.02%	184	1.6%	IPMVP Option A
SCI	PECO-11-03345	2,893,203	4.48%	475	0.0%	IPMVP Option D

*From the PECO PY4annual report, savings per program: C&I = 64,530 MWh and 11.0 MW; GNI = 77,893 MWh and 11.8 MW; SCI = 8,494 MWh and 1.80 MW

Project number PECO-10-01385 involved the installation of a large CHP plant. The SWE agrees with the evaluation contractor's general savings calculation approach - using on-site verification of equipment, leveraging trend data from the customer's supervisory control and data acquisition (SCADA) system, and employing the same savings algorithms as was used by the implementation CSP. The SWE found the project's calculation spreadsheets and corresponding project report to be clearly and completely written. Further, the SWE was pleased that the Evaluation contractor leveraged a longer metering period to determine more accurate hours of use estimates, as well as investigated and modeled the plant's dependence on outdoor air temperatures.

Project number PECO-10-01393 entailed the installation of 1,491 programmable thermostats with occupancy sensors in a hotel. On-site activities included verifying different set points according to guest-room settings such as rented occupied, rented unoccupied, and unrented hibernating using data loggers and guest check-in status of nine guest rooms. While the evaluation approach is well documented (eQUEST model inputs, building characteristics, assumptions of variables), the final project report does not include any comparison or reference to the implementation CSP's approach and only states that "detailed calculations for these savings values are not included in the project files". With realization rates of 87% for energy and only 57% for demand, the SWE would have expected the evaluation contractor to work with PECO and the implementation CSP to investigate the large discrepancies in findings. If the approach used by the implementation CSP included using IPMVP Option D as well, the SWE recommends that the evaluation contractor review the inputs to the implementation CSP's model also.

Project PECO-11-03437 included an EMS and white roof installation. On-site activities included verifying the installation of both the new roof and EMS. However, on-site activities also revealed the installation of higher efficiency lighting and rooftop HVAC units. The evaluation contractor's analysis took these auxiliary measures into account by ensuring that the bill analysis was done post-lighting retrofit and also by individually calculating and then subtracting the savings gained by the higher rooftop unit (RTU) efficiencies. There also was an attempt to disaggregate the savings from the white roof and the EMS. The approach called for estimating the savings from the roof using the Department of Energy's (DOE's) Cool Roof Calculator, then subtracting those savings from the aggregate. However, as the evaluator stated in the project report, the calculator has a known validation issue for PECO's climate zone. While the SWE generally agrees with the evaluation contractor's approach of leaving the white roof and EMS savings in aggregate (as only project level savings are needed), the SWE encourages using more robust analyses at the individual measure-type level to more thoroughly support savings claims. In this case, perhaps another means of calculating the savings from the white roof could have been used in lieu of the DOE calculator.

The SWE generally agreed with the methodology and level of rigor used on the reviewed projects and the portfolio sample as a whole. However, there were some instances where there didn't appear to be sufficient documentation. For example, individual project reports sometimes lacked a clear explanation for very high or very low realization rates, or the annual report did not address the discrepancy between the realization rates reported in it and in the data request documents. However, these instances occurred infrequently, and overall the SWE was pleased with the evaluation contractor's inclusion of most key evaluation details in the annual report and the project files reviewed.

F.4.7 PPL

This section contains details on the SWE's audit of PPL's PY4 non-residential programs.

F.4.7.1 Site Inspection Findings

Table F-39 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of PPL non-residential project installations. Details about the SWE site inspection process can be found in Appendix B.

The PPL PY4 site inspection findings are categorized into two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table F-71: PPL PY4 Non-Residential Site Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
PPL-401	Lighting	RA	The number of fixtures controlled with occupancy sensors was incorrectly reported.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.
PPL-402	Lighting	RA	The evaluator did not obtain sufficient detail regarding lighting schedules to support the use of interview results.	Eval	The evaluator will emphasize with inspectors the importance of obtaining detailed schedules during inspections, particularly when interview results are used for the verified savings analysis.
PPL-403	Lighting	RA	The evaluator's original verified savings analysis did not account for two fixtures that were found t obe uninstalled during the site inspection.	Eval	The evaluator revised the verified savings to remove the savings associated with the two fixtures that were not installed.
			Baseline bulb count and fixture wattage were incorrect for a portion of the project.	Pro	The evaluator's verified savings analysis corrected the bulb count and fixture wattage to match those in the site contact's report.
PPL-404	Lighting	RA	Evaluator did not inquire about space conditioning or baseline fixture types.	Eval	The evaluator will emphasize with site inspectors the importance of asking about baseline fixture types, space conditioning, and other pertinent project details during future site inspections.
PPL-405	Lighting	RA	For a portion of the project, the evaluator failed to ask about baseline fixture type and counts. In addition, the evaluator did not inquire about lighting hours of use during the site inspection.	Eval	The evaluator will emphasize with site inspectors the importance of asking about all pertinent project details, including hours of use, baseline fixture types, and de-lamping during future site inspections.
PPL-406	Lighting	RA	The implementer chose the incorrect facility type (and associated lighting hours) from the TRM to characterize the facility.	Pro	The evaluator and SWE concurred that the incorrect facility type was selected by the implementer and that the verified savings reflects the appropriate building type and lighting hours of use.
			Several areas that were reported to be air conditioned were found not to be during the site inspection.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.
PPL-407	Lighting	RA	The implementer incorrectly reported space conditioning and fixture wattage for several spaces.	Pro	PPL will emphasize with implementers the importance of complete and detailed documentation of project details.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
			The evaluator did not adjust pre-installation fixture quantities in spaces where fewer fixtures than listed were observed.	Eval	The evaluator agreed and modified the verified savings analysis to reflect the reduced fixture quantities.
PPL-408	Lighting	RA	The evaluator used the incorrect lighting schedule to estimate hours of use for an area of the facility.	Eval	The evaluator agreed that the incorrect lighting schedule had been used.
PPL-409	Lighting	RA	The project documentation did not represent the as-installed fixture quantities and controls observed by the SWE and evaluator.	Pro	The evaluator and SWE both recommend that PPL emphasize with implementers the importance of accurate project documentation.
PPL-410	Lighting	RA	The site was in the middle of a tenant change within the first year of project savings. The evaluator performed logging at the time of site inspection to estimate hours of use, but did not use logging results because the evaluator's report stated "it was decided after the visit that facility operation at the time of the visit was not representative of the lifetime savings of the project." The evaluator used logging results from the implementer, performed six months earlier, to determine hours of use. The SWE believed these hours of use were not representative of the lifetime savings for the project and recommended TRM hours be used.	Eval	The SWE and evaluator differed on the lighting hours to represent the project impact. If future projects arise with this same issue, the SWE will provide guidance on treatment of such projects.
PPL-411	Lighting	RA	The evaluator did not inquire about permanent fixture removal during the site inspection.	Eval	The evaluator will stress with site inspectors the importance of inquiring about all key project details.
PPL-412	Lighting	IND	There were several instances where the on-site fixture quantities and fixtures types did not match the reported fixture types and quantities.	Pro	PPL will emphasize with implementers the importance of accurate and detailed documentation of project details.
PPL-413	Lighting	IND	The implementer did not use usage groups for this project as required by the TRM for projects with an impact of greater than 20 kW.	Pro	The SWE recommended using usage groups because the facility had a project impact of greater than 20 kW and distinct areas with different operating schedules.
PPL-414	VFDs	IND	All equipment was installed and operating as reported.	N/A	The SWE had no recommendations based on its review of this project.

F.4.7.2 Review of Savings Database

PPL listed five programs under the non-residential umbrella, which includes the small C&I, large C&I, and GNI sectors. Energy and demand savings were reported for all five programs during PY4. PPL's programs are designed to be cross-cutting, allowing customers from all rate classes to participate in them. Because the PY4 annual report format does not include sector-level insight, the SWE did not separate the participation and impacts of the non-residential portions of PPL's Appliance Recycling program from the participation and impacts of the residential portion. The Efficient Equipment Incentive program includes three subgroups; C&I Lighting – New Construction, C&I Lighting Retrofit, and EE Non-Lighting. Table F-40 shows the reported number of participants, energy savings, and demand savings from each reporting category in PY4 based on PPL's PY4 annual report. The Efficient Equipment Incentive program accounted for 76% of the gross reported energy savings and 83% of the gross peak demand savings from non-residential customers in PY4. The HVAC Tune-up and Renewable Energy programs contributed to a small portion of the total portfolio savings.

Table F-72: Annual Report Summary for PPL Non-Residential PY4 Programs

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	15,267	25,260	4.1
Custom Incentive *	112 projects paid in PY4 (some could have initiated before PY4) 83 new projects created in PY4	73,758	7.8
Efficient Equipment Incentive (lighting and non-lighting)	27,833	316,877	59.0
Renewable Energy	116	860	0.3
HVAC Tune-up	274	364	0.1
Total	**43,573**	**417,119**	**71.3**

*In the Custom Incentive Program, two metrics are used to count participants because of the time it takes to complete projects.

PPL provided a series of databases capturing all PY4 activity to the SWE Team for review. Table F-41 provides the participant count, energy savings, and demand savings by program according to the PPL database extracts.

Table F-73: Tracking System Summary for PPL Non-Residential PY4 Programs

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	15,267	24,561	4.1
Custom Incentive	83 new projects initiated in PY4	73,758	7.8
Efficient Equipment Incentive (lighting and non-lighting)	27,833	316,877	59.0
Renewable Energy	116	860	0.3
HVAC Tune-up	274	364	0.1
Total	**43,573**	**416,420**	**71.3**

Table F-42 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$\textit{Reported Figure} - \textit{Database Summary} = \textit{Variance}$$

Table F-74: Discrepancies Between PPL's Tracking System and PY4 Annual Report

Program	Number of Participants	Energy Savings (MWh/yr)	Demand Savings (MW)
Appliance Recycling (includes residential)	0	699	0.0
Custom Incentive	0	0	0
Efficient Equipment Incentive (lighting and non-lighting)	0	0	0
Renewable Energy	0	0	0.0
HVAC Tune-up	0	0	0.0
Total	**0**	**699**	**0**

The SWE compared the figures in Table F-40 to the program tracking data that PPL submitted for each quarter of PY4. The SWE found a minor difference in the energy savings for the Appliance Recycling program, but all other fields were in perfect agreement. Note that variances do not necessarily indicate inadequate QA/QC or incorrect reported savings. This variation is often the result of program implementers or evaluators discovering a mistake or obtaining additional information about a project after the close of the quarter and modifying the record in the program tracking system. The SWE understands that program tracking is a continuous process, and historical corrections are expected and encouraged. PPL's evaluator also clarified that the definition of the participant can vary by program and that there is a difference between the "work package approval date" and "installation date." PPL uses the work package approval date to assign participant counts to specific quarters. Given the volume of rebates processed by PPL in PY4 and the complexity of the Act 129 tracking and reporting requirements, the SWE believes PPL's EEMIS tracking system is performing quite well.

Based on its audit findings, the SWE Team recommends that PPL and its evaluator continue to perform periodic comparisons between the values reported in the quarterly and annual reports and those listed in tracking data extracts. This comparison will help ensure that the participant counts and savings impacts shown in the filed reports continue a high level of agreement with those in the database.

F.4.7.3 Review of Project Files

The SWE review of non-residential projects completed by PPL customers during PY4 was done using project documentation files uploaded quarterly to the SWE SharePoint site. These files included project-level savings calculation worksheets, specification sheets for equipment installed, invoices, customer incentive agreements, and post-inspection forms. The documentation provided was comprehensive, detailed, and organized and allowed for complete review of all uploaded projects.

Twenty projects were reviewed to assess the consistency of the program tracking database and the overall completeness of documentation for each project. The20 projects included 10 C&I Lighting Retrofit projects, 5 Custom Incentives projects, 3 EE Non-Lighting projects, 1 HVAC Tune-Up project, and 1 Renewable Energy project. Overall the documentation for the reviewed projects was quite good and consistent with the database, though there were some omissions on a specific basis. Table F-43 summarizes the discrepancies that were found in the reviewed projects between the project documentation and the program tracking database. The discrepancies are further detailed in the paragraphs below.

Table F-75: Summary of Discrepancies between PY4 Project Documentation and Program Tracking Database

Unique ID	Program	Reported kWh/yr	Reported kW	Rebate Amount
PPL-10-03744	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-LTO-12-0269	C&I Lighting Retrofit	Discrepancy	Discrepancy	Consistent
PPLDI-12-7293	C&I Lighting Retrofit	Discrepancy	Discrepancy	Consistent
PPLLTO-CC15-12-7066	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-7053	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPL-10-05365	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLLTO-MS20-10-04873	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLLTO-MS20-10-04729	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-4649	C&I Lighting Retrofit	Consistent	Consistent	Consistent
PPLDI-12-8738	C&I Lighting Retrofit	Consistent	Consistent	Consistent
233	Custom Incentives	Consistent	Consistent	Consistent
263	Custom Incentives	Consistent	Consistent	Consistent
363	Custom Incentives	Consistent	Consistent	Consistent
344	Custom Incentives	Consistent	Consistent	Consistent
373	Custom Incentives	Consistent	Consistent	Consistent
PPL-10-04831	EE Non-Lighting	Consistent	Consistent	Consistent
PPL-10-04798	EE Non-Lighting	Consistent	Discrepancy	Consistent
PPL-10-04615	EE Non-Lighting	Consistent	Consistent	Consistent
668964	HVAC Tune-Up Program	Consistent	Consistent	Consistent
64740653	Renewable Energy Program	Discrepancy	Discrepancy	Consistent
	Total Consistent	**17**	**16**	**20**
	Total Discrepancy	**3**	**4**	**0**

<u>C&I Lighting Retrofit Program</u>

Two projects (PPLDI-LTO-12-0269 and PPLDI-12-7293) had project documentation that disagreed with the tracking database in energy and demand savings. The first of these projects, a lighting retrofit and controls project, had an energy savings of 283,483.6 kWh/yr and a demand reduction of 44.19 kW in the program tracking database. This value was also listed in the TRM calculator. However, in the program application, post-installation inspection report, project completion form, and notification of payment, the energy savings was listed as 147,651.6 kWh/yr and the demand reduction of 52.35 kW. The cause for this discrepancy was a difference in the operating hours that were used to calculate the savings., According to the TRM calculation sheet, the EFLH was 4,290 based on it being categorized as a Manufacturing – Light Industrial facility, whereas the actual operating hours of the lighting ranged from

48 to 50 hours per week (less than 2,600 hours per year). While the energy savings and demand reduction in the project forms, other than the TRM calculator, are more accurate, the TRM calculation is correct based on the rules of the program.

For the second of the two projects, which involved a retrofit to seven exit lights, the same discrepancy was found between the program documents (2,140.32 kWh/yr and 0.25 kW) and the TRM calculator (1,198.58 kWh/yr and 0.29 kW). The cause for this discrepancy was also a difference in the operating hours that were used to calculate the savings. According to the TRM calculation sheet, the EFLH was 4,368 based on it being categorized as a Retail – Single-story Large facility, whereas the actual operating hours of the lighting were 24 hours/day (8,760 hours per year). While the energy savings and demand reduction in the project forms, other than the TRM calculator, are more accurate, the TRM calculation is correct based on the rules of the program. The observed differences between the TRM default EFLH and the actual site operating conditions highlight the need to move to more customer-specific data collection in Phase II of Act 129.

EE Non-Lighting Program

One project (PPL-10-04798) showed a difference in the reported demand savings in the submitted project information and the tracking database. The project took place at a community college and included a retrofit of HVAC fans and chiller pumps. The demand reduction was 8.94 kW in the program tracking database and in the TRM calculator as well, but in the application summary the demand reduction was 7.96 kW It is is unclear why 8.94 kW was found in the program tracking database. The SWE assumes it is a data-entry issue.

Renewable Energy Program

The one renewable energy project that was reviewed (64740653) did not include information on the reported energy or demand reduction. This project had information on the expected tonnage for the ground-source heat pump as well as the actual tons and the EER, but there was no summary of the expected level of generation capacity in terms of kWh/yr or kW. Based on the size and efficiency of the equipment, the savings estimates correspond to an EFLH of only approximately 450, which appears too low for a unit responsible for both heating and cooling.

Additional Discrepancies in Project Documents

Table F-44 summarizes the three types of PPL project documents that were either provided, not provided, or found to be incomplete. As can be noted in the table, nearly half of these documents were not provided by the EDC. While these can likely be considered nonessential documents, it will be important to emphasize more thorough provisioning of these documents in future program years.

Table F-76: Summary of PY4 Provision of Confirmation, Equipment Specs, and Invoices

Unique ID	Program	Installation Confirmation	Equipment Specs	Invoices
PPL-10-03744	C&I Lighting Retrofit	Provided	Provided	Provided
PPLDI-LTO-12-0269	C&I Lighting Retrofit	Provided	Not Provided	Provided
PPLDI-12-7293	C&I Lighting Retrofit	No notes	Not Provided	Not Provided
PPLLTO-CC15-12-7066	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
PPLDI-12-7053	C&I Lighting Retrofit	Provided	Provided	Not Provided
PPL-10-05365	C&I Lighting Retrofit	No notes	Provided	Provided
PPLLTO-MS20-10-04873	C&I Lighting Retrofit	No notes	Not Provided	Provided
PPLLTO-MS20-10-04729	C&I Lighting Retrofit	Provided	Provided	Provided
PPLDI-12-4649	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
PPLDI-12-8738	C&I Lighting Retrofit	Provided	Not Provided	Not Provided
233	Custom Incentives	Provided	Provided	Provided
263	Custom Incentives	No notes	Provided	Provided
363	Custom Incentives	Provided	Not Provided	Not Provided
344	Custom Incentives	No notes	Provided	Not Provided
373	Custom Incentives	Provided	Provided	Provided
PPL-10-04831	EE Non-Lighting	No notes	Provided	Provided
PPL-10-04798	EE Non-Lighting	No notes	Incomplete	Provided
PPL-10-04615	EE Non-Lighting	Provided	Provided	Not Provided
668964	HVAC Tune-Up Program	No notes	Provided	Provided
64740653	Renewable Energy Program	No notes	Not Provided	Provided
	Total Provided	11	11	12
	Total Not Provided	9	9	8

Overall the forms uploaded were well organized, easy to work with, and provided all the information required to complete a thorough review of the selected projects. The issues highlighted above were only observed on a small number of projects, and the project-specific inconsistencies were minimal for the size of the overall programs. The inconsistencies reported are minor database oversights and data-entry errors, which are expected given the volume of projects processed by PPL. The remaining projects reviewed showed consistency between the database and project-specific files. The SWE believes the uploaded documents provided sufficient insight into the savings calculations and documentation processes used by PPL and believes the associated reported savings estimates are valid.

F.4.7.4 Review of Sample Design

PPL's PY4 final annual report provides detailed information about the sample design and selection for the PY4 gross impact evaluation of non-residential programs. The sampling plan for PY4 continually aligns with and exceeds the requirements of the SWE annual sampling guidelines for Act 129 programs, including:

5. 90%/10% confidence and precision (C/P) at the portfolio level for non-residential programs
6. 85%/1%5 C/P for each program in the portfolio
7. GNI and low-income sector populations treated as independent program populations and sampled at 85%/15% C/P if the energy savings contribution to the respective sector-level portfolios is more than 20%
8. All C/P levels are minimum requirements, and EDC evaluators are encouraged to exceed them.

The initial sample design for each program in PY4 was based on PY3 participation, realization rates, and error ratios/coefficients of variation. The target numbers of sample points were established using conservative assumptions so that even if the PY4 results were more variable than PY3, PPL would still meet the required precision levels. PPL's evaluation contractor also conducted a quarterly review of the measure mix and distribution of measures by sector and made adjustments where necessary. In PY4Q4, the final verification of samples was conducted considering participation from the full program year.

Four PPL non-residential programs reported savings in PY4: the Efficient Equipment Incentive Program (includes lighting and non-lighting strata), the Renewable Energy Program, the HVAC Tune-Up Program, and the Custom Incentive Program.

F.4.7.4.1 Efficient Equipment Incentive Program

The non-residential Efficient Equipment Incentive Program evaluation group included lighting, non-lighting, and direct discount programs. Because of the large variation in unit ex-ante savings across measures from over 13,000 participants in this evaluation group in PY3, PPL's evaluation contractor stratified the program into large, medium, and small strata, based on total measure ex-ante energy savings (see Table F-45). Lighting measures were treated as the large stratum since they comprise the largest measure group. The medium stratum included the adjustable speed drive (ASD) and variable speed drive (VSD) measure groups, and the small stratum included HVAC measures, office equipment, and miscellaneous measures. The large (lighting) stratum received some additional sub-stratification as well. The medium and small strata targeted 15% precision at 85% confidence, while the large stratum targeted 10% precision at 90% confidence.

Table F-77: PPL PY4 Efficient Equipment Incentive Program Non-Residential Sector Strata

Stratum	Stratum Definition	Substratum	Measure Groups
Large	Top 80%	Direct Discount	Lighting
		Large Lighting	
		Medium Lighting	
		Small Lighting	
Medium	Next 10%		VSD, ASD, and refrigeration
Small	Last 10%		All others: HVAC, appliances, office equipment, insulation, other

Because participation in PY4 was anticipated to be similar to that in PY3, the proposed PY4 sampling plan was based on cumulative PY3 participation. The PY4 sampling plan was based on the final number of measures installed in PY3, along with respective ex-post verified savings and variability assumptions. By checking the quantities of measures rebated and the respective contribution of reported energy savings (kWh) to the total sector's savings, PPL's evaluation contractor determined there was no need to change the strata definitions or target number of sample points in each stratum. In the non-lighting samples, the site visits for the small stratum were originally planned to be nested within the medium stratum; however, it was not possible to reach the small stratum quota with this strategy. Therefore, the PPL's evaluation contractor conducted additional record reviews for the small measures to meet the quota. No site visits were conducted for the measures installed by participants only in the small stratum.

After receiving all records for PY4 at the end of the program year, PPL's evaluation contractor adjusted the original sampling plan for the medium and small strata to address the following issues.

4) *Different realization rates were calculated from motors and VSD samples installed in different years.*

The savings of many sampled motors and VSD projects that had been installed in 2010 and 2011 were calculated according to the methodology from the 2010 and 2011 TRMs, and the savings of the motors and VSD projects installed in PY4 were calculated according to the 2012 TRM methodology. Twelve VSD projects (medium stratum) and six motors projects (small stratum) were added to the records review sample by PPL's evaluation contractor, so that separate realization rates for 2010-2011 and 2012 could be calculated.

5) *New measures were processed after Q4 changed the target sample distribution.*

PPL's evaluation contractor drew an additional 11 measures from the medium stratum and an additional 13 measures from the small stratum. The samples were randomly chosen to reflect the underrepresented measures (including insulation, evaporator fans, [ASHPs], [DX AC], and chillers) in the original sample plan.

6) *The commercial insulation measures were originally part of the non-residential small stratum, but the realization rates for the initial sampled projects were not representative of all insulation projects or of the other measures in the commercial small stratum.*

PPL's evaluation contractor separated these measures into their own stratum because savings and realization rates were highly variable for insulation measures. The SWE reviewed these adjustments to the PY4 sampling plan and felt each was an appropriate response to the circumstances.

The PY4 stratification plan within the large stratum was based on the number of non-residential lighting projects installed in PY3 and their distribution between direct discount and standard (referring to prescriptive rebates) delivery paths observed in PY4Q1. The kWh error ratio of 0.4 was used for calculating the sample size for this stratum. The 0.4 value was rounded up from the observed PY3 error ratio of 0.34. A stratified sampling approach was used to separate the lighting stratum into four substrata: direct discount, standard large, standard medium, and standard small. Sample sizes for each substratum were based on its contribution to total reported kWh savings. According to the information provided in PPL's final annual report, new construction was added as a fifth substratum to the lighting stratum, with 10 samples for site visits and records review. One sample point was added in the direct discount stratum, 10 sample points were added in the standard small stratum, and 4 sample points were reduced from the standard large stratum. Details of the targeted sample sizes and completed sample sizes for the non-residential Efficient Equipment Incentive Program projects are shown in Table F-46.

Table F-78: PPL PY4 Efficient Equipment Incentive Program Nonresidential Projects Sample Plan

Stratum	Substratum	PY4 Sampling Rigor & Cv	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	Direct Discount	90/10, Cv=0.4	24	25	Site Visits & Records Review
	Standard Large		12	8	
	Standard Medium		8	8	
	Standard Small		8	18	
	New Construction		-	10	
Medium	-	85/15 at program level, 90/10 at sector level; assumed Cv or proportion in sample design: 0.5	20	43	Records Review
			20	21	Site Visits
Small	-		20	39	Records Review
			20	1	Site Visits

The observed error ratios and the relative precision for each stratum of PY4 non-residential Efficient Equipment Incentive Program projects are shown in Table F-47.

Table F-79: PPL Efficient Equipment Incentive Program Nonresidential Sector Evaluation Results

Stratum	Observed Error Ratio for Energy	Relative Precision for Energy	Observed Error Ratio for Demand	Relative Precision for Demand
Non-residential Large (Lighting)	0.19	4.54%	0.17	1.00%
Non-residential Medium	0.86	21.15%	0.75	18.47%
Non-residential Medium, Small (Motors/VSDs from 2010 and 2011)	0.31	6.98%	0.67	15.19%
Non-residential Small (Insulation)	N/A*	N/A*	N/A*	N/A*
Non-residential Small	2.38	48.59%	2.1	42.74%
*This stratum did not include sampling. Cv and Precision are not meaningful.				

F.4.7.4.2 Renewable Energy Program

In PY4, the Renewable Energy Program was only available to the GNI sector for a few remaining projects in progress. All projects were included in the sample for records review, and five projects received site visits by PPL's evaluation contractor.

F.4.7.4.3 HVAC Tune-Up Program

The HVAC Tune-Up Program used a census approach that covered PY4 program participants. All measures were included in the desk review and analysis. This program's evaluation did not include sampling, thus C_v and precision are not meaningful.

F.4.7.4.4 Custom Incentive Program

Projects in the Custom Incentives Program were defined as large or small projects for the purpose of verification. A census of the 41 projects in the large stratum in PY4 was included in the impact evaluation sample and was verified. A sample of 8 projects was selected from 71 total projects in the small stratum in PY4 and was verified. The error ratio is reported instead of coefficient of variation because the realization rate (for the small stratum) was calculated using ratio estimation, and the error ratio is used in sample planning. For the large stratum, the observed error ratio was 0.39 for energy, which is only for the 10 projects for which PPL paid the incentive prior to verification. There is no sampling uncertainty for the large stratum because a census of completed projects was verified. For the small stratum, the observed error ratio was 0.27 and the relative precision was 13.6% for energy. The program total observed error ratio was 0.33 for energy and 0.16 for demand. The program total relative precision was 6.2% for energy and 3.0% for demand.

F.4.7.5 Review of Verified Savings Analysis

Table F-48 summarizes the data resulting from the M&V activities conducted by the PPL evaluation contractor.

Table F-80: PPL PY4 Non-Residential Energy Efficiency Programs - Realization Rates and Relative Precisions for Energy and Demand Savings

Program	Realization Rate (Energy)	Relative Precision (Energy)	Realization Rate (Demand)	Relative Precision (Demand)
Custom Incentive	98%	6.2%	102%	3%
Efficient Equipment Incentive[1]	97%	4.2%	91%	3.2%
HVAC Tune-Up	100%	N/A[2]	100%	N/A[2]
Renewable Energy	72%	9.8%	78%	14.9%
Total Portfolio[3]	**98%**	**1.9%**	**90%**	**1.8%**

[1] Values shown in this table for this program include both residential and non-residential sectors.
[2] This program did not include sampling, therefore relative precision is not applicable.
[3] Total portfolio realization rates include all programs – residential and non-residential.

During PY4, PPL performed a variety of evaluation activities in order to verify its reported savings. Evaluation activities were to be performed in accordance with each program's QA/QC and EM&V plan submitted by PPL in May 2012. The plans specified data collection and reviewing activities, including EEMIS data and other required data included with the rebate application forms, billing data, participant surveys, on-site visits, and metering for some lighting and most custom projects.

The level of rigor used to evaluate projects sampled in each program generally followed the program's corresponding QA/QC and EM&V plan. The HVAC Tune-Up, Renewable Energy, and non-lighting portion of the Efficient Equipment Incentive programs only used a basic level of rigor in their evaluation efforts, opting to use simple on-site verification and/or desk reviews for their entire samples. This was likely due to the programs' relatively low contribution to the portfolio savings, as shown in Figure F-6. Further, it appears that the other programs – Custom Incentive and the lighting portion of Efficient Equipment Incentive – follow the same trend, where the level of rigor used in each program is proportionate to the program's savings contribution to the overall portfolio (see Figure F-7). Overall, the SWE feels that this is a valid approach for using limited EM&V funds toward the highest impact projects. However, the SWE still suggests that the evaluation contractor review the use of high rigor evaluation approaches in programs with smaller, yet still significant, savings.

Figure F-20: PY4 Evaluation Sample Verified kWh Savings by Program (rounded to the nearest percent)

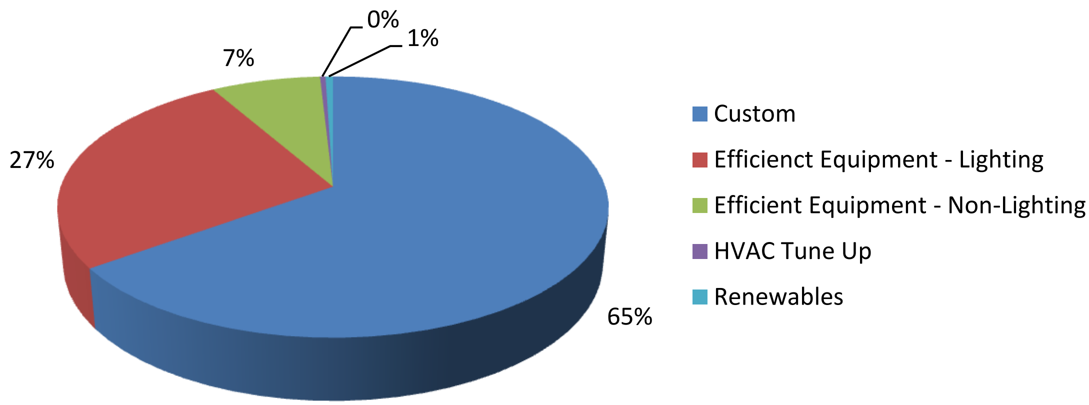


Figure F-21: Level of Rigor Use by Project Count in PPL Non-Residential Programs

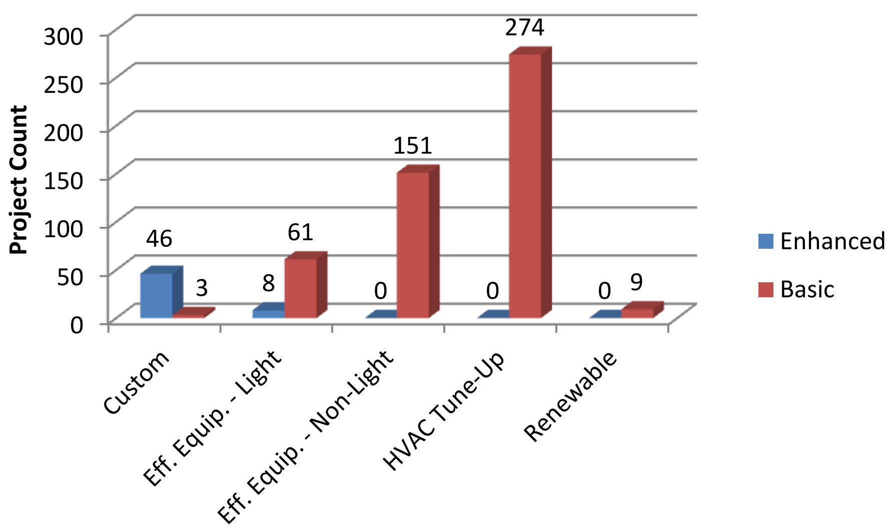


Figure F-8 depicts the frequency of each type of M&V performed by the evaluation contractor across the non-residential programs and the associated energy savings (kWh) for each M&V approach.

Figure F-22: PY4 M&V Approaches Used in PPL's Non-Residential Projects

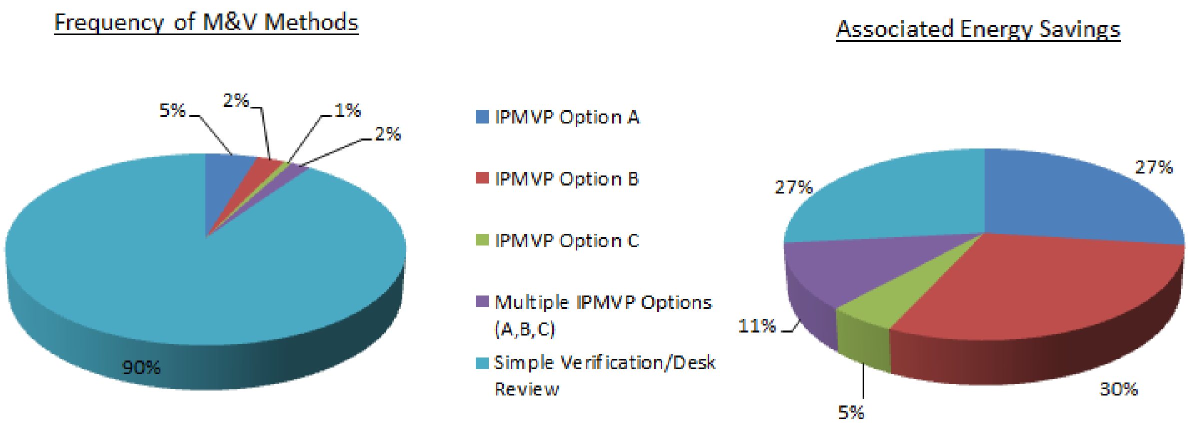


Figure F-8 indicates that 73% of verified energy savings were verified using enhanced levels of rigor, therefore reinforcing what was stated previously: it appears that the evaluation contractor correctly applied enhanced levels of rigor on projects with the highest impact. However, over one-quarter of the energy savings was still verified using a basic level of rigor. The SWE suggests that the evaluation contractor increase the quantity of projects verified at an enhanced level of rigor. This would result in both lowering the proportion of savings verified using a basic level of rigor and helping better understand savings from programs the currently do not have any projects that were verified at an enhanced level of rigor (see Figure F-7).

The SWE requested a subset of projects in the evaluator's sample for review. By and large, the SWE agreed with the level of rigor and calculation methodology used. Figure F-6: PY4 Evaluation Sample Verified kWh Savings by Program (rounded to the nearest percent)

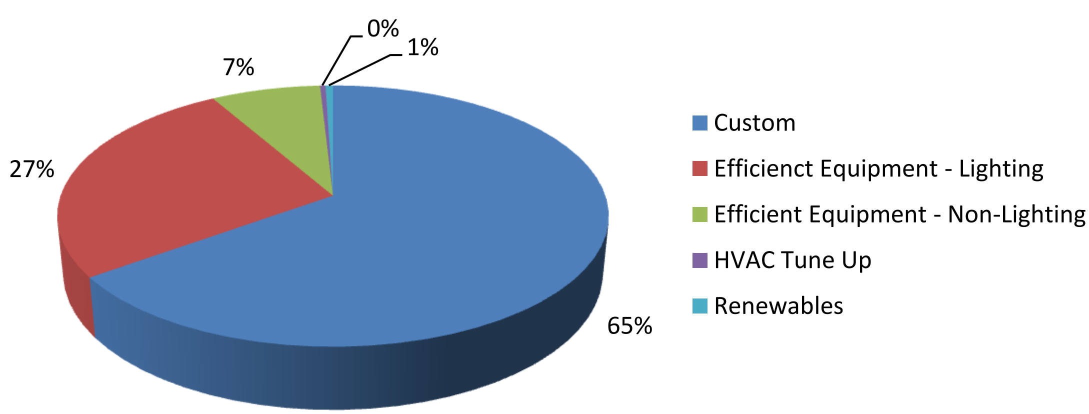


Figure F-7: Level of Rigor Use by Project Count in PPL Non-Residential Programs

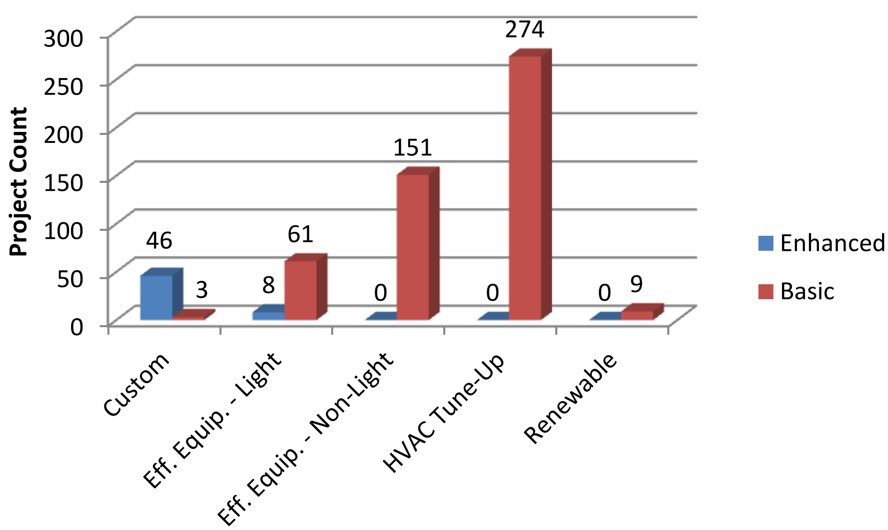


Figure F-8 depicts the frequency of each type of M&V performed by the evaluation contractor across the non-residential programs and the associated energy savings (kWh) for each M&V approach.

Figure F-8: PY4 M&V Approaches Used in PPL's Non-Residential Projects

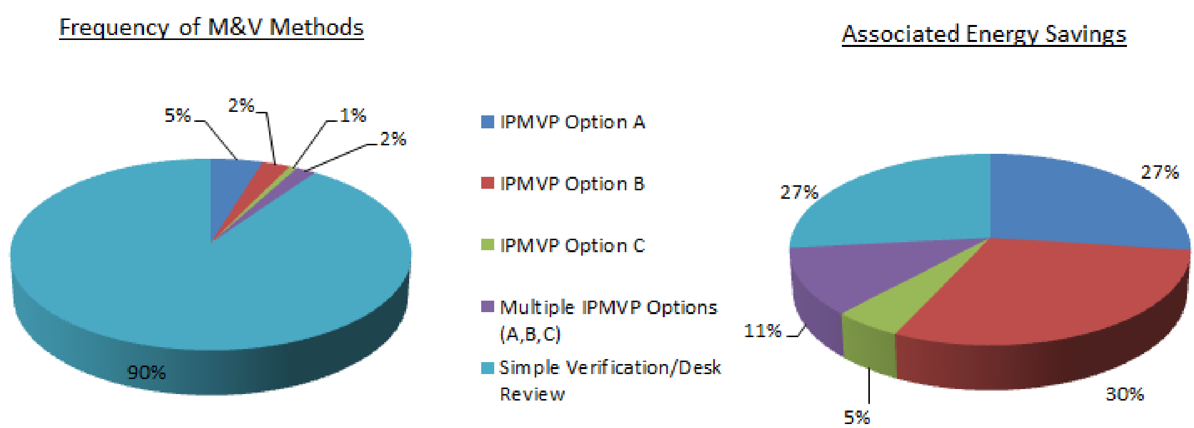


Figure F-8 indicates that 73% of verified energy savings were verified using enhanced levels of rigor, therefore reinforcing what was stated previously: it appears that the evaluation contractor correctly applied enhanced levels of rigor on projects with the highest impact. However, over one-quarter of the energy savings was still verified using a basic level of rigor. The SWE suggests that the evaluation contractor increase the quantity of projects verified at an enhanced level of rigor. This would result in both lowering the proportion of savings verified using a basic level of rigor and helping better understand savings from programs the currently do not have any projects that were verified at an enhanced level of rigor (see Figure F-7).

The SWE requested a subset of projects in the evaluator's sample for review. By and large, the SWE agreed with the level of rigor and calculation methodology used. Table F-49 shows the energy and demand savings for the projects chosen for SWE review, as well as the M&V method that was selected for site evaluation.

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Table F-81: IPMVP Methods and Verified Savings of PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Program Energy Savings	Verified Demand Savings (kW)	% of Program Demand Savings	Method
Custom	212	3,407,005	5.4%	454	6.7%	IPMVP Options B & C
Custom	233	1,164,004	1.8%	86	1.3%	IPMVP Option B
Eff. Equip. – Lighting	PPL-10-05158	6,061,995	11.7%	645	8.6%	Simple Verification
Eff. Equip. – Lighting	PPLLTO-T12-10-04205	2,212,185	4.3%	323	4.3%	IPMVP Option A
Eff. Equip. – Non-lighting	PPLLTO-VSD-10-04442	195,194	2.7%	91	12.7%	Simple Verification (Desk Review)
Eff. Equip. – Non-lighting	PPLLTO-MS20-10-05785	170,443	2.3%	15	2.1%	Simple Verification (Desk Review)
Eff. Equip. – Non-lighting	PPL-10-05554	6,416	0.1%	11	1.5%	Simple Verification (Desk Review)

Project 212 included removing two transformers and adding VFDs on two 600HP motors. The savings calculation from removing the two transformers was relatively straightforward and was based on simple verification and determining no-load losses and additional oil circulation pumps and cooling fans used by the removed transformers. The VFDs were measured using the facility's existing meters, with the evaluator noting a correlation between tons of material processed and fan use. Using these as a proxy and three months of post-retrofit metering data, the VFD savings were calculated. The SWE feels that this method is a valid approach but still may take into account variances in other loads fed by the meters. The most robust process would be to meter the power draw to the VFDs directly, as outlined in the project's SSMVP. The project's verification report stated that directly metering the VFDs was not possible due to the equipment being connected to high voltage (2300 V) lines. The SSMVP took this safety issue into account and stated that the metering was to be performed using a current transducer (CT) on a secondary circuit or, if a secondary circuit was unavailable, directly from measuring the input to the VSD and after the step-down transformer (480 V). However, the verification report did not cite a reason why direct measurement was not done, only that it had not been done.

Project PPL-10-05158 involved retrofitting metal halide fixtures with high-bay T8 lighting. The evaluation contractor verified fixture types and counts installed on site and used the light metering data from the implementation CSP to verify the savings. The evaluation contractor used information from a customer interview to determine that the facility operates 24 hours/day on weekdays and 18 hours/day on weekends, with three shut-down days per year, which yields approximately 8,062 operating hours/year. However, 7 lighting loggers were installed for 25 consecutive days and showed that the lights were on very close to 100% of the time. The evaluation contractor then revised the estimated hours of use based on extrapolating the light metering data and a customer interview indicating the facility is shut down 5 days per year, arriving at 8,638 operating hours/year. The SWE agrees with this methodology and encourages the use of logged data over interview data, when available.

Project PPLLTO-VSD-10-04442 involved adding VFDs to motors serving chilled water pumps, condensing water pumps, and a cooling tower fan. The ex-ante savings notes the installation of eight VFDs, whereas the invoices indicate seven VFDs were installed. During the on-site visit, the evaluation contractor noted the installation of only seven VFDs and remarked that this more closely matched the invoices than the ex-ante savings estimate. However, the evaluation contractor's calculations appeared to still count savings from eight VFDs, and showed a verified quantity of eight VFDs for this particular project. No documentation from the evaluation contractor's further explaining the discrepancy between the calculation and the remark was found in the project file submitted to the SWE. The SWE highly recommends that the evaluation contractor pay closer attention to calculation inputs. Moreover, the SWE suggests that the evaluation contractor increase the level of documentation (e.g., on-site photos, checklists, notes, etc.) supplied for each project file. This would likely mitigate the discrepancy issues and allow for a quicker and more robust review. Further, the SWE notes the size of this project. While the 2011 TRM (applicable to this project based on the installation date) does not specify a minimum kWh savings that would trigger an enhanced level of rigor to be performed, the SWE would have expected the evaluation contractor to consider using enhanced rigor to evaluate this project given its size, and to document the reason for choosing not to pursue an enhanced level of rigor -- especially since this project was evaluated during PY4, when the evaluation contractor could reference the current TRM (2012 TRM), which used a 50,000 kWh savings minimum threshold to trigger a mandatory metering study.

Generally, the SWE agreed with evaluation contractor's savings calculation methodologies when sufficient documentation was present in the project file for the SWE to review. Many of the reviewed project files lacked detailed documentation explaining alternative calculations or deviations from the ex-ante savings calculations. The SWE recommends that the evaluation contractor be more detailed in documenting and more systematic in recording the evaluation work and corresponding outcomes.

F.4.8 Met-Ed

This section contains details on the SWE's audit of Met-Ed's PY4 non-residential programs. The sections "Site Inspection Findings" and "Review of Project Files" (Sections F.4.4.3 and F.4.4.3 respectively) also include information from Penelec, Penn Power, and West Penn Power. This is because all four FirstEnergy companies presented audit information for these two sections to the SWE in aggregate.

F.4.8.1 Site Inspection Findings (Met-Ed, Penelec, Penn Power, and West Penn Power)

Table F-50 summarizes the SWE PY4 ride-along (RA) and independent (IND) site inspections of FirstEnergy non-residential project installations. Details about the SWE site inspection process can be found in Appendix B.

The FirstEnergy PY4 site inspection findings are categorized into three types

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluator savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.
- TRM findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

Table F-82: FirstEnergy PY4 Non-Residential Site-Inspection Findings

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
FE-401	Lighting	RA	The evaluator did not adjust the fixture counts for a small number of uninstalled fixtures and instead applied a discount rate to the savings to account for delayed installation.	Eval	The evaluator revised the savings to account for the uninstalled fixtures. The SWE recommended that savings for the delayed fixtures begin in PY5 since it was highly likely the fixtures were going to be installed imminently. However, applying a discount rate is not appropriate since Phase I compliance is based on measures that are installed and operational by May 31, 2013.
			None of the versions of the Appendix C in the project file matched the reported savings for this project.	Pro	The SWE recommended to FirstEnergy that for future projects the contents of project files should be clearly labeled and the version of the Appendix C supporting the reported savings should be provided.
FE-402	Lighting	RA	The evaluator did not conduct a census of the installed fixtures. The SWE judged that the quantity of fixtures included in the project was not prohibitive to obtaining an exact fixture count. Also, there was uncertainty in the project scope that could have been clarified via a census.	Eval	The evaluator agreed with the SWE and will be more diligent in future projects that are similar.
FE-403	Lighting	RA	The evaluator installed two light loggers to monitor fixtures controlled by occupancy sensors and assumed that if one logger indicated that the lights were on, then all lights affected by the project were assumed to be on. The SWE noted that one logger was installed in a high-use location and the other in a low-use location and thus the evaluator's assumption may not be valid.	Eval	The evaluator revised the logger data analysis to calculate hours of use for each logger separately (high- and low-use) and then averaged the results to more accurately represent the average hours of use of for all fixtures affected by the project.
			Reported fixture counts did not agree with site inspection findings.	Pro	The evaluator corrected the fixture count discrepancies in verified savings analysis.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
FE-404	Lighting	RA	Some of the evaluator's fixture types and counts did not agree with the site inspection findings, and the lighting hours of use in the evaluator's analysis differed from the hours posted on the facility's website.	Eval	The evaluator corrected the fixture types and counts to agree with the site inspection findings and the hours of use to agree with the posted hours.
			Reported fixture counts and fixture types did not agree with site visit findings for a portion of the project.	Pro	The SWE recommends that FirstEnergy emphasize with implementers the importance of documenting accurate project details.
FE-405	Lighting	RA	The evaluator assumed that rebated lamps were sold by the customer with merchandise and thus assumed residential lighting hours of use. Based on the SWE's interview with the site contact, the SWE does not believe the rebated lamps were sold.	Eval	The evaluator revised the hours of use to be consistent with the SWE's interview with the site contact.
FE-406	VFDs	RA	Ex-ante savings analysis was not included in the project file.	Pro	The SWE requested that the implementer's savings analysis be included as part of all future project files.
			The implementer's engineering analysis was presumed by the evaluator and SWE to be inappropriate for the application of the VFDs. The result was that the reported savings was significantly overstated.	Pro	The evaluator corrected the implementer's assumptions and calculation to reflect the application of the VFDs included in this project. The evaluator and SWE agreed on the verified savings impact.
FE-407	Lighting	RA	The project documentation did not include any supporting calculations or assumptions to support lighting hours of use that differed from the TRM hours.	Pro	The SWE recommended that FirstEnergy emphasize with implementers that all hours of use estimates should be documented in a transparent manner (i.e., detailed lighting schedules).
			The evaluator did not inquire about lighting hours of use in all spaces or attempt to quantify the number of fixtures that were on occupancy dimming controls prior to the project.	Eval	For future projects the evaluator will emphasize with inspectors the importance of obtaining detailed lighting schedules for all spaces.
			Lighting controls were not accounted for in peak demand reduction calculations.	TRM	The 2014 TRM incorporates this finding and allows for peak demand reduction impacts of lighting controls to be accounted for.
FE-408	Lighting	RA	The implementer did not use TRM fixture codes for any fixtures but rather listed all fixtures as custom.	Pro	The SWE recommended that the implementer use TRM fixture codes for fixtures that are in the TRM.
			The project documentation did not provide accurate support for fixture wattages and ballast types.	Pro	The SWE recommended that the implementer provide better project documentation.

SWE ID	Measures	Inspection Type	Finding	Finding Type	Resolution
			The implementer and evaluator both incorrectly characterized space cooling for the warehouse areas of the facility.	Pro/Eval	The evaluator concurred and adjusted the space cooling of the warehouse areas to match on-site findings.
FE-409	Lighting	RA	The implementer labeled fixture types as custom when TRM fixture codes existed and used the incorrect wattages for some custom fixtures.	Pro	The SWE recommended that the implementer use TRM fixture codes for fixtures that are in the TRM and provide better project documentation.
			The implementer reported what the evaluator and SWE agreed was an unrealistic quantity of fixtures as removed and not replaced and provided no documentation to support this removal.	Pro	The SWE recommended that the implementer provide better project documentation.
FE-410	Lighting	IND	Hours of use assumptions and calculations were not documented in the project file. Also, specification sheets were not provided to support all custom fixture codes.	Pro	First Energy has recently implemented a practice of having applicants provide signed letters that document hours of use assumptions, particularly for large projects.
FE-411	Lighting	IND	The implementer did not use an hour of use estimate that accurately reflected the lighting schedule of the facility.	Pro	The SWE recommended that the implementer use hours of use estimates that accurately reflect the lighting schedule of the facility.
FE-412	VFDs, HVAC controls, vending machine controls	IND	The prescriptive portion of the project (which was a minor contributor to total project savings) was not reported using TRM protocols.	Pro	The SWE recommended that implementerd use TRM protocols for measures included in the TRM. The calculations should be transparent and any departures from the TRM based on project-specific data should be clearly identified and documented..

F.4.8.2 Review of Savings Database

Met-Ed lists five programs in its non-residential portfolio. It defines programs within that portfolio primarily by customer sector. All five programs achieved energy and demand savings during PY4. The reported gross energy savings from non-residential programs was 88,130 MWh, and the reported gross demand savings was 33.49 MW. The number of participants, gross reported energy impact, and gross reported demand impact for PY4 are shown in Table F-51.

Table F-83: Met-Ed Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	401	25,538	7.23
Large C&I Performance Contracting/Equipment	94	38,087	18.30
Non-Profit	11	455	0.10
Remaining Government/Non-Profit	358	24,043	7.86
Streetlighting	1	7	0.00
Total	**865**	**88,130**	**33.49**

FirstEnergy provided the SWE Team a database of project activity for each of its operating companies. This database contained the key reporting metrics for each project reporting savings for each quarter. It also contained detail on the types of EE equipment installed at each site to generate savings. The SWE Team identified each of the distinct participants and the energy and demand impacts associated with that participant for each Met-Ed non-residential program. Table F-52 shows the total participant counts, energy savings, and demand savings by program from Met-Ed's non-residential projects in the FirstEnergy savings database.

Table F-84: Met-Ed Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	401	25,538	6.20
Large C&I Performance Contracting/Equipment	94	38,087	15.70
Non-Profit	11	455	0.09
Remaining Government/Non-Profit	358	24,043	6.74
Streetlighting	1	7	0.00
Total	**865**	**88,130**	**28.72**

Table F-53 shows the variances between the reported figures and the information contained in the FirstEnergy tracking database. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Variance}$$

Table F-85: Met-Ed Non-Residential Program Discrepancies

Program	Participants	MWh	MW
Small C&I Performance Contracting/Equipment	0	0	1.03
Large C&I Performance Contracting/Equipment	0	0	2.60
Non-Profit	0	0	0.01
Remaining Government/Non-Profit	0	0	1.12
Streetlighting	0	0	0.00
Total	**0**	**0**	**4.77**

The total number of non-residential participants and total energy impacts (MWh) in the database summary match perfectly with the figures reported in Met-Ed's PY4 annual report for all the programs. The reported demand impacts were 4.77 MW higher than the impacts shown in the savings database. The SWE confirmed with the EDC evaluation contractor that this variance in peak demand is a function of the application of line losses in the reported figures, but not in the program tracking data. Based on its audit findings, the SWE Team commends FirstEnergy for the zero variance between tracked and reported energy savings and participant counts for Met-Ed's non-residential programs.

F.4.8.3 Review of Project Files (Met-Ed, Penelec, Penn Power, and West Penn Power)

FirstEnergy provided the SWE Team with project files for 112 individual C&I projects completed during PY4. A sample of four projects from each of the operating companies -- Met Ed, Penelec, Penn Power, and West Penn Power -- was reviewed. The majority of the reviewed projects consisted of retrofits to lighting, motors, controls, and other. Some of the other projects included photovoltaic panel installation and streetlighting retrofits.

The majority of the projects reviewed contained the appropriate documentation, including applications, invoices, equipment spec sheets, and savings calculations. However, some improvements can be made to the documents provided to contribute to consistency and ease of review. The savings calculation documents can be improved by adding dates or consistent revisions to the file name or within the document so it is clear which the most current savings values are. An invoice or a copy of the rebate check mailed to participants would clarify the final rebate amount allotted to each applicant, as it appears this number often changed from the start to the end of project processing. Inclusion of a post-application form would also ease the documentation review process, as several projects have multiple iterations between inception and completion.

Incomplete Documentation

The two streetlighting projects reviewed provided the least documentation for evaluation. The three documents provided in both projects were an application, master request detail, and rebate inventory. It was assumed that the lack of a calculation sheet was due to the straightforward nature of the TRM savings protocol for streetlighting.

Several other projects were missing savings calculation sheets, including, MD39112, SLB36625, NSLB90739, and CI70764. This made the review of the savings values difficult to follow, as the application in these cases also did not have any savings values associated. Therefore the reported values could not be confirmed, except for NSLB90739 and CI70764 which both had savings values in the application forms. Unfortunately, the savings values listed in the application for NSLB90739 did not match with the reported values. There was little supporting documentation to support either of the values found. However, in the case of CI70764 the application value did match the reported value. For the remaining projects with more complete documentation, two documents were reviewed to confirm the reported values, the application, and the savings calculations worksheet.

kWh Inconsistencies

The gross reported kWh values in the program tracking system and submitted to the SWE matched the calculation sheet values for 70% of the projects reviewed. Of the projects reviewed, 40% had a matching value for all three documents: reported values, application, and calculation sheet. The three projects with inconsistent values between the reported kWh values and the calculation sheet values were NSLB73318, CI66397, and MD36686. Lighting project NSLB73318 had a reported savings of 31,080 kWh and a calculated savings of 25,682 kWh. According to the invoice, 36 2-lamp T8 fixtures, one LED exit sign, three refrigerator CFL lamps, and five additional T8s were installed at this facility. After reviewing the calculation sheet and invoices, it appeared that six more 2 x 32W T8 fixtures were installed than was initially proposed, resulting in the higher reported savings value than what was initially used in the calculation documents. This could be clarified by including the final calculation sheet for this project. Custom project CI66397 installed a 240.27 kW photovoltaic system. This project had a very small difference between the reported gross kWh of 304,935 kWh, and the calculated kWh value in the supporting documentation of 304,973 kWh. It appears that the calculations were based on the SAIC review of the project and could be the result of rounding error.

Motors and drives project MD36686 had almost double the kWh savings in the calculation sheet than what was reported by Penelec in the program tracking data. From the calculation sheet, it appeared that the actual installed equipment had lower cubic feet per minute (CFM) and average kW values than initially proposed. It appears that both the old compressor and the new compressor were monitored for a period of time and that those numbers were used in the saving calculations. It is unclear why the data gathered through M&V activities was not used instead of the specs of the proposed equipment. It is possible that the post-install data collected would be leveraged by the evaluation contractor if the project was selected in the Penelec evaluation sample. The proposed compressor specifications were

257 CFM with an average power draw of 48.8 kW, but the actual installed equipment had 96 CFM and 15.4 average kW. This savings value calculated using the post-install monitored data was 350,862 kWh compared with the gross reported value 142,595 kWh.

kW Inconsistencies

In general, the application kW savings and the calculation sheet savings values matched or very nearly matched, but those confirmed numbers did not match the reported values. The cases in which the reported values and the calculation sheet values differed greatly were NSLB82063, NSLB82055, NSLB73318, NSLB66271, NSLB54815, NSLB61060, and MD36686. Project NSLB82063 had a typo as there were no reported kW savings but a savings of 3.14 kW was determined through the calculation sheet. Lighting project NSLB73318 had a gross reported peak demand impact of 5.08 kW, but a calculated kW of 3.19 in the supporting documentation. This discrepancy is most likely due to six more fixtures being installed than initially proposed, as was stated above under “kWh Inconsistencies.” This could be clarified by including the final calculation sheet with the FirstEnergy file export. Lighting projects NSLB82055, NSLB66271, NSLB54815, and NSLB61060 all reported the demand savings as opposed to the change in connected load savings; however, the calculation sheets support the reported values. This can be clarified by consistently reporting either the demand savings or the connected load savings. As mentioned above under “kWh Inconsistencies,” the motors and drives project MD36686 had more savings associated in the calculation sheet than what was reported by Penelec due to the lower average kW and CFM in the actual equipment installed than the proposed equipment. This resulted in a higher kW savings value of 56.3 kW compared with the reported kW savings value of 22.9 kW.

Incentive Inconsistencies

There were no reported incentive values available to the SWE Team, so the application form and savings calculation sheet were compared to confirm the incentive amount. Once again, to improve on this analysis a scanned copy of the final check or an invoice would be a good confirmation of the final incentive allocated to the applicant. Of the projects reviewed, the calculation sheet and the application incentive matched for 50% of the projects. This could be due to errors in the participant filling out the application form correctly or revisions to the incentive calculations once the projects were completed and final data entered.

F.4.8.4 Review of Sample Design

Met-Ed’s PY4 final annual report provides detailed information about the sample design for the PY4 gross impact evaluation of non-residential programs. Met-Ed’s evaluation contractor used a stratified sampling technique for each of the non-residential programs and targeted precision of 15% at the 85% confidence level for each program annually. At the end of Q2, Q3, and Q4, tracking data were reviewed by the evaluation contractor to draw a sample population for that quarter. The sample population was separated by operating companies and programs first, and then was stratified by technology at the measure level according to the realization rates, variability of realization rates, modes, and rebated savings. The evaluator used a minimum Cv value of 0.4 for each stratum based on PY2 and PY3 evaluation results.

In the PY4 non-residential sample plan, each program contained multiple strata and the C_V values were equal to or greater than 0.4. The achieved sample sizes, by program, for the sample draw were: 14 for Large C&I, 30 for Small C&I, 20 for Governmental/Remaining Non-Profit, 1 for Street Lighting, and 5 for Governmental/Non-Profit. Table F-54 shows detailed Information for Met-Ed's PY4 non-residential sample plan. More strata were used in Met-Ed's sample plan than are listed in this table. Table F-54 contains information only for those strata that had participants in PY4. The +/- 15% sampling error requirement was achieved for each program's energy savings estimate, but several programs failed to meet the requirement for the demand savings estimate.

Table F-86: Met-Ed PY4 Non-Residential Programs Sample Plan

Program	Stratum	Stratum Boundaries (kWh)	Participants	Observed Cv for Energy	Observed Cv for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample
Small Commercial/Industrial Equipment Program	NSL0	100,000	269	0.4	0.4	18%	18%	10
	NSL1	500,000	30	0.4	0.4	21%	21%	6
	NSL2	-	5	0.4	0.4	21%	21%	3
	SLB0	100,000	3	0.6	0.6	68%	68%	1
	Prescriptive0	499,999	44	1.6	1.6	221%	221%	1
	Custom0	499,999	29	0.4	0.4	27%	27%	4
	PV0	500,000	15	0.3	0.3	24%	24%	2
	PV1	2,000,000	2	0.3	0.3	0%	0%	2
	SAL0	99,999	4	0.4	0.4	50%	50%	1
Program Total			**401**			**9%**	**16%**	**30**
Large Commercial/Industrial Equipment Program	NSL0	1,500,000	61	0.4	0.4	32%	32%	3
	NSL1	5,555,555	1	0.4	0.4	0%	0%	1
	Prescriptive0	100,000	3	1.6	1.6	182%	182%	1
	Custom0	500,000	18	0.4	0.4	38%	38%	2
	Custom2		1	0.4	0.4	0%	0%	1
	PV0	1,000,000	4	0.3	0.3	31%	31%	1
	PV1	3,000,000	2	0.3	0.3	25%	25%	1
	PV2		4	0.3	0.3	0%	0%	4
Program Total			**94**			**10%**	**10%**	**14**
Governmental/Non-Profit Program	NSL0	500,000	7	0.4	0.4	53%	53%	1
	NSL1		3	0.4	0.4	0%	0%	3
	SLB0	500,000	1	0.6	0.6	0%	0%	1
Program Total			**11**			**10%**	**7%**	**5**
Governmental/Remaining Non-Profit Program	NSL0	100,000	191	0.4	0.4	28%	28%	4
	NSL1	600,000	32	0.4	0.4	27%	27%	4
	NSL2		2	0.4	0.4	0%	0%	2
	Prescriptive0	100,000	48	1.6	1.6	221%	221%	1
	Custom0	285,000	28	0.4	0.4	57%	57%	1
	Custom1	500,000	1	0.4	0.4	0%	0%	1
	Custom2		1	0.4	0.4	0%	0%	1
	PV0	500,000	2	0.3	0.3	25%	25%	1
	PV1	750,000	4	0.3	0.3	18%	18%	2
	SAL0	10,000	27	0.4	0.4	39%	39%	2
	SAL1	100,000	14	0.4	0.4	56%	56%	1
Program Total			**350**			**13%**	**30%**	**20**
Governmental/Non-Profit Street Lighting Program	SAL0	10,000	1	0.4	-	0%	-	1
Program Total			**1**			**0%**		**1**

F.4.8.5 Review of Verified Savings Analysis

Met-Ed's PY4 M&V activities for non-residential programs involved selecting a sample of 71 projects for verification. The sample was broken down by measure type into six strata each of which was further broken down by project size (kWh) into three substrata. Ex-ante energy savings thresholds were established to delineate the substrata. Figure F-9 shows the sampling breakdown by stratum, and Figure F-10 shows it by program.

Figure F-23: PY4 Non-Residential Sample Breakdown by Stratum

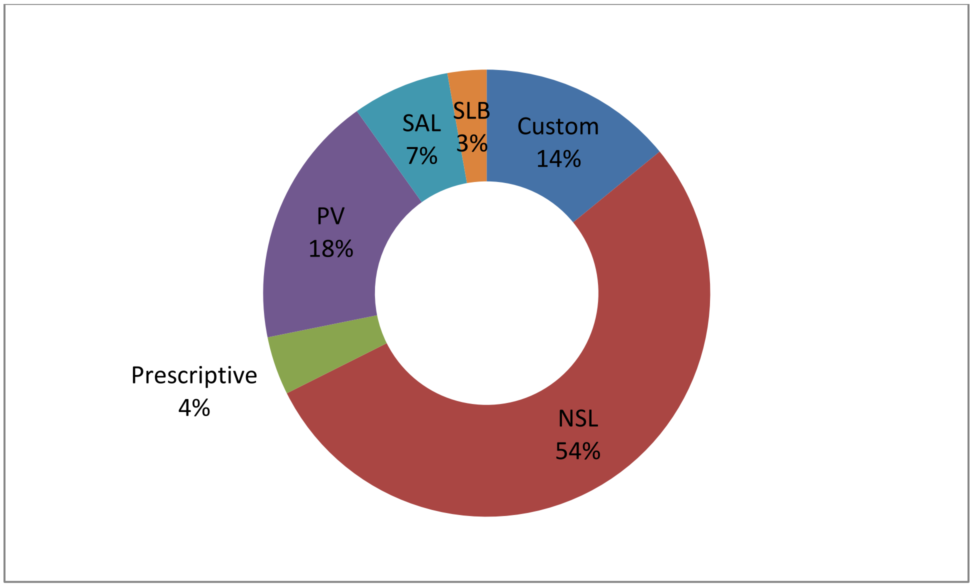
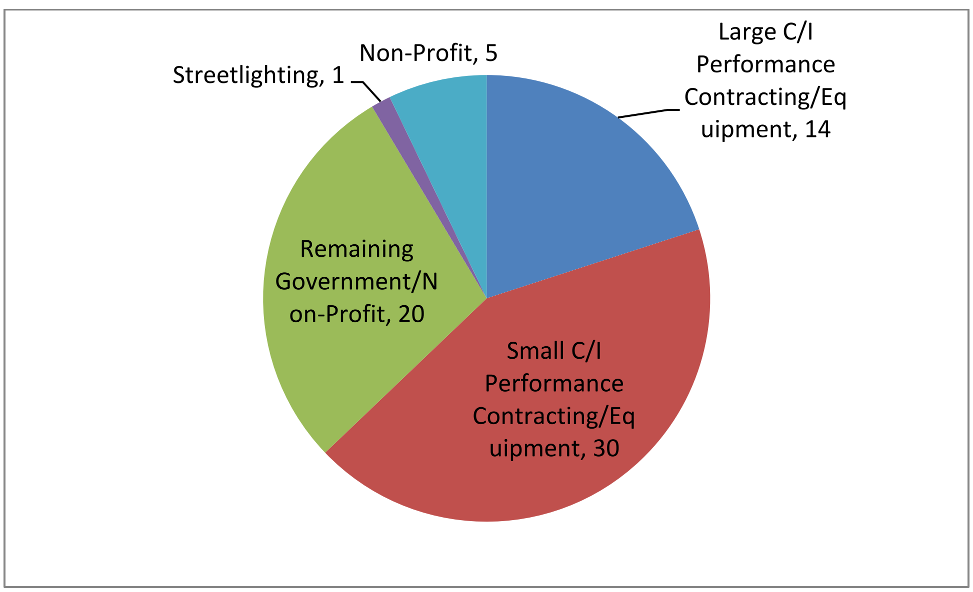


Figure F-24: PY4 Non-Residential Sample Breakdown by Program



Forty-six of the 71 sampled projects involved a visit to the project site, and of those 46, 15 involved deploying data logging instruments. Figure F-11 shows the breakdown of sampled projects by M&V technique.

Figure F-25: PY4 Non-Residential Sample Breakdown of M&V Technique by Project Count

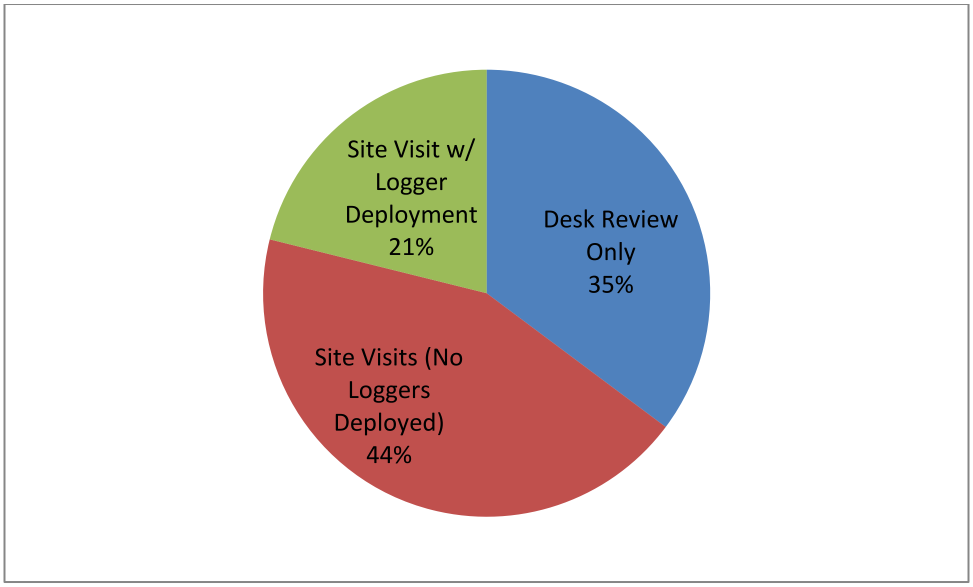
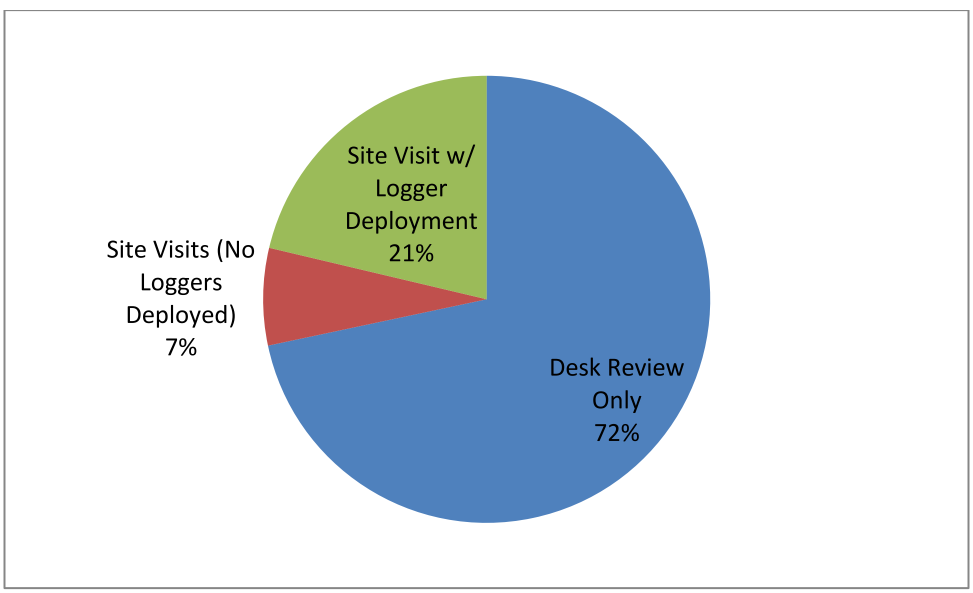


Figure F-12 shows the breakdown of the ex-post energy savings associated with those sampled projects by M&V technique.

Figure F-26: Sample Breakdown of M&V Technique by ex-post kWh



The vast majority of logger deployments, 14 of 15, were used for projects in the non-standard lighting (NSL) stratum, representing 7.5 GWh of verified energy savings. The remaining one logger deployment was used for a project in the largest custom substratum.

A detailed view of the sampling and verified savings results for each stratum is shown in Table F-55.

Table F-87: Met-Ed PY4 Sampling and Savings Detail

Stratum/ Substratum	Sample Points	Site Visits	Logger Installs	Sum of Ex-Ante kWh	Sum of Ex-Ante kW	Sum of Ex-Post kWh	Sum of Ex-Post kW	kWh RR	kW RR
Custom0	7	2	0	513,869	115	369,409	30	0.72	0.26
Custom1	1	1	0	259,534	27	259,534	27	1.00	1.00
Custom2	2	1	1	3,099,408	225	1,514,554	204	0.49	0.91
NSL0	19	16	2	594,511	117	497,596	100	0.84	0.86
NSL1	14	13	9	4,206,224	730	3,548,028	649	0.84	0.89
NSL2	5	5	3	8,608,321	1,108	6,888,799	991	0.80	0.89
Prescriptive0	3	1	0	12,659	9	10,166	8	0.80	0.86
Prescriptive1	0	0	0	-	-	-	-		
Prescriptive2	0	0	0	-	-	-	-		
PV0	4	0	0	772,455	512	851,544	250	1.10	0.49
PV1	5	0	0	4,727,151	2,986	4,967,641	1,315	1.05	0.44
PV2	4	0	0	14,990,426	10,460	17,162,127	5,100	1.14	0.49
SAL0	4	4	0	20,747	1	20,880	1	1.01	0.99
SAL1	1	1	0	13,022	1	13,101	1	1.01	1.01
SAL2	0	0	0	-	-	-	-		
SLB0	2	2	0	11,310	2	12,864	4	1.14	1.77
SLB1	0	0	0	-	-	-	-		
SLB2	0	0	0	-	-	-	-		
TOTAL	***71***	***46***	***15***	***37,829,637***	***16,293***	***36,116,242***	***8,680***		
Weighted Average								***0.95***	***0.53***

Table F-56 shows the program-level realization rates and the relative precision (given at 85% confidence levels) for each of Met-Ed's non-residential programs in PY4.

Table F-88: Met-Ed PY4 Program-Level Realization Rates and Relative Precision

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Large C/I Performance Contracting/Equipment	90%	14%	54%	11%
Small C/I Performance Contracting/Equipment	90%	9%	67%	10%
Remaining Government/Non-Profit	96%	13%	76%	20%
Streetlighting	100%	0%	100%	0%
Non-Profit	98%	10%	89%	7%

For its non-residential portfolio, Met-Ed depicts a near-1 realization rate for kWh savings but just over 0.5 for kW reductions. Several characteristics of the M&V results affected these values. As Table F-55 showed, the energy savings realization rates among the custom, NSL, and prescriptive strata came in moderately lower than 1 in most cases. The portfolio-level energy realization rate was bolstered by greater than 1 realization rates among the photovoltaic (PV), Streetlighting (SAL), and Standard Lighting for Business (SLB) strata. The largest substratum of PV projects resulted in an energy realization rate of 1.14.

Met-Ed's demand savings realization rate at the portfolio level was, by contrast, adversely affected by the findings in the PV strata. Each of the three PV substrata netted sub-0.5 realization rates for kW savings.

Figure F-13 and Figure F-14 show the relationship between ex-ante and ex-post savings for kWh and kW, respectively, for projects sampled from Met-Ed's PY4 non-residential programs.

Figure F-27: Comparison of Med-Ed Ex-Post and Ex-Ante Energy Savings

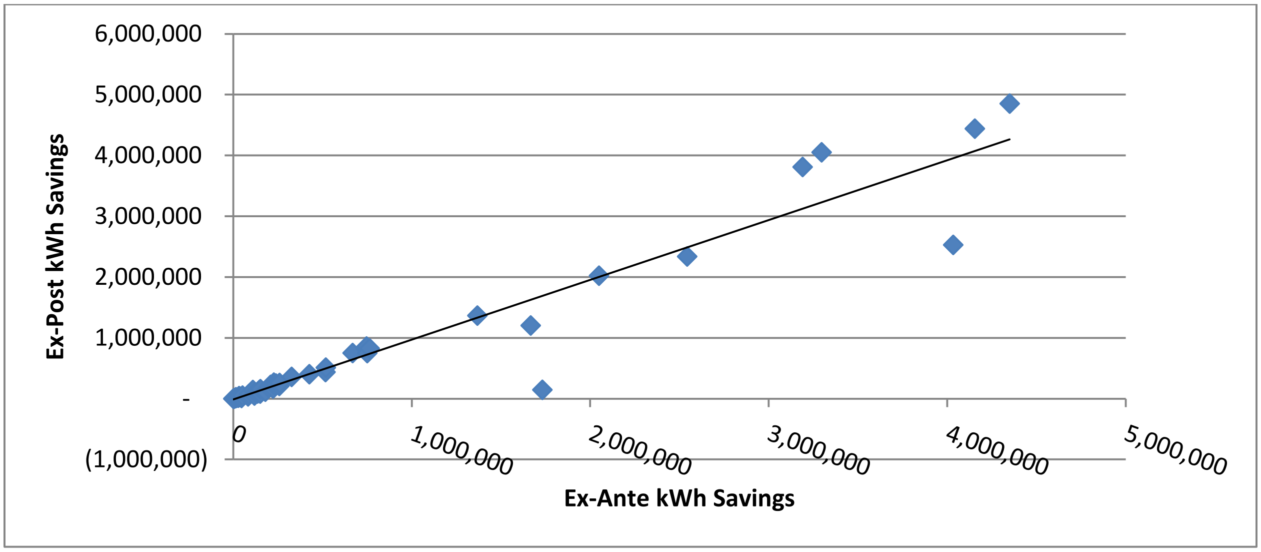
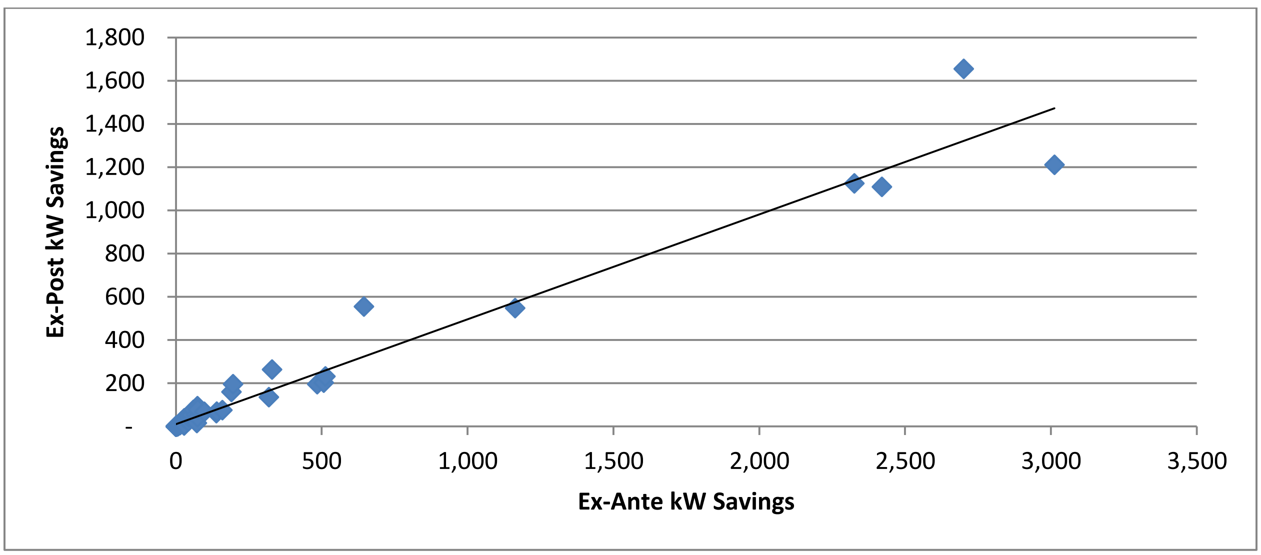


Figure F-28: Comparison of Med-Ed Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of Met-Ed sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Figure F-13 and Figure F-14 show the relationship between ex-ante and ex-post savings for kWh and kW, respectively, for projects sampled from Met-Ed's PY4 non-residential programs.

Figure F-13: Comparison of Med-Ed Ex-Post and Ex-Ante Energy Savings

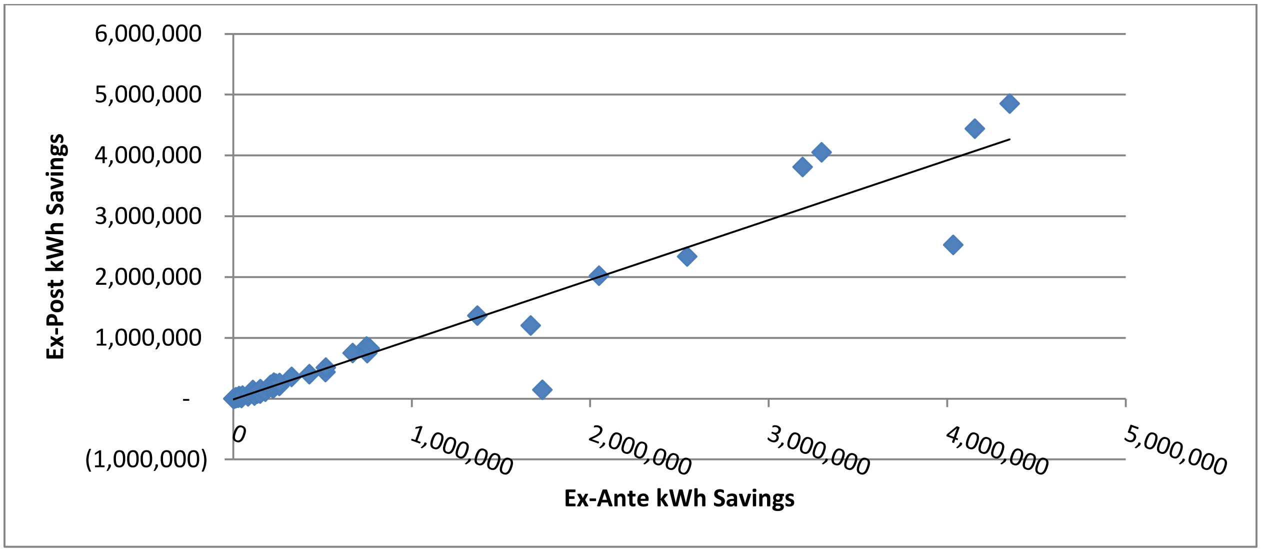
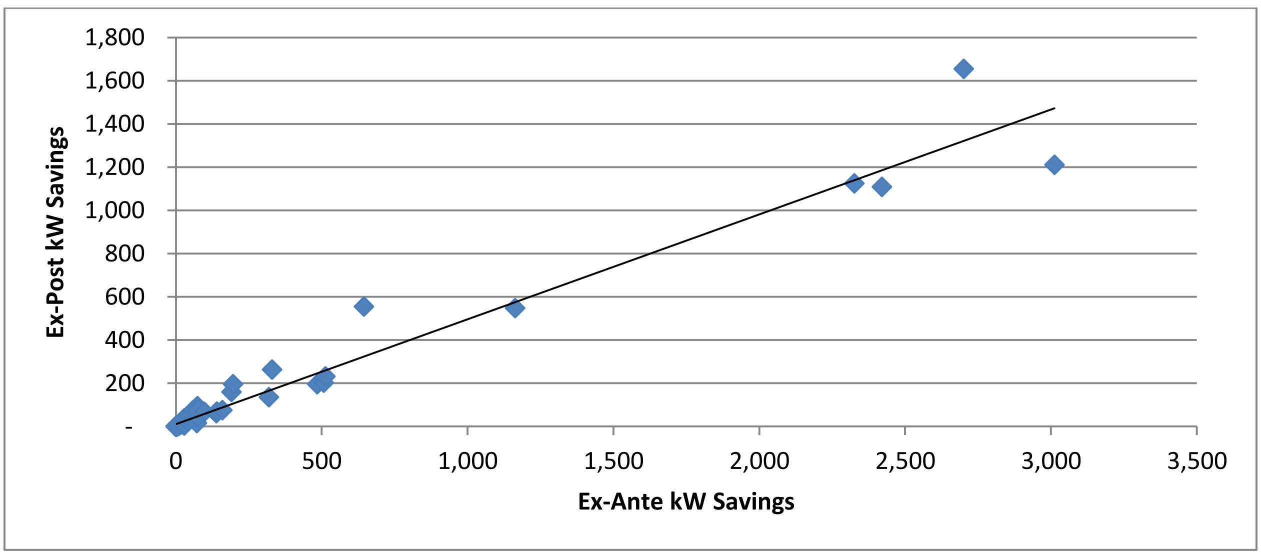


Figure F-14: Comparison of Med-Ed Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of Met-Ed sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Table F-57 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-57 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-89: IPMVP Methods and Verified Savings of Met-Ed PY4 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Method
Large C&I	3010	4,442,115	1,211.0	IPMVP Option D
Small C&I	3021	1,011	0.7	IPMVP Option D
Remaining Gov/NP	3022	34,877	2.8	IPMVP Option A
Large C&I	3025	2,340,161	263.7	IPMVP Option A
Small C&I	3050	4,053,467	1,125.0	IPMVP Option D

Project 3010 represented 4.4 million kWh in energy savings and 1.2 MW in demand savings. The project involved construction of a 3.1 MW solar PV system at a food co-op in Harrisburg. The evaluation contractor performed a desk review of the project, completing a simulation using the National Renewable Energy Laboratory's System Advisor Model (SAM) tool. The modeling tool uses specific inputs for module and inverter type, as well as string size and array configuration, to develop detailed hourly estimates of energy production. While the SWE would have expected to see one of the more extensive M&V methods used for a project of such significant savings, the SWE believes there is enough evidence to support the use of IPMVP Option D given the relative accuracy of the SAM tool for predicting PV system energy production. However, larger PV projects like this one could be considered in the future as candidates for on-site inspection to verify inputs into the SAM tool such as module quantity, angle and azimuth, and string and array size. It is important to note that verified results for each evaluated project were informed by actual generation records obtained by the EDC evaluator.

Project 3021 involved replacing three HVAC rooftop units (RTUs): one unit at 12.5 tons and two units at 10 tons. The project netted a verified 1,011 kWh in energy savings and 0.7 kW in demand savings. The evaluation contractor performed a desk review for this project, using AHRI specifications and product invoices, as well as other inputs specific to the project site, which was a chain drug store. The evaluation contractor provided a spreadsheet with two simple formulas for each type of RTU. The results of the analysis provided differ only slightly in kWh savings from what was reported. The analysis showed 1,020 kWh savings, whereas the M&V tracking database showed 1,011 kWh savings. The SWE recommends a more robust analysis spreadsheet, providing more detail. Additionally, the evaluation contractor should ensure that the savings values match between the project analysis file and what is reported and tracked in the M&V tracking database.

Project 3022 accounted for 34,877 kWh in energy savings and 2.8 kW in demand savings. The project involved installing several VFDs on different types of equipment, including two condenser water pumps and two energy recovery ventilation units. The evaluation contractor performed a site visit to verify equipment specs and operating schedules, although no data logging took place. The verified characteristics were then used as inputs into a spreadsheet model to determined verified energy and demand savings. The savings from the spreadsheet model matched the M&V tracking database entries.

Project 3025 involved a comprehensive lighting retrofit at a paper company in Spring Grove. The retrofit netted a verified energy savings of 2.3 million kWh and a demand reduction of 264 kW. Lighting types replaced included several types of high intensity discharge (HID) fixtures, a variety of incandescent lamps, and several different configurations of T12 linear fluorescent fixtures. These fixtures were mainly replaced by T8 linear fluorescent fixtures of various configurations. The evaluation contractor performed a site visit to verify the types and quantities of installed fixtures and to deploy seven data loggers. These data loggers measured the lighting schedules in several disparate locations within the facility for nearly two months. The results were used to estimate annual operating hours for each location, and for the associated lighting. The SWE, however, could not locate an analysis spreadsheet that made use of these annual hours of use calculations to generate the final verified kWh and kW savings values.

Project 3050 was a large-scale solar PV project, similar to project 3010. This project accounted for verified energy savings of over 4 million kWh and demand savings of over 1.1 MW. The project was reviewed in much the same way as project 3010 by running the SAM tool with inputs specific to the project. The tilt of the PV arrays for this project, however, was estimated using a photograph of the system. The evaluation contractor estimated the tilt to be 45 degrees based on this image. While this is one of many inputs into the SAM tool, variations in this input can have an appreciable effect on the outcome. The SWE recommends a more rigorous attempt to verify such inputs, such as contacting a site representative to measure the angle if a site visit is not possible.

F.4.9 Penelec

This section contains details on the SWE's audit of Penelec's PY4 non-residential programs.. The site inspection findings and review of project details for Penelec are discussed above in this appendix, in sections F.4.4.3 and F.4.4.3 respectively.

F.4.9.1 Review of Savings Database

Penelec lists five programs in its non-residential portfolio. It defines the programs in that portfolio primarily by customer sector. All five programs achieved energy and demand savings during PY4. The reported gross energy savings from non-residential programs was 68,798 MWh, and the reported gross demand savings was 12.56 MW. The number of participants, gross reported energy impact, and gross reported demand impact for PY4 are shown in Table F-90.

Table F-90: Penelec Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	251	14,258	3.50
Large C&I Performance Contracting/Equipment	108	28,281	4.25
Streetlighting	49	975	0.00
Non-Profit	8	244	0.09

Remaining Government/Non-Profit	197	25,040	4.72
Total	**613**	**68,798**	**12.56**

FirstEnergy provided the SWE Team a database of project activity for each of its operating companies. This database contained the key reporting metrics for each project reporting savings. It also included details on the types of EE equipment installed at each site to generate savings. The SWE Team identified each of the distinct participants and the energy and demand impacts associated with that participant for each Penelec non-residential programs. Table F-91 provides the participant counts, energy impacts, and demand impacts for each program.

Table F-91: Penelec Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	251	14,258	2.88
Large C&I Performance Contracting/Equipment	108	28,281	3.52
Streetlighting	49	975	0.00
Non-Profit	8	244	0.07
Remaining Government/Non-Profit	197	25,040	3.90
Total	**613**	**68,798**	**10.38**

Table F-92 shows the variances between the reported figures and the information contained in the database. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Variance}$$

Table F-92: Penelec Non-Residential Program Discrepancies

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	0	0	0.6
Large C&I Performance Contracting/Equipment	0	0	0.7
Streetlighting	0	0	0.0
Non-Profit	0	0	0.0
Remaining Government/Non-Profit	0	0	0.8
Total	**0**	**0**	**2.2**

The total number of non-residential participants and the total energy impacts in the database summary match perfectly with the figures reported in Penelec's PY4 annual report. The reported demand impacts were 2.2 MW higher than the impacts shown in the savings database. The SWE confirmed with the EDC evaluation contractor that this variance in peak demand is a function of the application of line losses in the reported figures, but not in the program tracking data. Based on its audit findings, the SWE Team commends FirstEnergy for the absence of variance between tracked and reported savings for Penelec's non-residential programs.

F.4.9.2 Review of Sample Design

Penelec's PY4 final annual report provides detailed information about the sample design for the PY4 gross impact evaluation of non-residential programs.

Penelec's evaluation contractor used the stratified sampling method for each of the non-residential programs and targeted precision of 15% at the 85% confidence level for each program annually. At the end of Q2, Q3, and Q4, tracking data were reviewed by the evaluation contractor to draw a sample population for that quarter. The sample population was separated by operating companies and programs first, and then was stratified at the measure level according to the realization rates, variability of realization rates, modes, and rebated savings. The evaluator used a minimum Cv value of 0.4 for each stratum based on PY2 and PY3 evaluation results.

In the PY4 non-residential sample plan, each program contained multiple strata, and the C_V values were equal to or greater than 0.4. The achieved sample sizes, by program, were 14 for Large C&I, 22 for Small C&I, 19 for Government/Remaining Non-Profit, 11 for Street Lighting, and 4 for Government/Non-Profit. Table F-93 shows detailed information on Penelec's PY4 non-residential sample plan. The plan used more strata than are shown in this table. Table F-93 contains information only for those strata that had participants in PY4. The Prescriptive stratum proved highly variable across all programs and led to a missed precision target for the Remaining Government/Non-Profit Program.

Table F-93: Penelec PY4 Non-Residential Programs Sample Plan

Program	Stratum	Stratum Boundaries (kWh)	Participants	Observed Cv for Energy	Observed Cv for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample
Small Commercial/Industrial Equipment Program	NSL0	100,000	170	0.4	0.4	21%	21%	7
	NSL1	500,000	27	0.4	0.4	17%	17%	8
	NSL2	-	3	0.4	0.4	24%	24%	2
	SLB0	100,000	4	0.6	0.6	73%	73%	1
	Prescriptive0	200,000	12	1	1.6	214%	214%	1
	Custom0	100,000	30	0.6	0.4	57%	57%	1
	Custom1	1,200,000	3	0.6	0.4	47%	47%	1
	SAL0	10,000	2	0.4	0.4	41%	41%	1
Program Total			**251**			**12%**	**12%**	**22**
Large Commercial/Industrial Equipment Program	NSL0	700,000	63	0.4	0.4	28%	28%	4
	NSL1	2,000,000	6	0.4	0.4	24%	24%	3
	NSL2		2	0.4	0.4	0%	0%	2
	SLB0	100,000	4	0.6	0.6	73%	75%	1
	Prescriptive0	100,000	6	1.6	1	204%	131%	1
	Custom0	500,000	26	0.4	0.6	39%	59%	2
	Custom2		1	0.4	0.6	0%	0%	1
Program Total			**108**			**14%**	**14%**	**14**
Governmental/Non-Profit Program	NSL0	100,000	2	0.4	0.4	0%	0%	2
	NSL1	500,000	1	0.4	0.4	0%	0%	1
	SLB0	100,000	4	0.6	0.6	73%	73%	1
Program Total			**7**			**8%**	**5%**	**4**
Governmental/Remaining Non-Profit Program	NSL0	200,000	93	0.4	0.4	28%	28%	4
	NSL1	1,000,000	19	0.4	0.4	31%	31%	3
	NSL2		4	0.4	0.4	0%	0%	4
	SLB0	100,000	11	0.6	0.6	80%	80%	1
	Prescriptive0	100,000	15	1.6	1.6	216%	216%	1
	Custom0	300,000	18	0.4	0.4	38%	38%	2
	Custom1	600,000	2	0.4	0.4	N/A	N/A	0
	Custom2		3	0.4	0.4	0%	0%	3
	SAL0	10,000	1	0.4	0.4	0%	0%	1
Program Total			**166**			**16%**	**17%**	**19**
Governmental/Non-Profit Street Lighting Program	SAL0	30,000	37	0.4	0	27%	N/A	4
	SAL1	65,000	10	0.4	0	18%	N/A	5
	SAL2		2	0.4	0	0%	N/A	2
Program Total			**49**			**12%**	n/a	**11**

F.4.9.3 Review of Verified Savings Analysis

Penelec's PY4 M&V activities for the non-residential sector involved selecting a sample of 70 projects for review. The sample was broken down by measure type into five strata, each of which was further broken down by project size (kWh) into three substrata. Ex-ante energy savings thresholds were established to delineate the substrata. Figure F-29 shows the sample breakdown by stratum, and Figure F-30 shows it by program.

Figure F-29: Sample Breakdown by Stratum

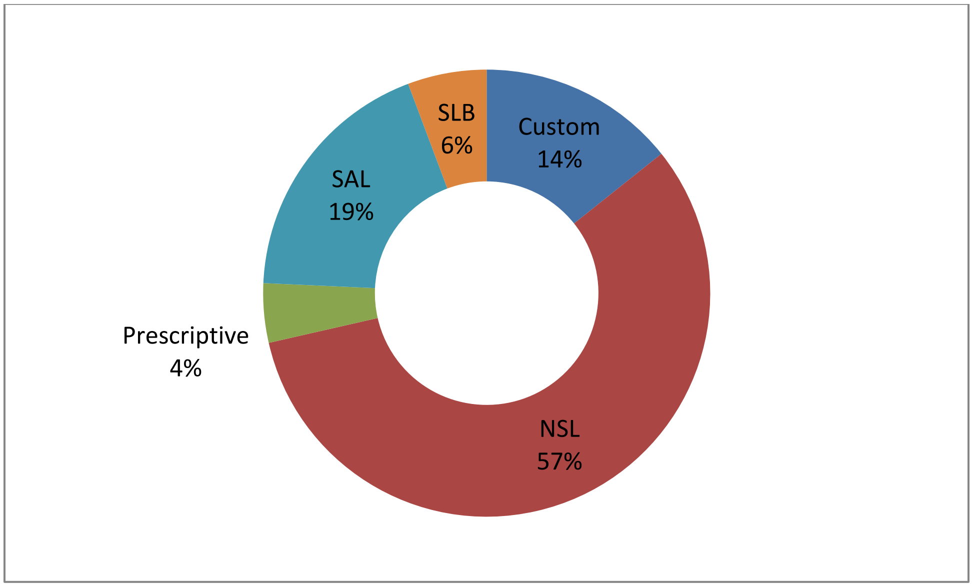
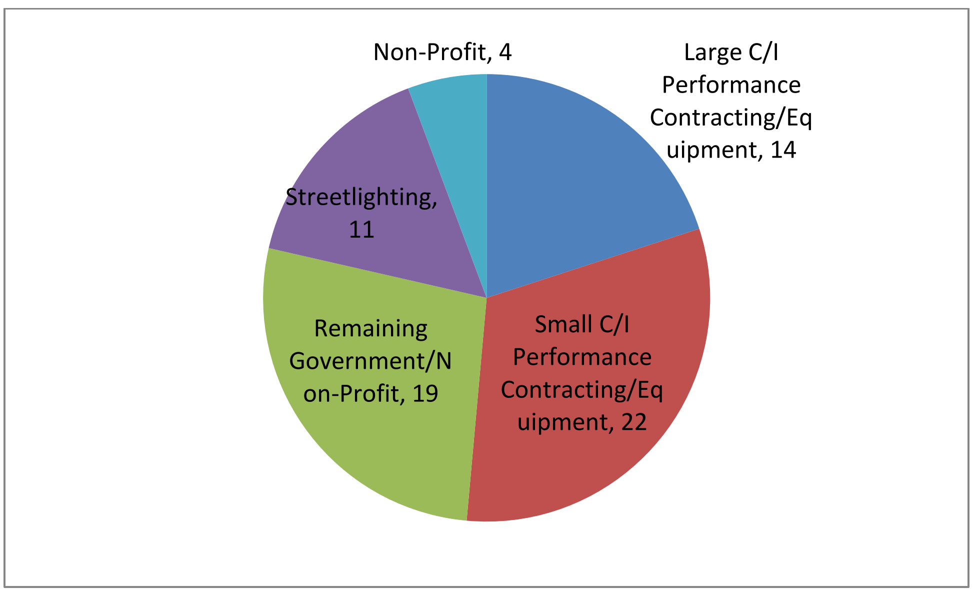


Figure F-30: Sample Breakdown by Program



Fifty-six of the 70 sampled projects involved a visit to the project site, and of these 56, 16 involved deploying data loggers. Figure F-31 shows the breakdown of sampled projects by M&V technique.

Figure F-31: Sample Breakdown by M&V Technique

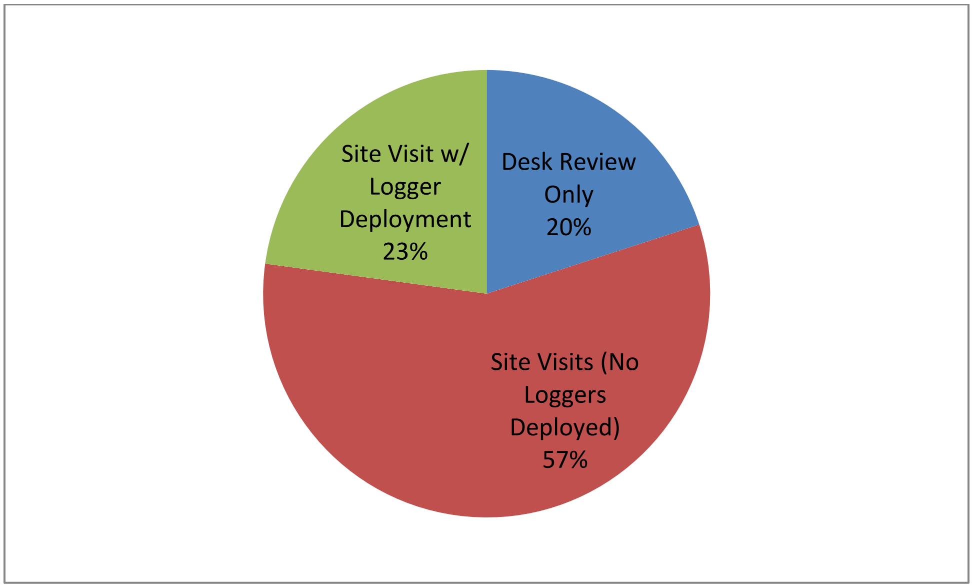
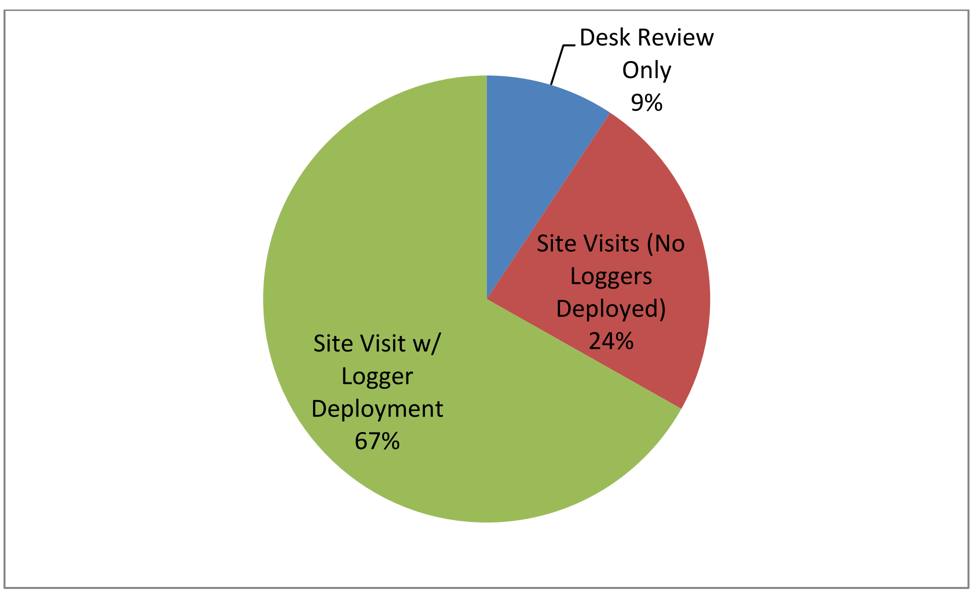


Figure F-32 shows the breakdown of the ex-post energy savings associated with those sampled projects by M&V technique.

Figure F-32: Sample Breakdown of Ex-Post Energy Savings by M&V Technique



The majority of logger deployments, 12 of 16, were used for projects in the NSL stratum, representing nearly 16 GWh of verified energy savings. The remaining four loggers were used for projects in the custom stratum.

A detailed view of the sampling and verified savings results for each stratum is shown in Table F-94.

Table F-94: Penelec PY4 Sampling and Savings Detail

Stratum/ Substratum	Sample Points	Site Visits	Logger Installs	Sum of Ex-Ante kWh	Sum of Ex-Ante kW	Sum of Ex-Post kWh	Sum of Ex-Post kW	kWh RR	kW RR
Custom0	5	2	2	965,418	27	628,590	71	0.65	2.59
Custom1	1	0	0	228,016	106	228,673	26	1.00	0.24
Custom2	4	3	2	5,344,853	345	3,719,736	255	0.70	0.74
NSL0	17	13	2	1,691,307	240	1,313,967	219	0.78	0.91
NSL1	15	14	5	7,079,386	1,054	6,239,760	1,078	0.88	1.02
NSL2	8	8	5	16,454,360	2,461	13,224,473	2,162	0.80	0.88
Prescriptive0	3	0	0	54,753	42	31,966	29	0.58	0.68
Prescriptive1	0	0	0	-	-	-	-		
Prescriptive2	0	0	0	-	-	-	-		
PV0	0	0	0	-	-	-	-		
PV1	0	0	0	-	-	-	-		
PV2	0	0	0	-	-	-	-		
SAL0	6	6	0	37,393	-	36,533	-	0.98	
SAL1	5	5	0	246,661	-	240,727	-	0.98	
SAL2	2	1	0	189,252	-	190,981	-	1.01	
SLB0	4	4	0	20,817	2	12,611	3	0.61	1.27
SLB1	0	0	0	-	-	-	-		
SLB2	0	0	0	-	-	-	-		
TOTALS	***70***	***56***	***16***	***32,312,216***	***4,277***	***25,868,018***	***3,842***		
Weighted Average								***0.80***	***0.90***

Table F-95 shows the program-level realization rates and the relative precision (given at 85% confidence level) for each of Penelec's PY4 non-residential programs.

Table F-95: Penelec PY4 Program-Level Realization Rates and Relative Precision

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Large C/I Performance Contracting/Equipment	79%	12%	87%	14%
Small C/I Performance Contracting/Equipment	103%	12%	121%	12%
Remaining Government/Non-Profit	66%	10%	85%	13%
Streetlighting	99%	12%	100%	0%
Non-Profit	89%	4%	77%	7%

Figure F-33 and

Figure F-34 show the relationship between ex-ante and ex-post kWh and kW savings, respectively, for project samples from the non-residential programs.

Figure F-33: Comparison of Penelec PY4 Ex-Post and Ex-Ante Energy Savings

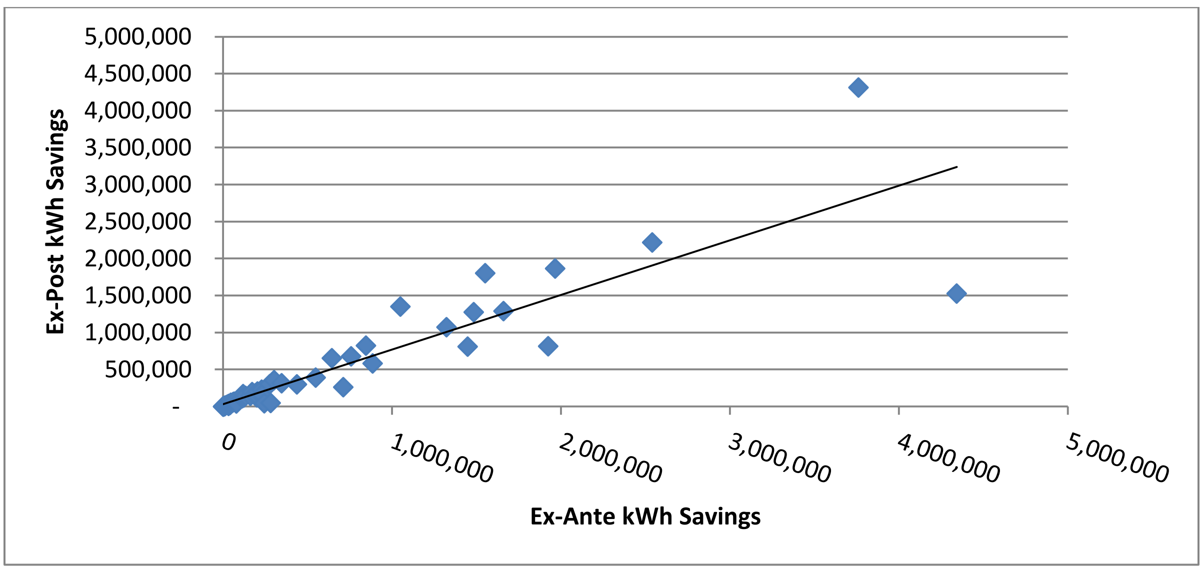
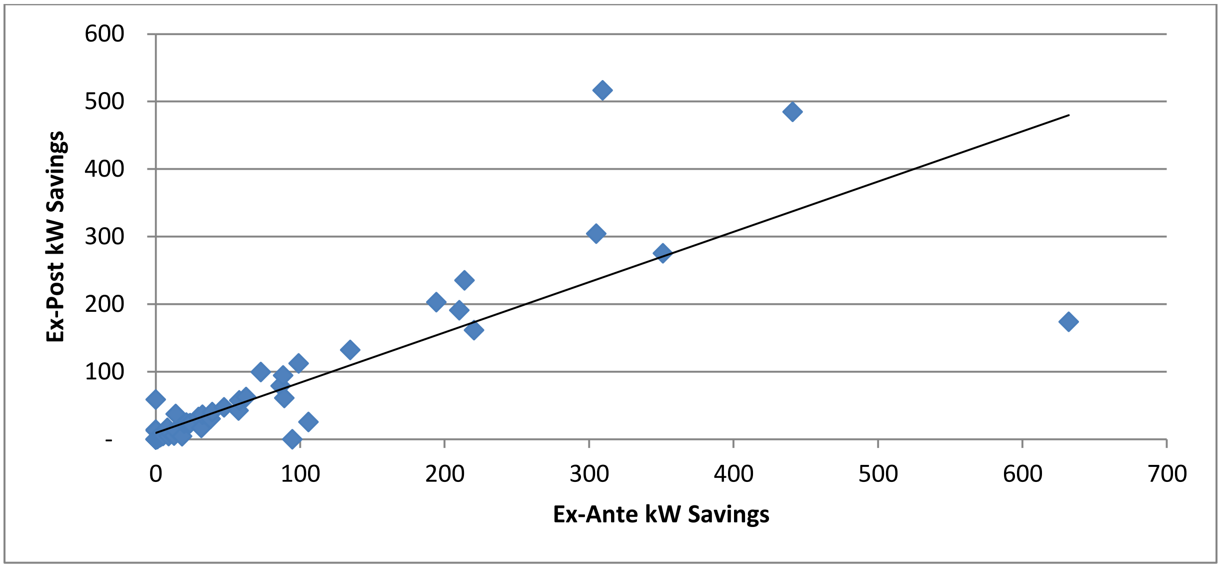


Figure F-34: Comparison of Penelec PY4 Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Table F-96 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-96: IPMVP Methods and Verified Savings of Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Method
Small C&I	1001	228,673	26	IPMVP Option D
Large C&I	1005	1,290,782	61	IPMVP Option A
Remaining Gov/NP	1008	815,433	95	IPMVP Option A
Small C&I	1027	653,664	112	IPMVP Option A
Large C&I	1079	22,498	24	IPMVP Option D

Project 1001 represented 228,673 kWh of energy savings and 26 kW of demand savings through the installation of a new air compressor with a VFD at a reinforced plastics facility. While the evaluation contractor originally slated this project for a site inspection, it ended up receiving a desk review only. Specifications for the new equipment were used in a spreadsheet analysis, along with specifications and assumptions about the older unit that was replaced. The decision to perform desk review only was justified by the fact that ample baseline operational data were available, and that data logging would not add significant value to the project review. Through their analysis, the evaluation contractor found that the ex-ante energy savings estimates were accurate, within a small margin, but that the ex-ante demand savings value of 106 kW was four times larger than the estimated value. The verified demand savings was concluded to be 26 kW. The evaluation contractor concluded that 106 kW is likely greater than even the full-load power draw of the baseline air compressor.

Project 1005 accounted for almost 1.3 million kWh of verified energy savings and 61 kW of demand savings. The project involved installing eight 300 HP VFDs on the eight pump motors of a 3,500-ton hydraulic press. Review of the project incorporated production profiles and trending data directly from the press itself. The result of the trending data showed inconsistent behavior of facility staff with regard to shutting off, leaving on, or putting the machine in bypass mode during nights and weekends. The evaluation contractor took the appropriate steps to interview staff about the most likely scenario for the machine overnight and on weekends, and generated three different energy savings scenarios. Through these interviews, the evaluation contractor was able to conclude which energy savings scenario would be most likely in the long term. That scenario provided for the nearly 1.3 million kWh savings for this project, a project energy realization rate of 77.8%.

Project 1008 involved installing three air handlers with efficient 150 HP motors with VFDs, as well as two parking garage exhaust fans with efficient 20 and 30 HP motors with VFDs. The project accounted for a verified energy savings of 815,433 kWh and a verified demand savings of 95 kW. The evaluation contractor installed data loggers at the project site to capture operational characteristics of the equipment, and the captured data were extrapolated and used to perform an 8,760-hour analysis of energy usage. The evaluation contractor noted two discrepancies during the analysis, both of which affected the verified savings. First, the application noted baseline efficiencies for the motors as 80%, but these were verified at 95% by contacting the manufacturer. While this affected the overall savings, it had a relatively small impact since the bulk of the project's savings came from the VFDs. Second, during logger installation it was noted that the CO/CO_2 control scheme for the parking lot exhaust fans had not been implemented. The controls were still not implemented during logger pickup, so the evaluation contractor appropriately removed VFD savings from the parking garage exhaust fan portion of the analysis. Once again, this had a minor impact on the overall project savings since the parking garage exhaust fans were not a major component.

Project 1027 was a comprehensive lighting retrofit for a medical facility in Erie, netting 653,664 kWh in verified energy savings and 112 kW in demand savings. The project consisted mainly of replacing T12 linear fluorescent lamps with high-efficiency T8 linear fluorescent lamps and ballasts. Some incandescent lamps were also replaced. The facility has several different space types that have varied operating schedules. The space with the highest impact on savings is the main lab/front office area, for which the lighting is on 24 hours/day, seven days/week. The evaluation contractor installed a lighting logger in this space to verify this schedule, and interviewed staff to determine operating schedules for the other spaces. These characteristics, along with verification of types and quantities of fixtures installed, were used to recalculate energy savings using the Appendix C PA Act 129 Lighting Audit and Design Tool.

Project 1079 was a prescriptive HVAC project for a large retail store in Pittsburgh. The project involved 3 air-source heat pumps and 11 air conditioning units of various capacities. The evaluation contractor verified that this project netted energy savings of 22,498 kWh and demand savings of 24 kW, nearly a 100% realization rate for both. Due to the fact that the submitted invoices and cut sheets matched the equipment detailed in the application, and to the relatively small savings for this project, the evaluation contractor had reason to not opt for a site visit or data logging for this review.

F.4.10 Penn Power

This section contains details on the SWE's audit of Penn Power's PY4 non-residential programs. The site inspection findings and review of project details for Penn Power are discussed above in this appendix, in sections sections F.4.4.3 and F.4.4.3 respectively.

F.4.10.1 Review of Savings Database

Penn Power lists five programs in its non-residential portfolio. Three of these programs reported savings during PY4: Small C&I Equipment, Large C&I Equipment, and Remaining Government/Non-Profit. Table F-66 shows the reported number of participants, energy savings, and demand savings for the programs. The gross reported energy savings of these programs was 27,981 MWh, and the gross reported demand savings was 14.04 MW.

Table F-97: Penn Power Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	187	12,735	2.12
Large C&I Performance Contracting/Equipment	36	9,872	2.11
Remaining Government/Non-Profit	81	5,374	1.14
Totals	**304**	**27,981**	**5.37**

FirstEnergy provided the SWE Team a database of project activity for each of its operating companies for PY4. The database for Penn Power contained the key reporting metrics for each project reporting savings in the quarter. It also contained details on the types of EE equipment installed at each site to generate savings. The SWE Team identified each of the distinct participants and the energy and demand impacts associated with that participant for each Penn Power non-residential program that reported savings.

Table F-98: Penn Power Non-Residential Programs Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	187	12,735	1.9
Large C&I Performance Contracting/Equipment	36	9,872	1.8
Remaining Government/Non-Profit	81	5,374	1.0
Total	**304**	**27,981**	**4.70**

Table F-68 shows the variances between the figures reported in Penn Power's quarterly report and the information contained in its savings database. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ - Database\ Summary = Variance}$$

Table F-99: Penn Power Non-Residential Program Discrepancies

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Small C&I Performance Contracting/Equipment	0	0	0.22
Large C&I Performance Contracting/Equipment	0	0	0.31
Remaining Government/Non-Profit	0	0	0.14
Total	**0**	**0**	**0.67**

The total number of non-residential participants and the total energy impacts in the database summary match perfectly with the figures reported in Penn Power's PY4 annual report. The reported demand impacts were 0.67 MW higher than the impacts shown in the savings database. This variance is explained entirely by line losses. The reported figures are grossed up to the system level while the database figures are presented at the meter level. Based on its audit findings, the SWE Team commends FirstEnergy for the zero variance between tracked and reported energy savings, demand savings, and participant counts for Penn Power's non-residential programs.

F.4.10.2 Review of Sample Design

Penn Power's PY4 final annual report provides detailed information about the sample design for the PY4 gross impact evaluation of non-residential programs.

Penn Power's evaluation contractor used the stratified sampling method for each of the non-residential programs and targeted precision of 15% at the 85% confidence level for each program annually. At the end of Q2, Q3, and Q4, tracking data were reviewed by the evaluation contractor to draw a sample population for that quarter. The sample population was separated by operating companies and programs first, and then was stratified at the measure level according to the realization rates, variability of realization rates, modes, and rebated savings. The evaluator used a minimum Cv value of 0.4 for each stratum based on PY2 and PY3 evaluation results.

In the PY4 non-residential sampling plan, each program contained multiple strata and the C_V values were equal to or greater than 0.4. The achieved sample sizes, by program, were: 15 for Large C&I, 14 for Small C&I, and 12 for Governmental/Remaining Non-Profit. There were no participants in PY4 in the Street Lighting Program, and no participants or impacts were reported in PY4 for the Government/Non-Profit Program. Table F-69 shows detailed information on Penn Power's PY4 non-residential sample plan. More strata were used in the plan than are listed in the table. Table F-69 contains information only for those strata that had participants in PY4. Poor correlation between reported and verified savings estimates for the Prescriptive stratum led to sampling errors slightly greater than the acceptable limits in the audit plan for the Small C&I and Government Non-Profit programs. The SWE recommends that FirstEnergy work with the implementation CSPs to improve the reported savings estimates for the measures where savings values showed poor correlation.

Table F-100: Penn Power PY4 Programs Sampling Plan

Program	Stratum	Stratum Boundaries (kWh)	Participants	Observed Cv for Energy	Observed Cv for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample
Small Commercial/Industrial Equipment Program	NSL0	100,000	137	0.4	0.4	28%	28%	4
	NSL1	700,000	19	0.4	0.4	26%	26%	4
	NSL2		3	0.4	0.4	24%	24%	2
	Prescriptive0	300,000	10	1.6	1.6	212%	212%	1
	Custom0	100,000	13	0.4	0.4	55%	55%	1
	Custom1	300,000	5	0.4	0.4	32%	32%	2
Program Total			**187**			**16%**	**16%**	**14**
Large Commercial/Industrial Equipment Program	NSL0	100,000	7	0.4	0.4	53%	53%	1
	NSL1	400,000	11	0.4	0.4	16%	16%	6
	NSL2		6	0.4	0.4	24%	24%	3
	Custom0	40,000	1	0.4	0.4	n/a	n/a	0
	Custom1	666,000	9	0.4	0.4	27%	27%	3
	Custom2		2	0.4	0.4	0%	0%	2
Program Total			**36**			**13%**	**12%**	**15**
Governmental/Remaining Non-Profit Program	NSL0	300,000	51	0.4	0.6	24%	37%	5
	NSL1	1,000,000	1	0.4	0.4	0%	0%	1
	Prescriptive0	100,000	5	1.6	1	200%	129%	1
	Custom1	500,000	14	0.4	0.6	29%	44%	3
	Custom2		1	0.4	0.6	0%	0%	1
	SAL1	100,000	1	0.4	0.4	0%	0%	1
Program Total			**73**			**19%**	**17%**	**12**

F.4.10.3 Review of Verified Savings Analysis

Penn Power's PY4 M&V activities for the non-residential sector involved selecting a sample of 41 projects for review. The sample was broken down by measure type into four strata, each of which was further broken down by project size (kWh) into three substrata. Ex-ante energy savings thresholds were established to delineate the substrata. F-21 shows the sample breakdown by stratum, and F-22 shows it by program.

Figure F-35: Penn Power PY4 Sample Breakdown by Stratum

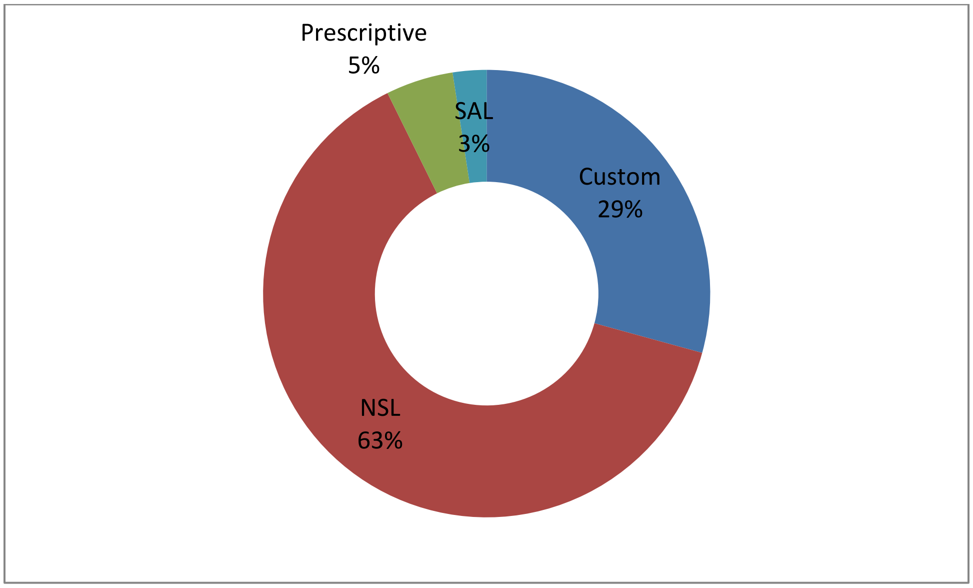
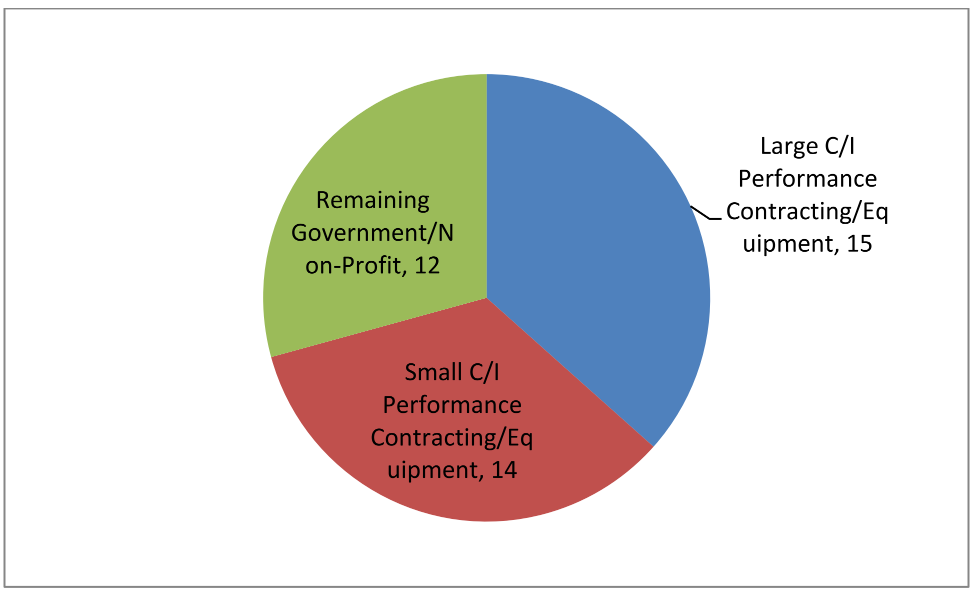
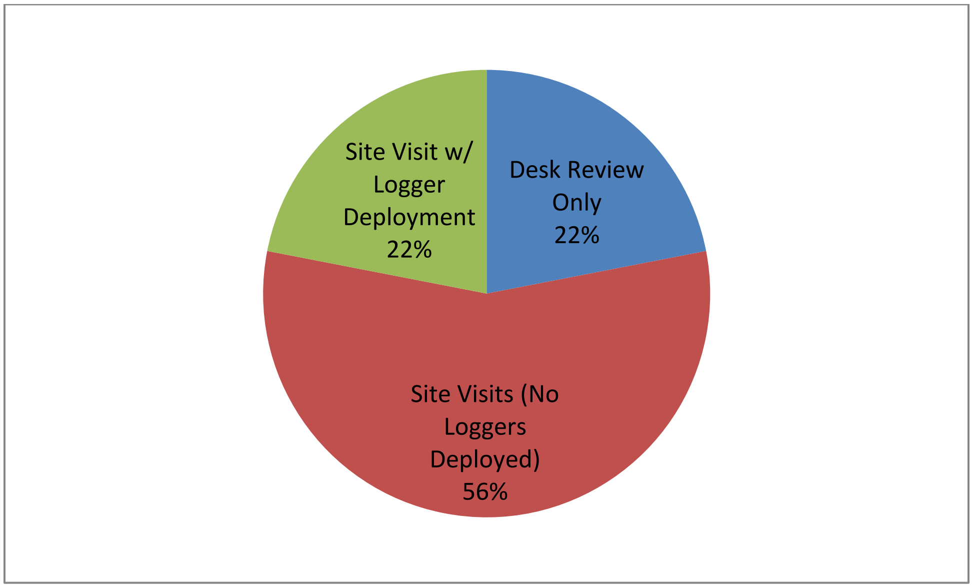


Figure F-36: Penn Power PY4 Sample Breakdown by Program



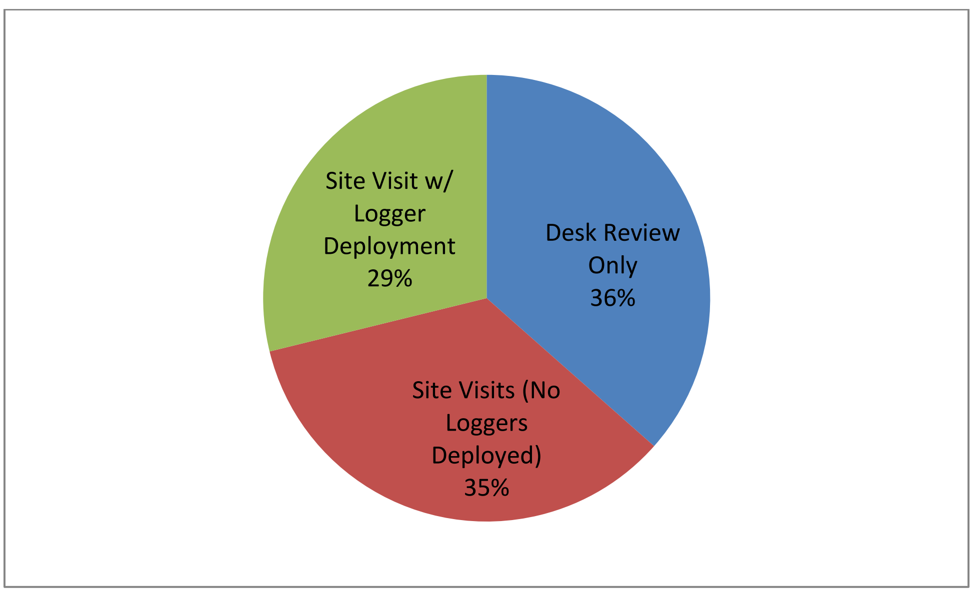
Thirty-two of the 41 sampled projects involved a visit to the project site, and of those 32 9 involved deploying data loggers. F-23 shows the breakdown of sampled projects by M&V technique.

Figure F-37: Sample Breakdown by M&V Technique



F-24 shows the breakdown of the ex-post energy savings associated with those sampled projects by M&V techniques.

Figure F-38: Sample Breakdown of Ex-Post Energy Savings by M&V Technique



Six of the nine logger deployments were for projects in the NSL stratum, representing 2.6 GWh of verified energy savings. The remaining three logger deployments were for projects in the custom stratum.

A detailed view of the sampling and verified savings results for each stratum is shown in Table F-70.

Table F-101: Penn Power PY4 Sampling and Savings Detail

Stratum/ Substratum	Sample Points	Site Visits	Logger Installs	Sum of Ex-Ante kWh	Sum of Ex-Ante kW	Sum of Ex-Post kWh	Sum of Ex-Post kW	kWh RR	kW RR
Custom0	1	1	0	35,161	4	42,223	4	1.20	1.08
Custom1	8	5	3	1,447,923	87	910,630	57	0.63	0.66
Custom2	3	0	0	3,399,553	695	3,399,553	695	1.00	1.00
NSL0	10	9	0	284,029	45	234,269	37	0.82	0.82
NSL1	11	11	3	2,581,407	462	2,252,075	454	0.87	0.98
NSL2	5	4	3	4,238,588	666	3,407,265	471	0.80	0.71
Prescriptive0	2	1	0	271,856	4	271,284	4	1.00	0.98
Prescriptive1	0	0	0	-	-	-	-		
Prescriptive2	0	0	0	-	-	-	-		
PV0	0	0	0	-	-	-	-		
PV1	0	0	0	-	-	-	-		
PV2	0	0	0	-	-	-	-		
SAL0	0	0	0	-	-	-	-		
SAL1	1	1	0	12,814	-	12,814	-	1.00	
SAL2	0	0	0	-	-	-	-		
SLB0	0	0	0	-	-	-	-		
SLB1	0	0	0	-	-	-	-		
SLB2	0	0	0	-	-	-	-		
TOTALS	***41***	***32***	***9***	***12,271,331***	***1,963***	***10,530,112***	***1,722***		
Weighted Average								***0.86***	***0.88***

Table F-71 shows the program-level realization rates and the relative precision (given at 85% confidence level) for each of Penn Power's PY4 non-residential programs.

Table F-102: Penn Power PY4 Program-Level Realization Rates and Relative Precision

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Large C/I Performance Contracting/Equipment	81%	11%	81%	9%
Small C/I Performance Contracting/Equipment	89%	14%	95%	15%
Remaining Government/Non-Profit	60%	11%	62%	17%

Figure F-25 and Figure F-26 show the relationship between ex-ante and ex-post kWh and kW savings, respectively, for projects sampled from the non-residential programs.

Figure F-39: Comparison of Penn Power PY4 Ex-Post and Ex-Ante Energy Savings

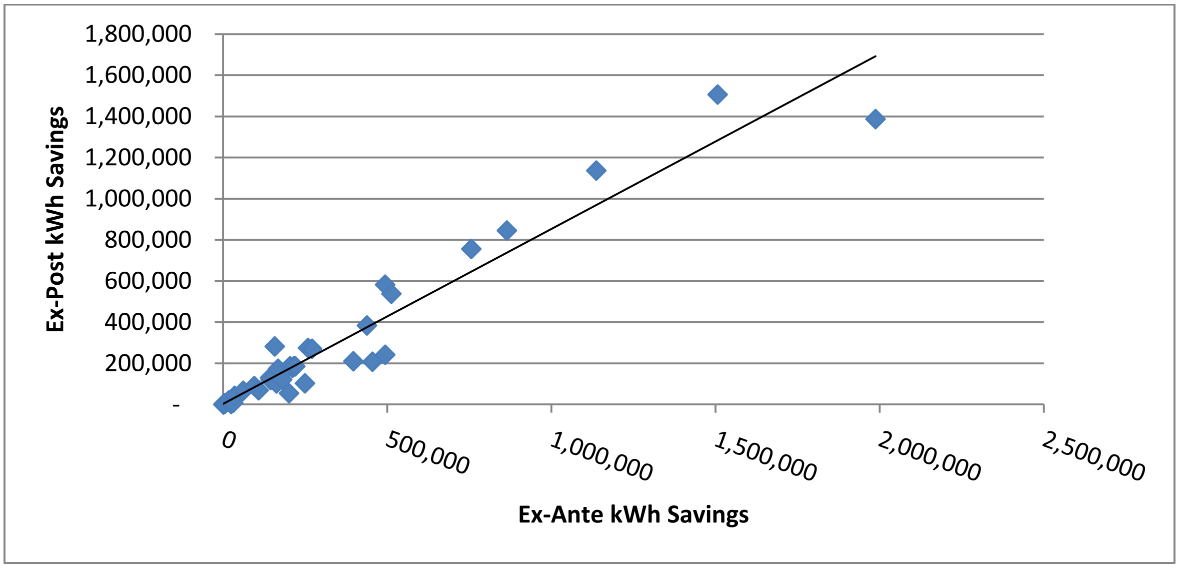
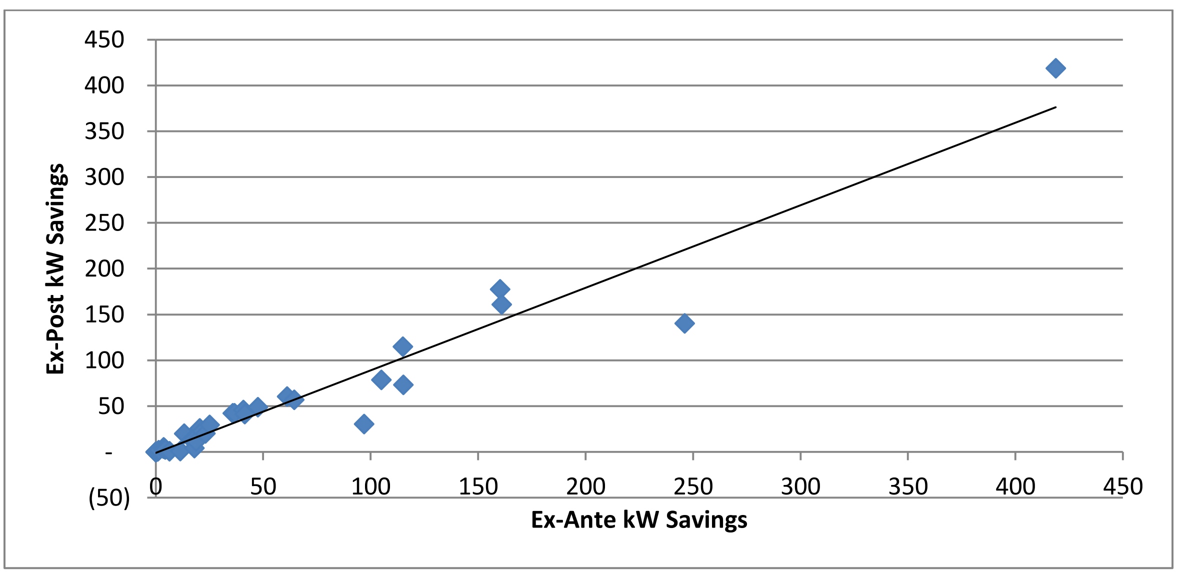


Figure F-40: Comparison of Penn Power PY4 Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Table F-72 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-103: IPMVP Methods and Verified Savings of PY4 SWE Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Method
Large C&I	2004	241,952	1	IPMVP Option A
Small C&I	2007	1,387,113	178	IPMVP Option D
Small C&I	2017	282,346	4	IPMVP Option D
Remaining Gov/NP	2036	12,814	-	IPMVP Option D
Large C&I	2043	1,136,900	419	IPMVP Option A

Project 2004 represented 241,952 kWh of energy savings and 1 kW of demand savings through replacement of motors and drives in three makeup air units supplying the baking room of an ice-cream-cone production facility. The evaluation contractor installed meters on the makeup air units to capture their operational characteristics. The realization rate for energy and demand savings was low for this project (49% and 9%, respectively) due to overestimated run hours for the units. The evaluation contractor's metering efforts concluded appreciably lower operating hours than those claimed in the application.

Project 2007 resulted in verified energy and demand savings of almost 1.4 million kWh and 178 kW, respectively. The project involved a comprehensive lighting retrofit for a retail chain's warehouse and distribution center, including replacing high-bay metal halide fixtures and T12 linear fluorescent fixtures with mainly T8 linear fluorescent fixtures and ballasts. The project also involved installing occupancy sensors. This warehouse and distribution facility operates 24 hours/day, seven days/week. The evaluation contractor found that, while the project application claimed 7,072 operating hours to account for holidays and other down times, the submitted lighting calculator used 8,760 hours for all measures. The evaluation contractor's site visit concluded an even lower value of 6,281 operating hours, accounting for holidays, but more important, accounting for the fact that the facility is not operational during approximately 3 hours every weekday night and 12 hours every weekend night. These results led the evaluation contractor to conclude an energy savings realization rate of less than 70%.

Project 2017 consisted of installing an anti-sweat heater control system for 150 refrigeration system doors at a retail store in Pittsburgh. The project netted verified energy savings of 282,346 kWh and demand savings of 4 kW. The evaluation contractor used the algorithms specified in section 3.8 of the 2012 PA TRM to determine energy and demand savings from the measure. This calculation involved multiplying the number of doors by the door width to obtain a value for linear feet of affected door for input into the algorithm. Due to insufficient documentation provided for the project, it is unclear whether a different approach was taken to determine ex-ante savings. The result of the evaluation contractor's review resulted in an energy savings realization rate of 179% and a demand realization rate of 24%.

Project 2036 resulted in verified energy savings of 12,814 at a realization rate of 100%. There was no demand savings from the project. The project involved replacing 10 mercury vapor lighting fixtures with LED fixtures for exterior lighting at a school. The evaluation contractor verified the lighting type and quantity and concluded that the dusk-to-dawn hours of operation of 4,300 hours were correct.

Project 2043 consisted of replacing six 7.5 kW motors with no control system with three 7.5 kW motors with VFDs. The motors operate calibration tables on extrusion lines at a production facility. Several of these calibration tables had not yet been upgraded at the time of the evaluation contractor's review of this project, so there was ample opportunity for investigation of baseline characteristics for identical systems. Data logging had been performed by eCap, a third-party consultant, on one of the baseline system types, as well as on the retrofit system. Upon review of eCap's analysis, the evaluation contractor initially determined that there had been an overestimation of savings. Once the project was assigned for SWE review, however, the evaluation contractor caught an error in their interpretation of an input into the analysis and concluded that eCap's original estimation was correct. The evaluation contractor should ensure proper QC procedures are in place to capture these types of errors in the future.

F.4.11 West Penn Power

This section contains details on the SWE's audit of West Penn Power's PY4 non-residential programs. The site inspection findings and review of project details for West Penn Power are discussed above in this appendix, in sections sections F.4.4.3 and F.4.4.3 respectively.

F.4.11.1 Review of Savings Database

West Penn Power reported the impacts produced by its non-residential EE programs using the same categories as the other three FirstEnergy companies. Three programs achieved energy and demand savings for PY4: the Small C&I Equipment, Large C&I Equipment, and GNP programs. The reported gross energy savings from non-residential programs was 154,353 MWh, and the reported gross demand savings was 60.48 MW. The number of participants, gross reported energy impact, and gross reported demand impact for PY4 are shown in Table F-104.

Table F-104: West Penn Power Non-Residential Programs PY4 Annual Report Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial & Industrial Equipment - Small	10,278	74,791	33.3
Commercial & Industrial Equipment - Large	149	53,619	14.5
Government and Institutional	420	25,943	12.8
Total	**10,847**	**154,353**	**60.48**

West Penn Power provided a tracking database to the SWE Team detailing project activity during PY4. The SWE Team identified each of the distinct participants and the energy and demand impacts associated with that participant for each West Penn Power non-residential program that reported savings. Table F-105 shows the participant counts and the sum of the energy and demand impacts for each program.

Table F-105: West Penn Power Non-Residential Programs PY4 Savings Database Summary

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial & Industrial Equipment - Small	10,278	74,791	27.7
Commercial & Industrial Equipment - Large	149	53,619	12.1
Government and Institutional	420	25,943	10.6
Total	**10,847**	**154,353**	**50.41**

Table F-106 shows the variances between the reported figures and the information contained in the program databases. All variances are reported as follows:

$$\boldsymbol{Reported\ Figure\ -\ Database\ Summary = Variance}$$

Table F-106: West Penn Power PY4 Non-Residential Program Discrepancies

Program	Number of Participants	Energy Savings (MWh)	Demand Savings (MW)
Commercial & Industrial Equipment - Small	0	0	5.54
Commercial & Industrial Equipment - Large	0	0	2.41
Government and Institutional	0	0	2.12
Total	**0**	**0**	**10.07**

The total number of non-residential participants and total energy impacts in the database summary match perfectly with the figures reported in West Penn Power's PY4 annual report. The reported demand impacts were 10.07 MW higher than the impacts shown in the savings database because the reported figures are presented at the system level and the tracking data is presented at the meter level. Application of West Penn's peak demand line loss factor to account for transmission and distribution losses eliminates this variance. Based on its audit findings, the SWE Team commends FirstEnergy for the zero variance between tracked and reported energy savings and participant counts for West Penn Power's non-residential programs.

F.4.11.2 Review of Sample Design

West Penn Power's PY4 final annual report provides detailed information about the sample design for the PY4 gross impact evaluation of non-residential programs.

West Penn Power's evaluation contractor used the stratified sampling method for each of the non-residential programs and targeted precision of 15% at the 85% confidence level for each program annually. At the end of Q2, Q3, and Q4, tracking data were reviewed by the evaluation contractor to draw a sample population for that quarter. The sample population was separated by operating companies and programs first, and then was stratified at the measure level according to the realization rates, variability of realization rates, modes, and rebated savings. The evaluator used a minimum Cv value of 0.4 for each stratum based on PY2 and PY3 evaluation results.

In the PY4 non-residential sample plan, each program contained multiple strata and the C_V values were equal to or greater than 0.4. The achieved sample sizes, by program, for PY4 were: 22 for Large C&I, 163 for Small C&I, and 22 for Governmental/Non-Profit. The large sample size for the Small C&I program is attributed to CFL measures. The evaluation activities for the CFL kits included survey, on-site visits, and a metering study in PY3. Table F-107 shows detailed information on West Penn Power's PY4 sample plan for non-residential programs. More strata were used in the plan than are listed in the table. Table F-107 contains information only for those strata that had participants in PY4. As for the other FirstEnergy companies, the high volatility in the Prescriptive strata inflated the sampling error associated with verified energy and demand savings for West Penn Power's non-residential programs.

Table F-107: West Penn Power PY4 Non-Residential Programs Sampling Plan

Program	Stratum	Stratum Boundaries (kWh)	Participants	Observed Cv for Energy	Observed Cv for Demand	Relative Precision for Energy	Relative Precision for Demand	Achieved Sample
Small Commercial/Industrial Equipment Program	CFL0	1,000	9,391	0.6	0.5	6%	6%	138
	ADI0	10,000,000	51	0.4	0.4	24%	24%	5
	NSL0	100,000	554	0.8	0.4	23%	23%	6
	NSL1	700,000	79	0.3	0.4	28%	28%	4
	NSL2		5	0.2	0.4	32%	32%	2
	Prescriptive0	100,000	69	1.6	1	143%	143%	1
	Prescriptive1	500,000	1		1	0%	0%	1
	Custom0	100,000	52	0.7	0.6	86%	86%	1
	Custom1	500,000	14	0.5	0.6	57%	57%	2
	Custom2		1	0.1	0.6	0%	0%	1
	SAL0	10,000	42	0.1	0.4	57%	57%	1
	SAL1	100,000	19	0.0	0.4	56%	56%	1
Program Total			**10,278**			**10%**	**15%**	**163**
Large Commercial/Industrial Equipment Program	NSL0	600,000	96	0.4	0.4	21%	21%	7
	NSL1	3,000,000	18	0.4	0.4	19%	19%	6
	NSL2		2	0.4	0.4	0%	0%	2
	Prescriptive0	100,000	8	0.4	1	135%	135%	1
	Custom1	1,000,000	20	0.4	0.6	58%	58%	2
	Custom2		5	0.4		19%		4
Program Total			**149**			**11%**	**14%**	**22**
Governmental/Non-Profit Program	NSL0	125,000	206	0.4	0.4	21%	21%	7
	NSL1	1,000,000	35	0.4	0.4	24%	24%	5
	NSL2		1	0.4	0.4	0%	0%	1
	Prescriptive0	100,000	25	0.4	1	141%	141%	1
	Custom1	750,000	66	0.4	0.6	49%	49%	3
	Custom2		3	0.4	0.6	0%	0%	3
	SAL0	999,999	7	0.4	0.4	34%	34%	2
Program Total			**343**			**13%**	**19%**	**22**

F.4.11.3 Review of Verified Savings Analysis

West Penn Power's PY4 M&V activities for the non-residential sector involved selecting a sample of 71 projects for review. The sample was broken down by measure type into five strata, each of which was further broken down by project size (kWh) into three substrata. Ex-ante energy savings thresholds were established to delineate the substrata. Figure F-41 shows the sample breakdown by stratum, Figure F-42 shows it by program.

Figure F-41: West Penn Power PY4 Sample Breakdown by Stratum

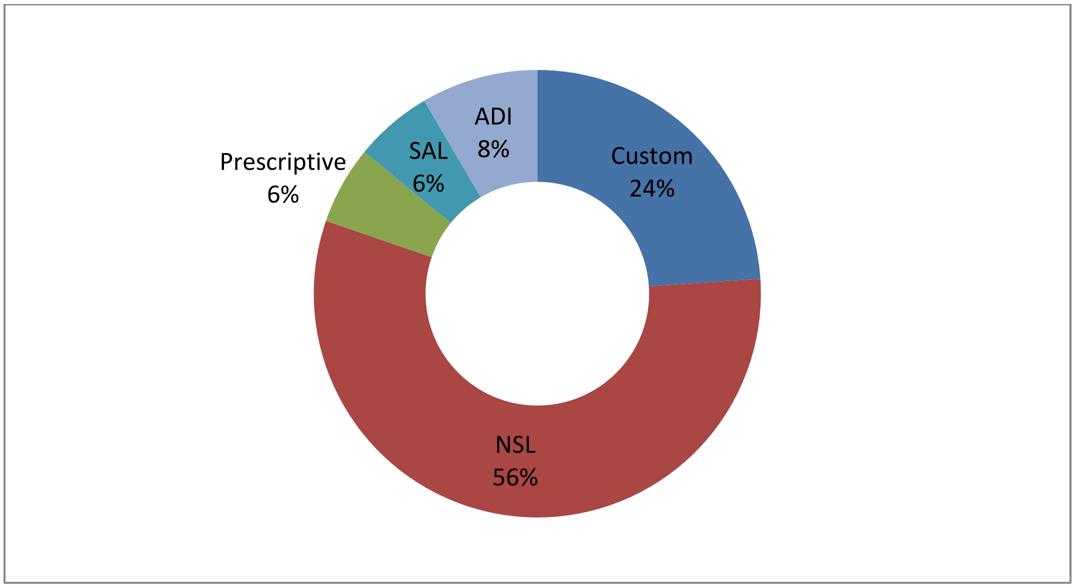
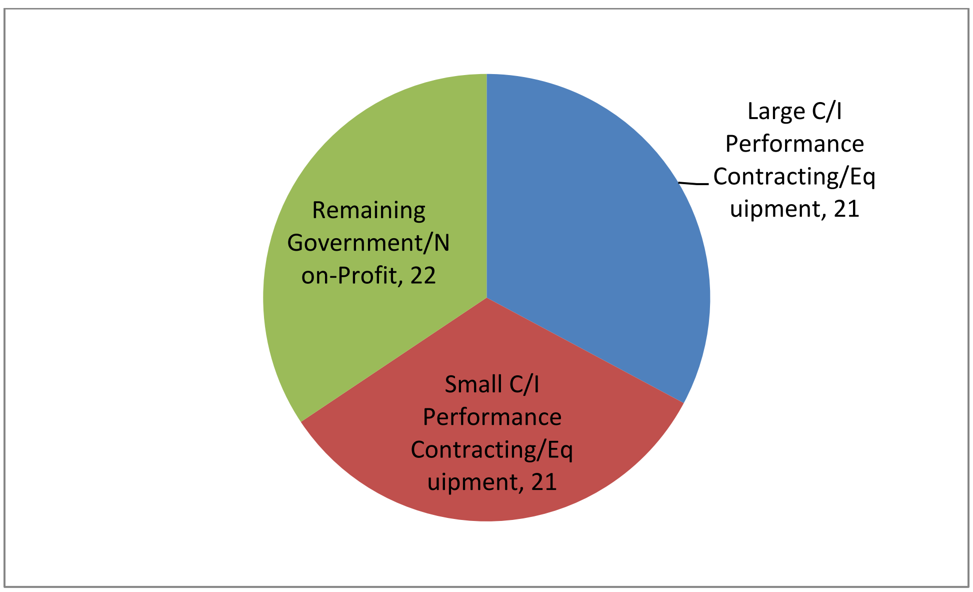


Figure F-42: West Penn Power PY4 Sample Breakdown by Program



Forty-nine of the 71 sampled projects involved a visit to the project site, and of those 49, 20 projects involved deploying data loggers. Figure F-43 shows the breakdown of sampled projects by M&V technique.

Figure F-43: West Penn Power PY4 Sample Breakdown by M&V Technique

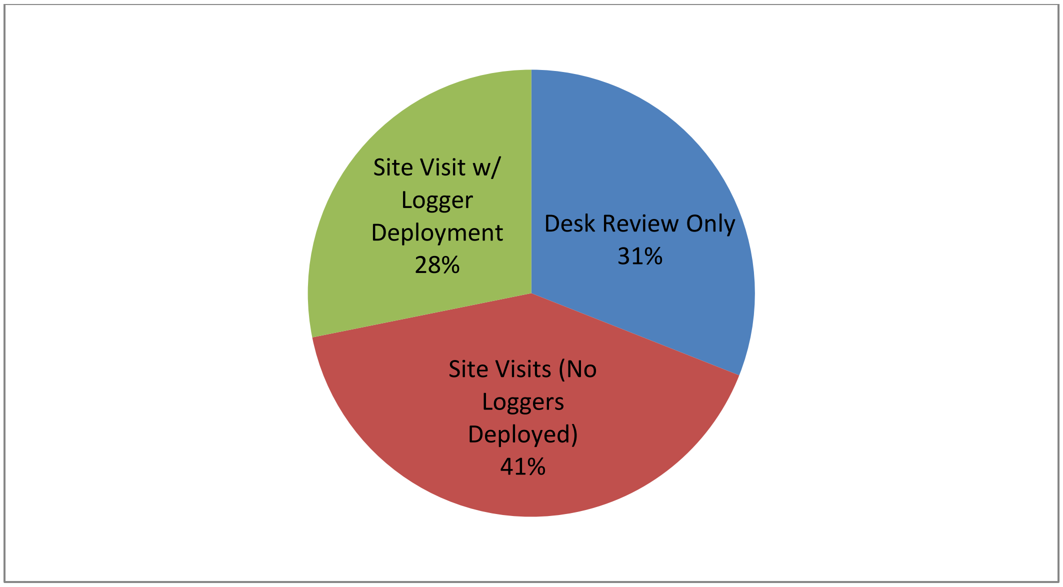
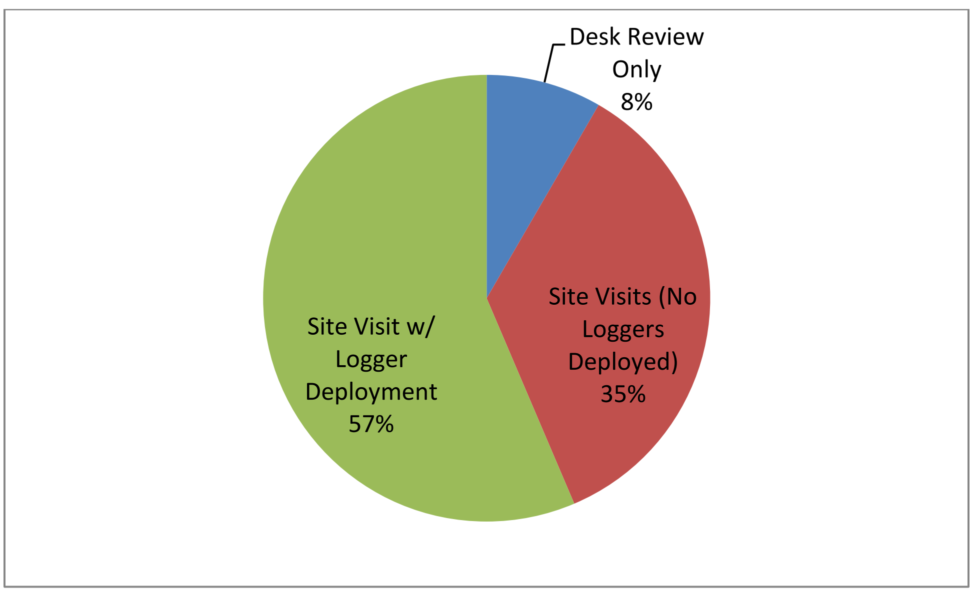


Figure F-44 shows the breakdown of the ex-post energy savings associated with those sampled projects by M&V technique.

Figure F-44: Sample Breakdown of Ex-Post Energy Savings by M&V Technique



Eighteen of the 20 logger deployments were for projects in the NSL stratum, representing over 17 GWh of verified energy savings. The remaining two logger deployments were for projects in the custom stratum.

A detailed view of the sampling and verified savings results for each stratum is shown in Table F-108.

Table F-108: West Penn Power PY4 Sampling and Savings Detail

Stratum/ Substratum	Sample Points	Site Visits	Logger Installs	Sum of Ex-Ante kWh	Sum of Ex-Ante kW	Sum of Ex-Post kWh	Sum of Ex-Post kW	kWh RR	kW RR
ADI0	6	0	0	826,684	88	198,481	21	0.24	0.23
Custom0	1	1	0	19,230	3	24,080	1	1.25	0.54
Custom1	8	3	2	1,174,597	101	635,577	86	0.54	0.85
Custom2	8	6	0	9,267,462	1,024	9,179,302	1,001	0.99	0.98
NSL0	20	17	5	2,342,285	280	2,231,475	318	0.95	1.14
NSL1	15	12	9	11,156,416	1,471	9,249,218	1,489	0.83	1.01
NSL2	5	5	4	12,173,956	1,568	9,896,637	1,402	0.81	0.89
Prescriptive0	3	2	0	7,995	7	10,433	10	1.30	1.34
Prescriptive1	1	0	0	455,813	52	706,220	186	1.55	3.57
Prescriptive2	0	0	0	-	-	-	-		
PV0	0	0	0	-	-	-	-		
PV1	0	0	0	-	-	-	-		
PV2	0	0	0	-	-	-	-		
SAL0	3	2	0	32,405	4	23,419	3	0.72	0.65
SAL1	1	1	0	11,288	1	11,592	1	1.03	1.02
SAL2	0	0	0	-	-	-	-		
SLB0	0	0	0	-	-	-	-		
SLB1	0	0	0	-	-	-	-		
SLB2	0	0	0	-	-	-	-		
TOTALS	***71***	***49***	***20***	***37,468,131***	***4,599***	***32,166,435***	***4,517***		
Weighted Average								***0.86***	***0.98***

Table F-109 shows the program-level realization rates and the relative precision (given at 85% confidence level) for each of West Penn Power’s PY4 non-residential programs.

Table F-109: West Penn Power PY4 Program-Level Realization Rates and Relative Precision

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Large C/I Performance Contracting/Equipment	88%	12%	113%	15%
Small C/I Performance Contracting/Equipment	86%	10%	55%	16%
Remaining Government/Non-Profit	71%	12%	73%	17%

Figure F-45 and Figure F-46 show the relationship between ex-ante and ex-post kWh and kW savings, respectively, for project samples from the non-residential programs.

Figure F-45: Comparison of West Penn Power PY4 Ex-Post and Ex-Ante Energy Savings

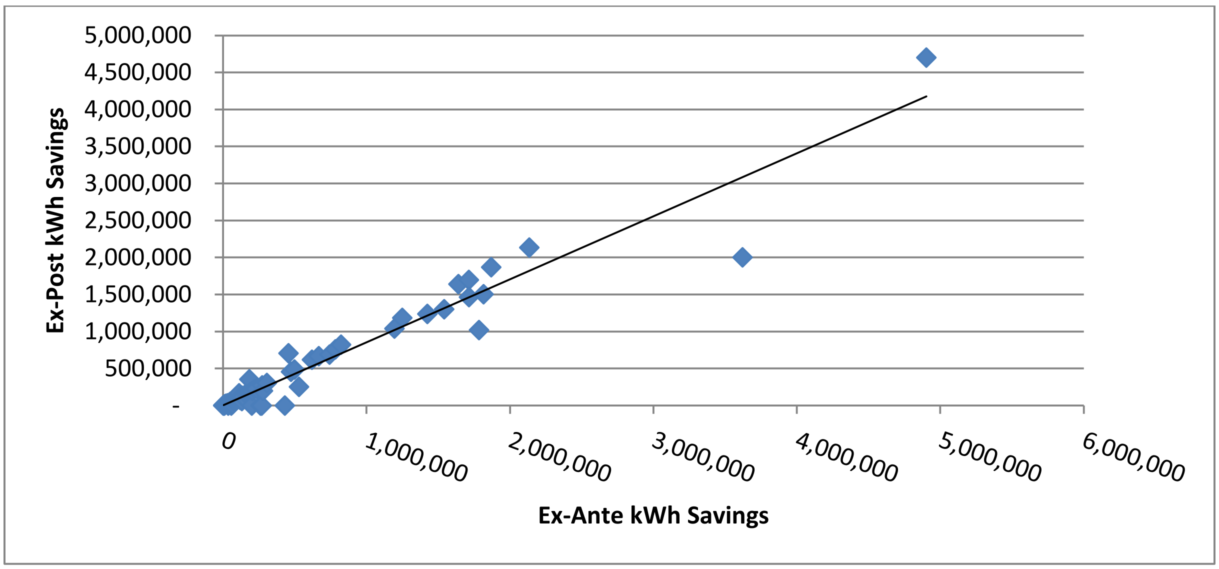
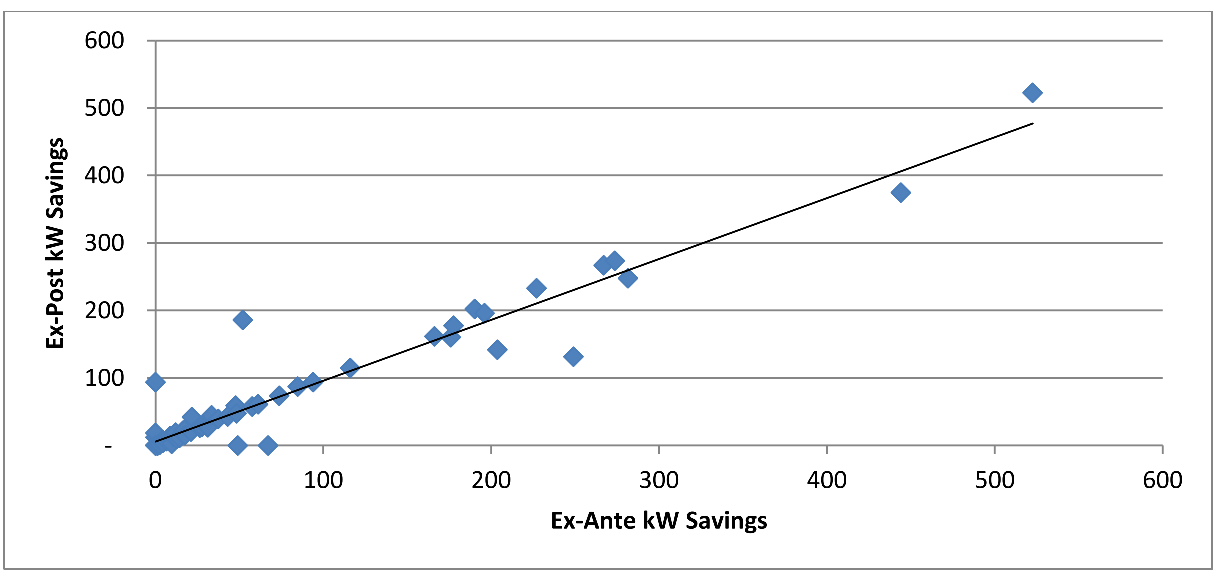


Figure F-46: Comparison of West Penn Power PY4 Ex-Post and Ex-Ante Demand Savings



Detailed SWE review of sampled sites generally revealed appropriate use of levels of rigor and M&V method selection. Table F-110 shows the energy and demand savings for the projects chosen for SWE review and the M&V method selected for site evaluation.

Table F-110: IPMVP Methods and Verified Savings of SWE Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Method
Small C&I	4005	2,134,635	0	IPMVP Option A
Large C&I	4006	1,184,496	132	IPMVP Option A
Small C&I	4013	7,466	8	IPMVP Option D
Remaining Gov/NP	4030	14,218	2	IPMVP Option D
Large C&I	4055	2,002,215	375	IPMVP Option A

Project 4005 represented more than 2.1 million kWh of energy savings but no demand savings. The project involved upgrading old snowmaking equipment and a new control system for on-mountain lighting at a ski area. The evaluation contractor performed data logging to capture operational characteristics of the new snowmaking system. The interval data capture on-site was used in a spreadsheet analysis to determine the verified energy savings. The evaluation contractor concluded that the savings from the snowmaking measure accounted for 1.95 million kWh savings, approximately 173% of the reported savings for that measure of 1.1 million kWh. The savings from the lighting measure was verified to be the same as what was reported. The overall energy savings realization rate for the project was 163%.

Project 4006 resulted in verified energy savings of almost 1.2 million kWh and demand savings of 132 kW from the installation of 16 VFDs on process fans in an industrial kitchen facility in Charleroi, PA. The horsepower ratings of the associated motors ranged from 100 HP to 250 HP. The evaluation contractor performed a site visit and gathered data on the installed equipment, including spot measurements on fan power and speed. The evaluation contractor’s analysis concluded that several of the fans on which VFDs were installed actually did not have the ability to vary their speed. Negative savings values resulted from these fans, reducing the overall verified energy savings by more than half and netting a realization rate of 45%.

Project 4013 was a new construction project that involved installing nine high-efficiency RTUs at a large retail store. The project resulted in verified energy savings of 7,466 kWh and demand savings of 8 kW. The realization rates were 149% and 180%, respectively. The increase in savings ex-post was a result of verified efficiency ratios being more efficient than noted in the application. The evaluation contractor performed a site visit for verification and noted that two of the larger units actually had an EER of 12, instead of the 11.2 noted in the application.

Project 4030 consisted of retrofitting 41 traffic signals to use LED lamps It resulted in verified energy savings of 14,218 kWh and demand savings of 2 kW. The evaluation contractor performed site visits to the traffic intersections to verify that the upgrades had taken place as stipulated in the application. The review of the project resulted in realization rates for energy and demand savings of 104% each.

Project 4055 resulted in verified energy savings of 2 million kWh and 375 kW of demand savings achieved through a comprehensive lighting retrofit at a large data storage facility. The project involved upgrading more than 7,000 fixtures. The evaluation contractor performed a site visit of the facility and also installed lighting loggers to verify operating schedules of the various spaces. Through both staff interviews and data logging, the evaluation contractor determined that many of the spaces had more limited operating hours than what was submitted in the original lighting calculator. The calculator submitted with the application stipulated that all spaces had 8,760 annual operating hours, whereas the evaluation contractor's findings determined that operating hours ranging from 781 to 8,760, with an average of 5,226 annual operating hours. This was the primary reason for the realization rates for this project ending up at 55% and 84% for energy and demand savings, respectively.

F.5 Audit Activity Detail: West Penn Power Conservation Voltage Reduction Program

Electric demand is basically the power consumed by a load, which is simplistically expressed in Equation F-1.

Equation F-1: Electric Power

$$Power\ (Watts) = Electric\ Voltage\ (Volts) * Current\ (Amps)$$

Energy is the demand over period of time, and it is usually expressed in terms of kWh (kilowatt hour). Electric demand and energy can be affected by changing the voltage in a power system. By reducing the voltage (within a tolerance required to ensure power quality and equipment performance by end-use customers), an EDC can lower both demand and energy consumption. With a properly executed voltage reduction program, the end-use consumers of electric power will not notice any negative impact in equipment (e.g., air-conditioning, lighting, motor) performance resulting from the change in voltage.

Based on the relationship between power and voltage shown in Equation F-1, a conservation voltage reduction (CVR) program decreases energy use by adjusting transformer settings at the substation feeder level to achieve load reduction. West Penn Power's CVR program is cross-cutting because the voltage regulation affects circuits that serve the residential, commercial, industrial, and GNI sectors. The impact evaluation of the program followed a modified version of the custom measure protocols (CMPs) for CVR that were submitted by PECO and approved by the SWE in 2010.

The basic formulas for estimating savings from the CVR program are shown in Equation F-2 and Equation F-3.

Equation F-2: Energy Savings from CVR

$$Energy\ Savings\ (kWh/year) = \Delta Voltage * CVRf * Total\ Energy\ (kWh/year)$$

Equation F-3: Peak Demand Savings from CVR

$$Demand\ Reduction\ (Top\ 100) = Avg\ top\ 100\ Demand\ (kW) * \Delta Voltage * CVRf$$

The term *ΔVoltage*, or ΔV, is the difference between the average pre-CVR voltage and the average post-CVR voltage expressed as a percent reduction. At West Penn, voltage drops were calculated as the difference between the average voltage for the 10 days preceding the voltage change and for the 10 days following the voltage change. West Penn Power data for 2012 show an average ΔV of 1.11% (unweighted), with an individual transformer maximum of 2.85% and minimum of 0%. Not all of the affected transformers in the program were in the CVR state during the top 100 hours of 2012, so the average ΔV for the top 100 hours in 2012 was 0.5%.

The term *CVRf* is the conservation voltage reduction factor expressed as the ratio of energy saved to average voltage reduced over a period of time – or the percent change in energy use divided by the percent change in voltage. This value can range from less than zero to greater than 1. The percent change in voltage was measured and the percent change in energy use was determined via a regression analysis of actual transformer load data both in and out of the CVR state. The basic form of the regression model is to use the natural log of the metered hourly load of the transformer as the response variable and weather variables, the hour of the day and an indicator variable for whether or not the transformer was in the CVR state during the hour. One minus the exponential of the regression coefficient for the CVR indicator variable is what is used to estimate percent change in energy use.

West Penn's evaluation contractor conducted three separate CVR tests to gather data for analysis. Table F-111 shows the date ranges of these tests and the resulting *CVRf*.

Table F-111: CVR Test Periods

CVR Test Season	Start Date	End Date	CVRf
Winter	1/15/2013	2/22/2013	0.64
Shoulder (Spring/Fall)	4/8/2013	5/15/2013	1.11
Summer	6/10/2013	7/10/2013	0.85

The SWE commends West Penn Power for conducting CVR tests across multiple seasons as the results of voltage reductions can vary significantly based on the types of loads being served (resistive versus inductive). Repeated measurement also helps stabilize estimates from what is inherently very "noisy" data.

Annual energy savings estimates were obtained from interval metered data accumulated for a one-year period and then weather-normalized. In the case of West Penn Power, about 53% of meters (58 out of

110) were interval meters where the *Total Energy* term from Equation F-2 and the *Average top 100 Demand* term from Equation F-3 were actually measured. The rest of the meters were ratchet meters, which only record a peak reading, so the energy usage and demand during the top 100 hours have to be estimated.

West Penn Power achieved 46,980 MWh/yr of verified gross energy savings from the PY4 CVR deployment. The energy savings measured at the transformers are scaled down by a factor of 0.9425 to equate them to savings at the meter level after accounting for transmission and distribution power losses. The gross verified demand savings during the top 100 hours at the system level from the program was 11.38 MW after the application of a 20% peak demand line loss factor. These savings calculations are based on the 110 affected transformers in the program, all of which had (non-coincidental) peak mega volt ampere (MVA) measurements. Of the 110 transformers, 58 used interval MWh meters that measured MWh; the other 52 ratchet meters measured only peak MVA. The average MWh savings/MVA value from the 58 interval MWh metered transformers was multiplied by the peak MVA of ratchet metered transformers to obtain energy savings for the 52 non-MWh metered transformers Of the documented gross energy savings, 71% came from the 58 interval MWh meters, whereas less than 30% savings came from the 52 ratchet meters.

The estimation method of MWh for non-MWh meters is a source of uncertainty in the verified savings estimates from the program because MWh per peak MVA varies significantly by transformer. For example, the transformers shown in Figure F-47 and Figure F-48 peak at approximately 9 MW, but transformer D430 (SHILOH 1) serves nearly five times the MWh over the year as transformer D018 (LAGONDA 62). Because West Penn's evaluation contractor averaged the MWh/MVA ratio from the 58 transformers with interval meters and used this average factor for the 52 ratchet metered transformers, the value should be a reasonable "middle of the road" estimate.

Figure F-47: West Penn Power Transformer with a Low Annual MWh per Peak MVA

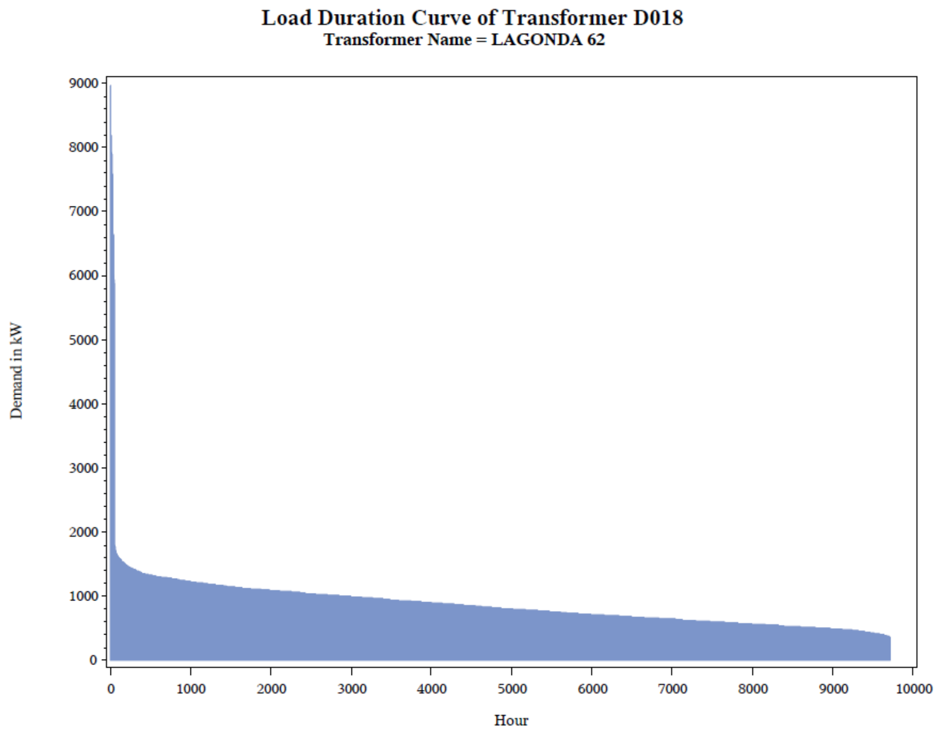
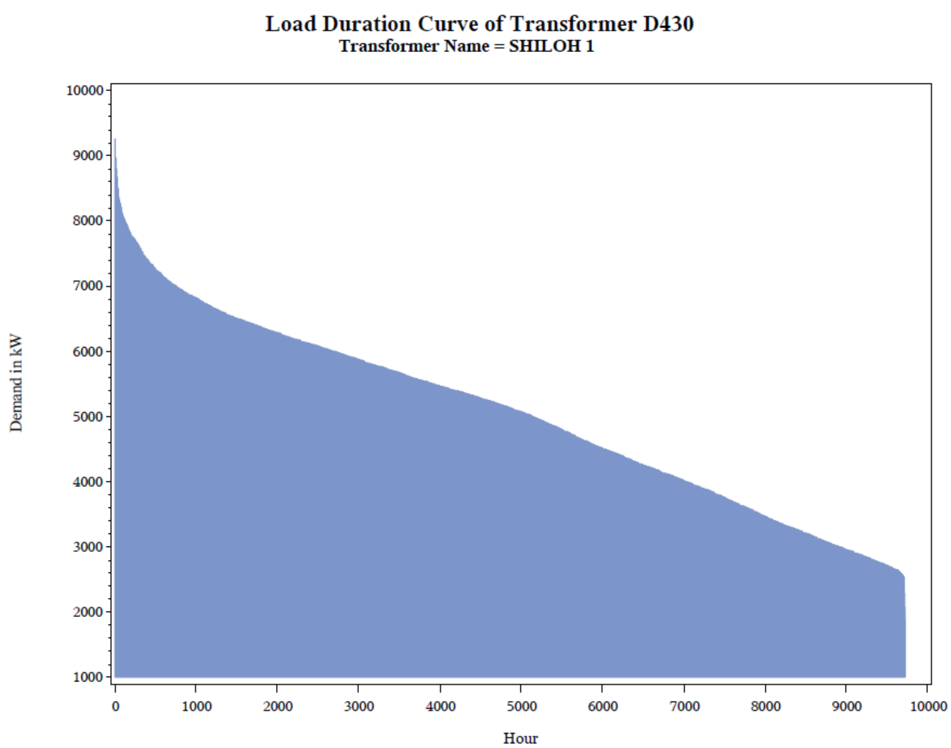


Figure F-48: West Penn Power Transformer with a High Annual MWh per Peak MVA



The SWE feels that given the absence of precedence for a better estimation method and the limitations in data availability, this was a reasonable methodology. The measurement uncertainty associated with the verified savings estimates was also well documented in the West Penn Power PY4 final annual report and the supporting analysis provided to the SWE. Needless to say, the quality of data and precision would have improved greatly if the ratchet meters had been upgraded to interval MWh meters once identified for CVR, but this expense would have hurt the TRC ratio of what was an extremely cost-effective program. As evaluated, the error band around the verified savings estimates including both sampling and measurement error was +/- 16% at the 85% confidence level, which is close to the level of uncertainty allowed by the audit plan from sampling alone.

The savings estimation for the West Penn CVR program differed from the approved Custom CMP for CVR in two ways. The use of seasonal testing rather than a single test during a shoulder month should provide better data on how CVR implementation affects load at extreme weather conditions, and should produce a better annual savings estimate. The regression model specifications used by West Penn Power were also slightly different from those specified in the CMPs. The SWE reviewed the model departures and the associated output and has no concerns about the form of the models used by West Penn.

F.6 Audit Activity Detail: Demand Response Programs

F.6.1 Duquesne

This section contains details on the SWE's audit of Duquesne's PY4 demand response (DR) programs. Table F-81 summarizes the DR programs that Duquesne implemented in Phase I.

Table F-112: Duquesne Demand Response Program Summary for PY4

Demand Response Program	Line Loss Adjustment Factor	Gross Verified Peak Demand Reduction (MW)
Direct Load Control	1.11	0.46
Curtailable Load	1.11	73.97
DR Total	**N/A**	**74.43**

F.6.1.1 Residential

Duquesne implemented the Watt Choices Direct Load Control Program for its residential customers in accordance with the Act 129 direct load control (DLC) and load curtailment guidelines.

The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[576]

[576] 2012 PA TRM, p. 302.

The Watt Choices Direct Load Control Program used digital control units to reduce air-conditioning compressor demand in a 50% cycling strategy, allowing for a combination, for example, of 15-minute compressor-run periods and 15-minute compressor-controlled periods. Duquesne's evaluation contractor performed an analysis of the collected data from 100 program participants and used a regression model to forecast hourly load savings based on a weighted temperature humidity index (WTHI) value of 80.7, as per PJM guidelines, for all active devices in 53 event hours registered during the summer of 2012. The subsequent savings value was applied to all event participants in Duquesne's top 100 hours, and this custom verification was used in lieu of the deemed savings found in PJM Manual 19, Attachment B. This custom approach was the product of a discussion between the EDC evaluator and the SWE, agreed on prior to implementation, in response to opinions on the symmetric additive adjustment as it applies to commercial versus residential operation.

Upon review of the data provided by the evaluation contractor showing the kW impact savings applied to each event in the top 100 hours, the SWE confirmed that the appropriate PJM and TRM guidelines were followed in determining the final MW reduction of 0.46 MW.

F.6.1.2 Non-Residential

In its PY4 annual report, Duquesne estimated 73.97 MW of gross verified peak demand reduction across the top 100 hours of 2012 from its Watt Choices Curtailable Load Program. This estimate represents approximately 66% of Duquesne's Phase I peak demand reduction target of 113 MW. Table F-82 shows the individual EE programs that funded the Watt Choices Curtailable Load Program and the savings they achieved.

Table F-113: Reported Reductions from Duquesne's Watt Choices Curtailable Load Program, by EE Program

Energy Efficiency Program	Gross Verified Demand Reduction (MW)
Commercial Sector Umbrella EE	0.5404
Commercial Sector Umbrella EE (Upstream Lighting)	0.0000
Healthcare EE	1.6308
Industrial Sector Umbrella EE	3.8452
Chemical Products EE	0.7952
Mixed Industrial EE	7.3706
Large Office Building EE	4.2861
Small Office Building EE	0.0728
Primary Metals EE	44.1750
Public Agency/Non-Profit	7.5185
Small Retail Stores EE	0.0000
Large Retail Stores EE	1.1293
Large Curtailable Demand Response	2.6022
Total:	**73.97**

In order to verify that customer baseline load (CBL) and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in Duquesne's Watt Choices Curtailable Load Program. The requested items were:

- The claimed peak load reduction for each hour that the site participated in a Duquesne curtailment event.
- The interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the Duquesne program.
- The PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[577]

[577] ibid.

Table F-114 shows the reported savings impacts from these five large customers during the top 100 hours of 2012. These values represent ex-post savings values submitted to the SWE on February 4, 2013, following verified savings analysis by Duquesne's evaluation contractor.

Table F-114: Reported Load Reductions by Customer – SWE Audit Sample

PMRS ID	CBL Method	Count of Top 100 Hours Curtailed	Verified kWh Savings in Top 100 Hrs	Average Verified kW Impact in Top 100 Hrs
1000006356.36.01	Standard with SAA	70	42,187	421.9
5000006607.35.01	Standard with SAA	60	37,517	375.2
7000648845.33.01	Consecutive Day with SAA	92	53,521	535.2
8000006714.33.01	Standard with SAA	47	30,695	307.0
9000008787.35.01	Standard with SAA	83	48,194	481.9

Using the load data provided by Duquesne, the SWE performed an independent assessment of the hourly load reductions achieved by the Duquesne program at these five sites according to its interpretation of the PJM business practices that were in place during the summer of 2012. Table F-115 compares the unverified peak demand impacts reported by Duquesne with the independent SWE impact calculations.

Table F-115: SWE Load Reduction Estimates - Duquesne Audit Sample

PMRS ID	Average kW Impact in Top 100 Hrs (Duquesne)	Average kW Impact in Top 100 Hrs (SWE)	SWE Site-Level Realization Rate Estimate
1000006356.36.01	421.9	421.9	100%
5000006607.35.01	375.2	375.2	100%
7000648845.33.01	535.2	535.2	100%
8000006714.33.01	307.0	307.0	100%
9000008787.35.01	481.9	481.9	100%
Total	**2,121.2**	**2,121.2**	**100%**

For each of 352 top 100 event hours across the five participating sites in the audit sample, the SWE's impact calculations matched the Duquesne estimates identically for all hours. Based on this audit, the SWE has confidence that PJM business rules and CBL calculations were applied correctly in the verified savings analysis for the Watts Choices Curtailable Load program.

F.6.2 PECO

This section contains details on the SWE's audit of PECO's PY4 DR programs.

F.6.2.1 Residential

PECO implemented the Residential Smart A/C Saver Program for its residential customers in an effort to help meet PECO's peak demand reduction target of 355 MW. The original estimate for PY4 savings as a result of residential DLC was 64.6 MW and represented a substantial contribution to the total demand reduction goal. The final reported gross demand reduction was 51.3 MW for PY4, or approximately 14% of the total demand reduction goal.

The EDC evaluator performed a stratified sample survey in order to determine a weighted average deemed savings based on average tonnage and the seasonal energy efficiency ratio (SEER). The results provided the deemed savings kW/unit used for the portion of the population with a connected load under 3.5 kW and a deemed savings kW/unit for those with a connected load of 3.5 kW or greater, respectively .66 kW and 1.15 kW. This custom approach followed PJM Manual 19, Attachment B[578] guidelines and is summarized in Table F-85.

Table F-116: PECO Evaluator Residential Deemed Savings Study Results

Strata	Number of Units in Population (with valid data)	Percent of Population	# Sample Points	% of Sample	% Greater than or equal to 3.5 kW	Variance	Absolute Precision (at 90% Conf)
1	17,095	19%	19	22%	0%	0%	3%
2	46,305	51%	44	52%	36%	23%	13%
3	26,541	30%	22	26%	100%	0%	2%
Overall	89,941	100%	85	100%	48%	6%	5%

PECO's evaluation contractor followed the PJM guidelines to use a WTHI of 83.2 and the hour of 4:00 to 5:00 p.m. in order to calculate the base savings value for comparison with program impacts. As referenced in the demand response aggregator and distributed energy resources program summaries in this report, the evaluator performed a regression analysis to determine the significance of the hours immediately surrounding the event in accordance with the *Amended and Restated Operating Agreement of PJM Interconnection,* but it was determined to be insignificant.

After adjusting for switch operability of .97 as reported by Comverge in PY3 and the line loss factor (LLF) of 1.1916, the population sample's weighted average deemed savings value of .90 kW/unit became 1.04 kW/unit. The new deemed savings value was applied to all active participants in the reported 54 event hours at a 50% cycling strategy over the course of 15 events in the summer of 2012.

[578] PJM Manual 19: Load Forecasting and Analysis, Attachment B: Direct Load Control Load Research Guidelines.

Upon review of the data requested and the accompanying program event tracking data provided by PECO's evaluation contractor, the SWE discovered a discrepancy with regard to PECO's total demand reduction calculations:

1) The SWE reviewed the event dates and hours in the program tracking data and compared them with those in the top 100 hour time periods. The DR Event Log shows approximately 6.2 MW of demand reduction that occurred in non-100 hour time periods, which is not applicable to the DLC total reduction.

F.6.2.2 Non-Residential

In its PY4 annual report, PECO estimated 113.4 MW of gross reported peak demand reduction across the top 100 hours of 2012 from its Demand Response Aggregators program. The Distributed Energy Resources program contributed an additional 16.4 MW of peak demand reduction. Together, these numbers represent approximately 36.6% of PECO's Phase I peak demand reduction target of 355 MW. The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[579] In order to verify that the CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in PECO's Demand Response Aggregators program and three of the largest customers in its Distributed Energy Resources program. The requested items were:

- The claimed peak load reduction for each hour that the site participated in a PECO curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the PECO program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[580]

Discussions between PECO and the SWE and a comparison of the SWE and PECO load reduction estimates revealed two differences with regard to the interpretation of PJM business rules. In both cases, the PECO interpretation produces larger load reduction estimates than the SWE interpretation. These two issues are discussed in more detail below.

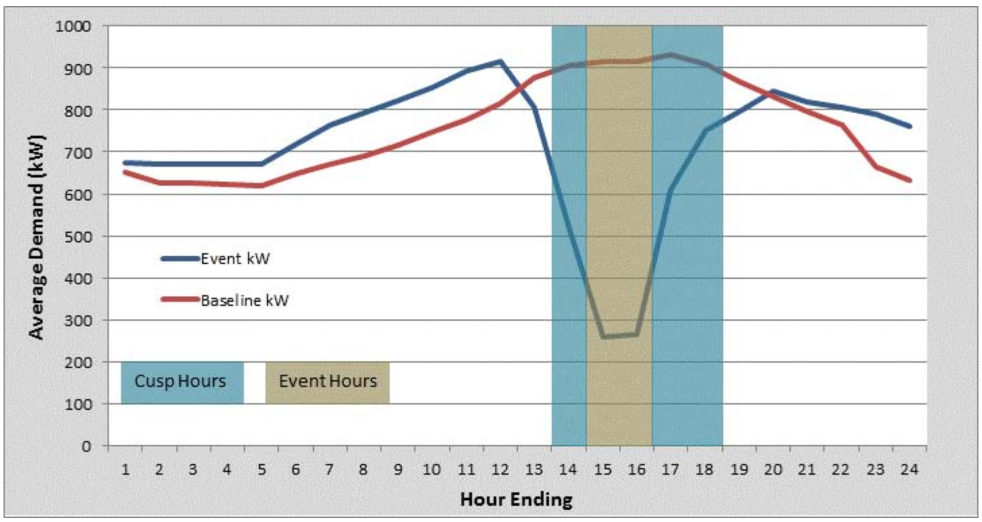
1) **How should an "event hour" be defined?** – The 2012 TRM states that "Peak load reductions from DLC, CPP and LC will be determined for each Act 129 DR event hour for June 1, 2012, through

[579] 2012 PA TRM, p. 302.
[580] ibid.

September 30, 2012."[581] However, no definition is provided for what constitutes an event hour. Because PJM business rules are called for in assessing participant load reductions, the SWE believes that the PJM definition of an "event hour" is implied. In the PJM DR programs, an event hour is any hour that a site is dispatched to curtail load and is eligible to receive a settlement. This same logic works for Act 129 because PECO called events with fixed start and end times and participants are paid for their performance during these hours.

In analyzing the customer behavior on event days, PECO observed that customers often began to reduce load prior to the beginning of a PECO event and ramped load back up gradually after the event. Figure F-49 shows this for a sample customer.

Figure F-49: Customer Load Reduction Before and After a PECO DR Event



PECO believes that the load reductions during the hour before and the two hours following a called event should be included in the impact analysis of its Demand Response Aggregators and Distributed Energy Resources programs if the hour is part of the top 100 hours. Using this approach provides PECO with load reductions during top 100 hours where events were not called and affects the calculation of the symmetric additive adjustment (SAA) for customers who use a CBL method with an SAA. This interpretation of an "event hour" increases the combined impact of PECO's two non-residential DR programs by 18.2 MW. The SWE believes that these 18.2 MW should not be counted toward PECO's 355 MW Phase I peak demand reduction target.

2) **Exclusion of Days from the Baseline Calculation** – The 2012 TRM states that "When determining customer baselines, Act 129 DR event days and PJM DR event days (e.g., for PJM emergencies and economic events for which participants have settlements) will be excluded to the extent that they

[581] Ibid.

are known."[582] The intent of this protocol is to prevent days during which a facility curtailed load from being included in the calculation of a CBL because it could cause the load reduction achieved by the facility on an event day to be underestimated.

The largest customer in PECO's Demand Response Aggregators program is a veteran of the PJM DR markets, but was forced to reregister to the PJM Economic Load Response program following changes in the program in spring 2012. Due to some administrative delays, this registration was not completed until early July. Consequently, the steel mill curtailed load on several days but did not receive a settlement from PJM. A strict interpretation of the TRM would require these days to be included in the CBL calculation because the days were not Act 129 events and the customer did not receive a settlement from PJM. Including these days in the CBL calculation for other Act 129 events lowers the load reduction achieved by the facility over the top 100 hours of 2012 by 2.7 MW.

The SWE has reviewed the interval load data from the facility during the days in question and feels that it is clear that the facility was curtailing load on these days even though it did not receive a settlement from PJM. The SWE believes that excluding these days from the CBL calculation produces the most accurate assessment of the impact of the PECO program during the top 100 hours, but the SWE is not at liberty to authorize a departure from the protocols set forth in the TRM.

The SWE understands that the PECO DR programs are structured somewhat differently from the PJM DR markets with regard to customer incentives. Because of this, PJM business rules may not always be a perfect solution. However, the 2012 TRM was clear that PJM business rules were to be followed in assessing the Act 129 impacts from LC programs and the SWE is not at liberty to authorize a departure from TRM protocols. The SWE believes that the most appropriate number for PECO to use across both contributing programs is 108.9 MW. This reflects the 129.8 MW gross verified savings less the 2.7 MW and 18.2 MW that were calculated using departures from PJM rules.

[582] ibid.

F.6.3 PPL

This section contains details on the SWE's audit of PPL's PY4 DR programs. Table F-86 summarizes the DR programs that PPL implemented in Phase I.

Table F-117: PPL Demand Response Program Summary

Demand Response Program	Line Loss Adjustment Factor1	Gross Verified Demand Reduction (MW)
Direct Load Control	1.0833	18.2
Load Curtailment – Large C&I	1.0412	110.8
Load Curtailment – Small C&I	1.0833	7.4
DR Total	**--**	**136.4**

F.6.3.1 Residential

PPL implemented the direct load control program known as the Peak Saver Program, in an effort to help reach its Phase I target demand reduction of 297 MW. The original demand reduction goal of the residential DLC program was 36 MW, or 12% of the total demand reduction target for the phase. The EDC contracted with a curtailment service provider, Comverge, to implement and administer the program logistics in accordance with PJM Manual 19, Attachment B, business practices. Over the course of 21 called events and 67 event hours, the gross verified demand reduction totaled 18.2 MW using the line losses of 1.0833 as shown in Table F-117 above.

PPL's curtailment service provider used real metering data in order to develop the per unit savings estimates for the gross impact. A controlled study survey was performed by the CSP and reviewed by the EM&V CSP in accordance with PJM standards to obtain relevant survey data, the survey was dividing into two groups using the savings approach shown here:

Table F-118: Savings Estimation Approach for PPL Residential DR Program

Event	Non-cycled Control	Average Non-Cycled (Control) Group Demand	Participant Cycled	Average Cycled Demand	Demand Reduction
Event 1	M&V Group A	76 kW	M&V Group B	35kW	41 kW
Event 2	M&V Group B	75 kW	M&V Group A	36kW	39 kW

Event 1: M&V Group A is controlled and not cycled, M&V Group B is cycled.
Demand reduction = 76kW – 35 kW = 41 kW

Event 2: M&V Group B is controlled and not cycled, M&V Group A is cycled.
Demand reduction = 75kW – 36 kW = 39 kW
Average Event Impact:
(Event 1 impact + Event 2 impact) / 2

$$(41 + 39) /2 = 40$$

The participant survey was further stratified to separate customers with HVAC units greater than 3 tons and less than 3 tons. The final results of the survey were used to provide the savings estimates for customers who were having their load controlled during an event versus the base case where the units were not controlled, the appropriate line loss factor is applied and no operability adjustments were made.

F.6.3.2 Non-Residential

PPL did not find the PJM M&V protocols for the Act 129 LC program to be sufficient for its customers and as such reported two sets of numbers. Following PJM M&V protocols exactly, PPL reported 118.20 MW of gross verified peak demand reduction across the top 100 hours of 2012 in its PY4 report. However, contrary to PJM's method of counting load increases in billing intervals, PPL believes that billing intervals with load increases should be set to zero. Using this alternative method of calculation, PPL reported 133.86 MW of gross verified peak demand reduction. The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[583] In order to verify that CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in PPL's LC program. The requested items were:

- The claimed peak load reduction for each hour that the site participated in a PECO curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the PECO program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[584]

Table F-119 shows the verified savings impacts from these five participants during the summer of 2012. These values represent ex-post savings values submitted to the SWE following verified savings analysis by PPL's evaluation contractor and reflect all hours during which the site curtailed load for the PPL program, not just the top 100 hours. Table F-119 also shows the sum of the independent SWE load reduction estimates for each site.

Table F-119: PPL Verified Demand Reductions – SWE Audit Sample

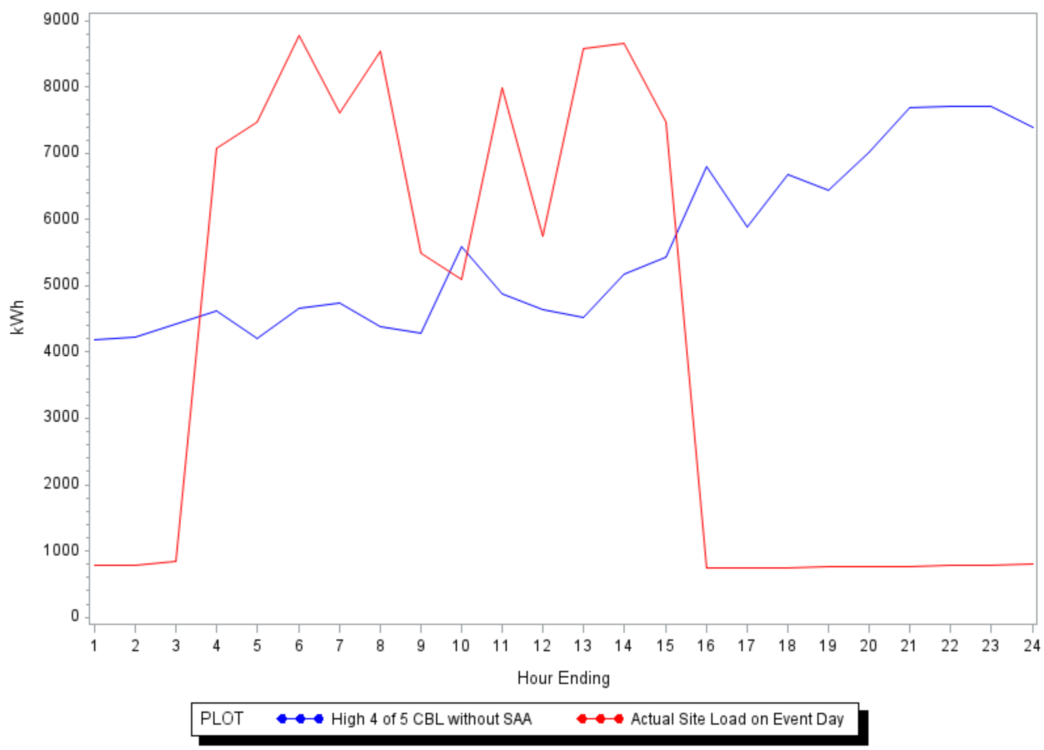
Unique ID	CBL Method	Sum of PPL kWh	Sum of SWE kWh	SWE Site-Level

[583] ibid.
[584] ibid.

		Savings Estimates	Savings Estimates	Realization Rate Estimate
PPL0014810274	Standard 3-day type	472,517	447,461	94.7%
PPL2120053001	Standard 3-day type with SAA	800,591	792,851	99.0%
PPL2140053007	Standard 3-day type	926,710	921,634	99.5%
PPL2259028005	Standard 3-day type	798,381	797,355	99.9%
PPL6372715043	Standard 3-day type	289,730	287,062	99.1%
Total		**3,287,929**	**3,246,363**	**98.7%**

Notice in Table F-119 that the SWE savings estimate for each of the five sites is lower than the PPL savings estimate. These differences are the result of a difference in the interpretation of the “PJM business rules” called for in the TRM. A detailed comparison of the SWE and PPL load reduction calculations revealed that customer baselines were determined in an identical manner. However, during any five-minute interval[585] where the metered consumption in the facility was greater than the CBL, PPL zeroed out the load impact estimate rather than counting a negative load reduction (a demand increase) for the site. Figure F-50 shows the situation for one customer.

Figure F-50: SWE Load Reduction Calculations – Site PPL0014810274 - August 8, 2012



585 PPL provided interval load data consisting of a demand reading (kW) every five minutes.

Customer PPL0014810274 was dispatched to curtail load from 2:00 p.m. (Hour Ending 15) to 7:00 p.m. (Hour Ending 19) on August 8. Notice in Figure F-50 how the load in the facility on the event day (red line) is actually higher than the CBL (blue line) during Hour Ending 15. Under PPL's interpretation of PJM business rules, a zero kW load reduction is assessed for the site for Hour Ending 15 rather than the -2,032.2 kW difference between the load on the event day and the CBL.

The PJM Operating Agreement states that "For purposes of load reductions qualifying for compensation hereunder, an Economic Load Response Participant shall accumulate credits for energy reductions in those hours when the energy delivered to the end-use customer is less than the end-use customer's Customer Baseline Load at the corresponding hourly rate. In the event the end-use customer's hourly energy consumption is greater than the Customer Baseline Load, the Economic Load Response Participant will accumulate debits at the corresponding hourly rate for the amount that the end-use customer's hourly energy consumption is greater than the Customer Baseline Load."[586] The SWE believes that the underlined portion of this passage makes clear that load impacts, both positive and negative, are to be quantified under PJM business rules.

Further, the SWE believes it is important to include these negative load reductions in the assessment of program impacts in order to cancel out "noise" in the data. The calculation of a CBL is not an exact science. Even if no curtailment were to take place in a facility, the SWE would expect the CBL to marginally over- and underestimate load in the facility due to natural variations in customer behavior. To attribute this "noise" to the program when the load is below the CBL and dismiss it when load is above the CBL produces a biased estimate of program impacts.

The SWE understands that the PPL LC program is structured somewhat differently from the PJM DR markets with regard to customer incentives. Because of this, PJM business rules may not always be a perfect solution. However, the 2012 TRM was clear that PJM business rules were to be followed in assessing the Act 129 impacts from LC programs, and the SWE is not at liberty to authorize a departure from TRM protocols. PPL's reporting shows that its alternative method of calculating savings increased the impacts of the program by 15.66 MW, from 118.20 MW to 133.86 MW. However, the SWE believes that 118.20 MW is more appropriate for assessing PPL's compliance with its Phase I peak demand reduction target of 297 MW.

F.6.4 Met-Ed

This section contains details on the SWE's audit of Met-Ed's PY4 DR programs.

F.6.4.1 Residential

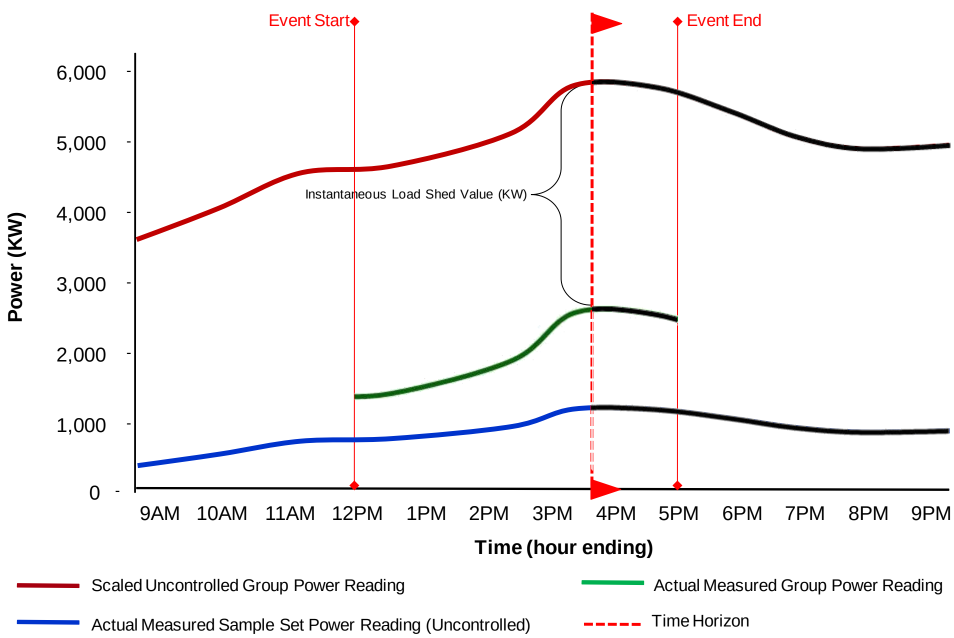
Met-Ed implemented a residential demand response program known as the Integrated Distributed Energy Resources Program, or IDER, in an effort to help reach its Phase I demand reduction goal of 119 MW. The estimate for gross verified savings of the residential demand reduction program was 8.9 MW,

[586] *Amended and Restated Operating Agreement of the PJM Interconnection, L.L.C.,* p..319; www.pjm.com/~/media/documents/agreements/oa.ashx.

or just over 7% of the total Phase I demand reduction goal. Met-Ed contracted with a project implementer to install direct load control equipment on the participant homes and a subsequent comparison of the controlled group versus the non-controlled group provided a benchmark kW savings to be applied across the participant selection.

Participants had the option of selecting to allow either a 4 degree or 6 degree rise in space temperature during an event, when the rise in temperature is successfully completed, control is returned to the participant through the direct load controller and event information is logged via current transformers. The instantaneous demand reduction as compared to the uncontrolled baseline group is shown graphically here:

Figure F-51: Met-Ed Residential DR Load Shed



The evaluation contractor was provided detailed audit information for each event showing the exact number of participants and measured kW reduction compared with that of the uncontrolled baseline group. This information did not match the original data provided by FirstEnergy, which was inaccurate in terms of the number of participants in the program. A review of a sample event audit was performed by the SWE and confirmed with the evaluation contractor as being accurate in its approach.

F.6.4.2 Non-Residential

In its PY4 annual report, Met-Ed estimated 53.61 MW of gross reported peak demand reduction across the top 100 hours of 2012 from its C&I LC program. This estimate represents approximately 45% of Met-Ed's Phase I peak demand reduction target of 119 MW. The evaluation contractor calculated a realization rate of 96%, providing the EDC with an associated verified savings of 51.20 MW.

The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[587] In order to verify that CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in Met-Ed's LC program. The requested items were:

- The claimed peak load reduction for each hour that the site participated in a Met-Ed curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the Met-Ed program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[588]
- The evaluation contractor's verification calculations and notes.

Separate analyses conducted by the EDC, the evaluation contractor, and the SWE revealed several differences in savings calculations. The discrepancies are summarized in Table F-120 and discussed in more detail below.

Table F-120: Met-Ed Savings Calculations for ItsFour Largest Customers

Site		Savings Reported by Utility	Savings Calculated by Evaluation Contractor	Savings Calculated by Statewide Evaluator
ME-0002004192	Savings (MW):	388.96	289.01	340.89
	CBL Type:	3-day type + SAA	3-day type + SAA	3-day type + SAA
	Event Hours:	58	60	58
ME-0002004193	Savings (MW):	213.11	203.66	209.72
	CBL Type:	3-day type	3-day type + SAA	3-day type + SAA
	Event Hours:	79	88	79
ME-0002206565	Savings (MW):	1,225.38	1,294.15	1,199.96
	CBL Type:	3-day type + SAA	3-day type + SAA	3-day type
	Event Hours:	64	56	64
ME-0002334693	Savings (MW):	437.76	311.33	344.33
	CBL Type:	3-day type + SAA	3-day type + SAA	Custom

587 2012 PA TRM, p. 302.
588 ibid.

	Event Hours:	96	98	98

Overall, there were inconsistencies in how many event hours were evaluated. Thorough review of supplied documents revealed that the EDC discounted all event hours producing negative savings by zeroing them out. The additional hours shown by the evaluation contractor all had negative savings associated with them. For example, in ME-0002004193 the EDC included only 79 hours whereas the evaluation contractor included 88. Over the 9 omitted hours, the evaluation contractor showed a demand increase of 7.515 MW over the calculated baseline. The inclusion of negative load reduction by the evaluation contractor helps cancel out “noise” in the data that occurs due to natural variations in customer behavior. To attribute this “noise” to the program when the load is below the baseline and to dismiss it when load is above the baseline produces a biased estimate of program impacts. The SWE believes that the rectification of this by the evaluation contractor provides a more accurate estimate of program impacts during the top 100 hours.

Event hours were also affected by the introduction of the voluntary reduction program. Customers often began to reduce load prior to the beginning of an event, and ramped load back up gradually at the conclusion of the event. The EDC included these supplemental reductions in its impact analyses for all hours included in the top 100 hours. Using this approach provided the EDC with load reductions during the top 100 hours where events were not specifically called, and affected the calculation of the SAA for the customers who used this CBL method. However, as the EDC paid the customers for these reductions, the SWE is comfortable with their inclusion in the savings calculations.

Other differences arose from the use of on-site generation, as can be seen in ME-0002334693. Review of files from both the EDC and evaluation contractor revealed that on-site generation was being used on non-event days as well as event days, which had not been taken into account in the EDC’s baseline calculations. The evaluation contractor made note of this and adjusted the calculations accordingly.

Despite the differences noted, the SWE believes that the analyses performed by the evaluation contractor represent the most accurate savings for the end-use customer. All deviations from expected values and methodologies were well documented and are agreeable to the SWE. The realization rate of 96% is readily accepted by the SWE.

F.6.5 Penelec

This section contains details on the SWE’s audit of Penelec’s PY4 DR programs.

F.6.5.1 Residential (Penelec and Penn Power)

Penelec and Penn Power implemented identical residential DLC programs in an effort to meet their respective Phase I demand reduction targets of 108 MW and 44 MW. Given that the two EDCs used the same implementation contractor, equipment, and program management, they are discussed together here.

This approach to DLC used two methods of controlling participants' compressors, either a radio signaled thermostat or an installed switch on the central air conditioner, as explained in a SWE Guidance Memo referencing PJM Manual 19: "Curtailment Service Providers with Direct Load Control programs which employ a radio signal may elect to either submit a load research study supporting base per-participant impacts for their program, or utilize the base per-participant impacts contained in the 'Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region report."[589]

Over the course of 22 event days for Penelec and 27 for Penn Power, devices were controlled in compliance with Act 129 DLC and LC guidelines. The EDC and its evaluator used deemed savings estimates from PJM Manual 19, Attachment B, for both Penelec and Penn Power participants, stratified into equipment groups based on whether the controlled unit totaled less than or more than 3.5 kW connected load. Units were provided various duty cycle options, but most typically ranged between 50% and 70%, which allowed the EDC to control units for 30 minutes per hour or less during an event.

Upon final review of the event tracking database, the total verified savings from Penelec's residential demand reduction was 5.92 MW, or 5% of its Phase I target. Penn Power's total verified savings from residential demand reduction was 1.15 MW, or just under 3% of its Phase I target

[589] PJM, Manual 19: Load Forecasting and Analysis, Attachment B: Direct Load Control Load Research Guidelines.

F.6.5.2 Non Residential

In its PY4 annual report, Penelec estimated 62.83 MW of gross reported peak demand reduction across the top 100 hours of from its C&I LC program. This estimate represents approximately 58% of Penelec's Phase I peak demand reduction target of 108 MW. The evaluation contractor calculated a realization rate of 87%, providing the EDC with an associated verified savings of 54.39 MW.

The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[590] In order to verify that CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in Penelec's LC program. The requested items were:

- The claimed peak load reduction for each hour that the site participated in a Penelec curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the Penelec program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[591]
- The evaluation contractor's verification calculations and notes.

[590] 2012 PA TRM, p. 302.
[591] ibid.

Separate analyses conducted by the EDC, the evaluation contractor, and the SWE revealed several differences in savings calculations. The discrepancies are summarized in Table F-121 and discussed in more detail below.

Table F-121: Penelec Savings Calculations for Its Five Largest Customers

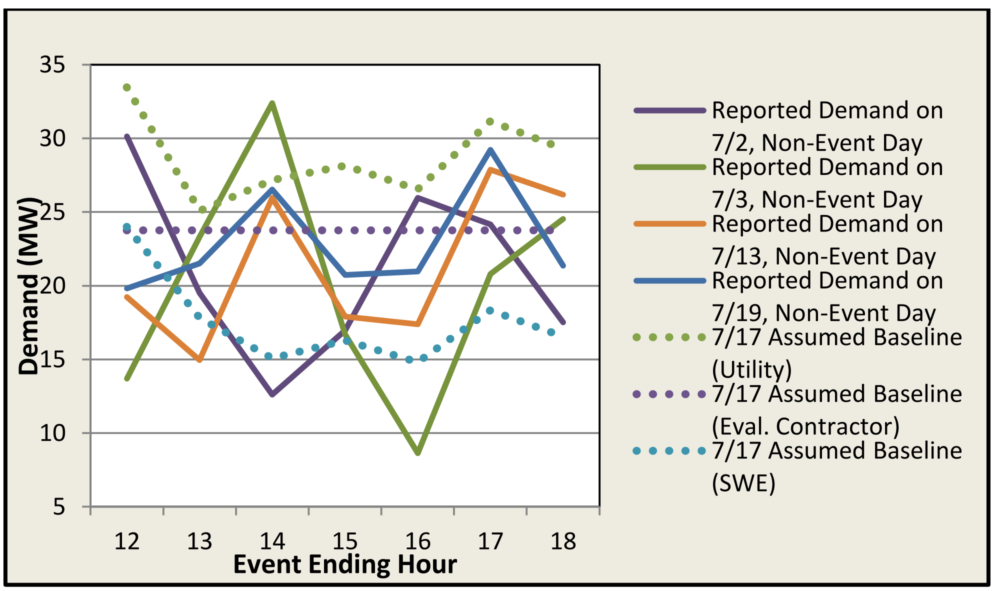
Site		Savings Reported by Utility	Savings Calculated by Evaluation Contractor	Savings Calculated by Statewide Evaluator
PN-0001108065	Savings (MW):	304.66	164.11	84.37
	CBL Type:	3-day type + SAA	ADM Custom (3/2)	3-day type + SAA
	Event Hours:	38	57	38
PN-0001197598	Savings (MW):	682.94	683.57	329.44
	CBL Type:	3-day type + SAA	3-day type + SAA	Custom
	Event Hours:	100	100	100
PN-0001395167	Savings (MW):	287.91	287.90	295.40
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	69	65	69
PN-0003099027	Savings (MW):	233.75	200.66	234.26
	CBL Type:	3-day type + SAA	3-day type + SAA	3-day type + SAA
	Event Hours:	84	81	84
PN-0005770076	Savings (MW):	974.25	994.58	900.56
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	78	91	78

Overall, there were inconsistencies in how many event hours were evaluated. Thorough review of supplied documents revealed that the EDC discounted all event hours producing negative savings by zeroing them out. The additional hours shown by the evaluation contractor all had negative savings associated with them. For example, in PN-0001108065 the EDC only included 38 hours whereas the evaluation contractor included 57. Over the 19 omitted hours, the evaluation contractor showed a demand increase of 117.378 MW over the calculated baseline. The inclusion of negative load reduction by the evaluation contractor helps cancel out “noise” in the data that occurs due to natural variations in customer behavior. To attribute this “noise” to the program when the load is below the baseline and to dismiss it when load is above the baseline produces a biased estimate of program impacts. The SWE believes that the rectification of this by the evaluation contractor provides a more accurate estimate of program impacts during the top 100 hours.

Event hours were also affected by the introduction of the voluntary reduction program. Customers often began to reduce load prior to the beginning of an event, and ramped load back up gradually at the conclusion of the event. The EDC included these supplemental reductions in its impact analyses for all hours included in the top 100 hours. Using this approach provided the EDC with load reductions during the top 100 hours where events were not specifically called, and affected the calculation of the SAA for the customers who used this CBL method. However, as the EDC paid the customers for these reductions, the SWE is comfortable with their inclusion in the savings calculations.

Other discrepancies arose in the selection of a customer baseline. The Operating Agreement of PJM Interconnection allows for selection of an alternative customer baseline methodology in the event that the standard calculated baseline does not accurately reflect the end-use customer's consumption pattern. Per the Operating Agreement, the alternative customer baseline is to be agreed on between the customer and PJM at the time of registration. One departure was found from this caveat as the evaluation contractor used a custom baseline for analysis of PN-0001108065. Figure F-52 shows the customer's demand on several non-event days as well as the unique baselines calculated by the EDC, the evaluation contractor, and the SWE.

Figure F-52: Reported Demand and Assumed Baselines for PN-0001108065



To demonstrate confidence in its selection of custom baselines, the evaluation contractor furnished baseline calculations for multiple methodologies for each customer as well as relative root mean square error (RRMSE) calculations for each method. These calculations were accomplished by performing the same baseline calculations for all non-event days throughout the summer as if there were events called. The error was then calculated between these mock baselines and the actual load on those days, to establish a confidence factor for each baseline methodology. The evaluation contractor then selected the baseline that provided the least amount of error. Table F-122 shows the results of this analysis for PN-0001108065. Notice that the evaluation contractor chose to use the baseline method that produced the least error (ADM Custom 3/2 method) rather than the method producing the highest savings (3-day type). The SWE is confident that this analysis by the evaluation contractor was unbiased and produced the most realistic baseline for this end-user's volatile load pattern.

Table F-122: Savings vs. RRMSE Calculations for PN-0001108065

Baseline Methodology	Calculated Event Hour Savings (kWh)	Average Baseline Usage Over Non-Event Hours (kWh)	Reported Average Usage Over Non-Event Hours (kWh)	RRMSE
3-Day	350,130	9,471	18,077	52.40%
3-Day (SAA)	82,540	8,475		46.90%
Non-Event Hrs.	164,106	7,112		39.30%
ADM (3/2)	**158,079**	**6,910**		**38.20%**
Custom	259,940	8,246		45.60%

Despite the differences noted, the SWE believes that the analyses performed by the evaluation contractor represent the most accurate savings for the end-use customer. All deviations from expected values and methodologies were well documented and are agreeable to the SWE. The realization rate of 87% is readily accepted by the SWE.

F.6.6 Penn Power

This section contains details on the SWE's audit of Penn Power's PY4 DR programs.

F.6.6.1 Residential

Penelec and Penn Power implemented duplicate direct load control programs. See Appendix F.6.5.1 for details on the SWE audit of Penn Power's direct load control program.

F.6.6.2 Non-Residential

In its PY4 annual report, Penn Power estimated 25.56 MW of gross reported peak demand reduction across the top 100 hours of 2012 from its C&I LC program. This estimate represents almost 58% of Penn Power's Phase I peak demand reduction target of 44 MW. The evaluation contractor calculated a realization rate of 106%, providing the EDC with an associated verified savings of 27.00 MW.

The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[592] In order to verify that CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in Penn Power's LC program. The requested items were:

[592] 2012 PA TRM, p. 302.

- The claimed peak load reduction for each hour that the site participated in a Penn Power curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the Penn Power program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[593].
- The evaluation contractor's verification calculations and notes.

Separate analyses conducted by the EDC, the evaluation contractor, and the SWE revealed several differences in savings calculations. The discrepancies are summarized in Table F-123 and discussed in more detail below.

Table F-123: Penn Power Savings Calculations for Its Five Largest Customers

Site		Savings Reported by Utility	Savings Calculated by Evaluation Contractor	Savings Calculated by Statewide Evaluator
PP-0000000342	Savings (MW):	45.69	32.37	30.34
	CBL Type:	3-day type + SAA	ADM Custom (3/2)	3-day type + SAA
	Event Hours:	41	77	41
PP-0000000371	Savings (MW):	609.98	682.78	441.37
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	57	86	57
PP-0000060450	Savings (MW):	1,398.99	967.32	1244.40
	CBL Type:	3-day type	ADM Custom (3/2)	3-day type
	Event Hours:	67	65	67
PP-0000060452	Savings (MW):	74.17	74.04	60.20
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	39	67	39
PP-0000000335	Savings (MW):	28.73	18.78	27.06
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	27	24	27

Overall, there were inconsistencies in how many event hours were evaluated. Thorough review of supplied documents revealed that the EDC discounted all event hours producing negative savings by

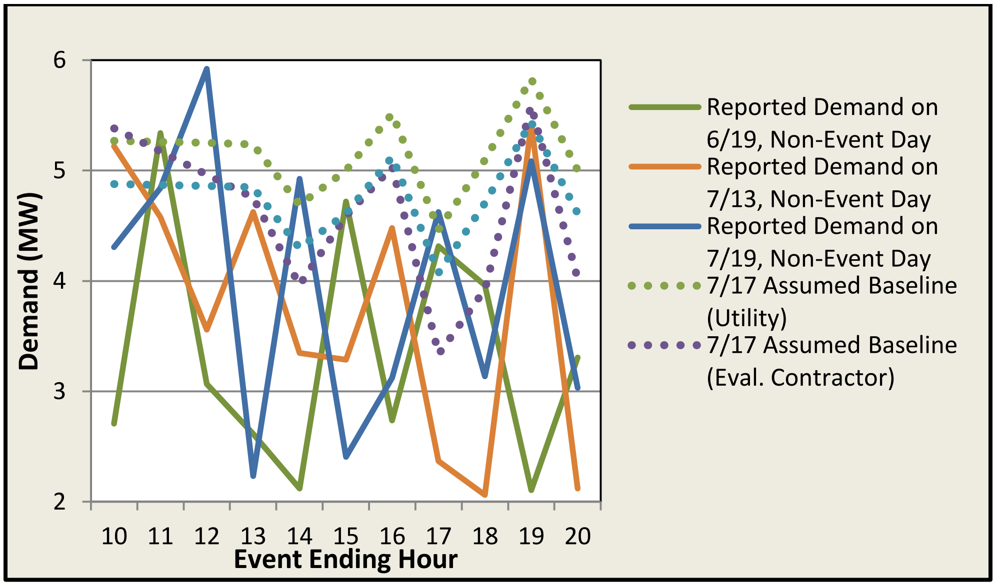
[593] ibid.

zeroing them out. The additional hours shown by the evaluation contractor all had negative savings associated with them. For example, in PP-0000000342 the EDC included only 41 hours whereas the evaluation contractor included 77. Over the 36 omitted hours, the evaluation contractor showed a demand increase of 21.885 MW over the calculated baseline. Inclusion of negative load reduction by the evaluation contractor helps cancel out "noise" in the data that occurs due to natural variations in customer behavior. To attribute this "noise" to the program when the load is below the baseline and to dismiss it when load is above the baseline produces a biased estimate of program impacts. The SWE believes that the rectification of this by the evaluation contractor provides a more accurate estimate of program impacts during the top 100 hours.

Event hours were also affected by the introduction of the voluntary reduction program. Customers often began to reduce load prior to the beginning of an event, and ramped load back up gradually at the conclusion of the event. The EDC included these supplemental reductions in its impact analyses for all hours included in the top 100 hours. Using this approach provided the EDC with load reductions during the top 100 hours where events were not specifically called, and affected the calculation of the SAA for the customers who used this CBL method. However, as the EDC paid the customers for these reductions, the SWE is comfortable with their inclusion in the savings calculations.

Other discrepancies arose in the selection of a customer baseline. The Operating Agreement of PJM Interconnection allows for selection of an alternative customer baseline methodology in the event that the standard calculated baseline does not accurately reflect the end-use customer's consumption pattern. Per the Operating Agreement, the alternative customer baseline is to be agreed on between the customer and PJM at the time of registration. Two departures were found from this caveat where the evaluation contractor used custom baselines for analyses, as can be seen in PP-0000000342. Figure F-53 shows the customer's demand on several non-event days as well as the unique baselines calculated by the EDC, the evaluation contractor, and the SWE.

Figure F-53: Reported Demand and Assumed Baselines for PP-0000000342



The SWE is confident that the baseline proposed by the evaluation contractor was calculated without bias and presents the most realistic savings for this end-user's volatile load pattern.

Despite the differences noted, the SWE believes that the analyses performed by the evaluation contractor represent the most accurate savings for the end-use customer. All deviations from expected values and methodologies were well documented and are agreeable to the SWE. The realization rate of 106% is readily accepted by the SWE.

F.6.7 West Penn Power

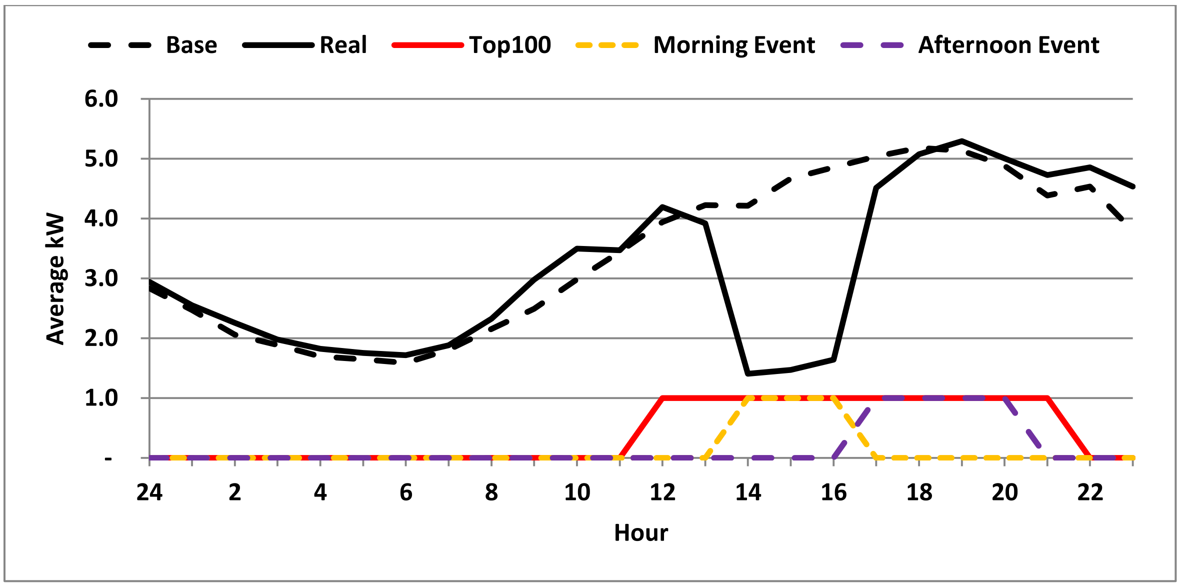
This section contains details on the SWE's audit of West Penn Power's PY4 DR programs.

F.6.7.1 Residential

West Penn implemented the Critical Peak Rebate Program, marketed as the Energy Savers Reward Program, in an effort to help meet its Phase I demand reduction target of 157 MW by May 31, 2013. The estimate for gross verified savings for this residential DR program was 5.16 MW during the top 100 hours.

The program divided participants into one of eight groups based on how a participant wanted to save energy. Stratification of the groups was based on distinct variables, including time of day (a.m. or p.m.), concentration on air conditioning (A/C) to reduce energy consumption, and the presence of in-home technology. Participants were notified prior to an individual event and were requested to reduce energy consumption according to their group; i.e., if a participant was in the group focused on air conditioning in the morning, then the participant would limit A/C usage for the appropriate time period as much as possible. Figure F- 40 shows demand in the morning air-conditioning group.

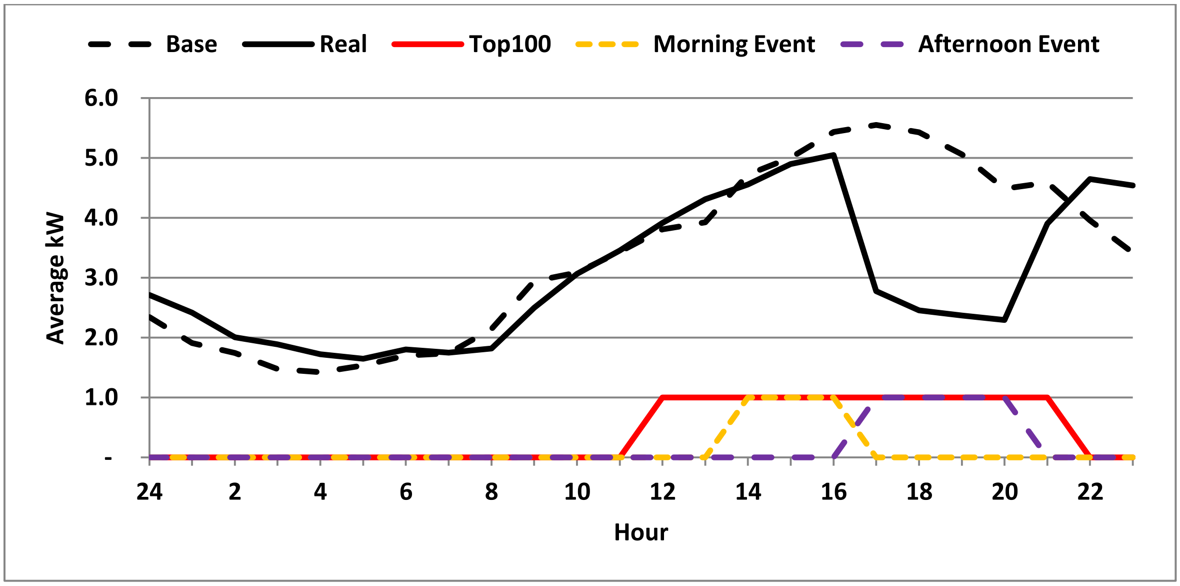
Figure F-54: Demand in West Penn Power Group DR11 – 7.17.12



The dashed black line in the graph above shows the baseline scenario as calculated in the absence of the Act 129 targets. The solid black line shows the measured reduction in energy for the sample group DR11.The solid red line shows the top 100 hour timeframe . The yellow "morning event" and purple "afternoon event" refer to the two different groups being called on the same event day, in this case July 17, 2012.

Figure F-41 shows how the graph shifted for sample group DR13, which limited air conditioning in the afternoon.

Figure F-55: Demand in West Penn Power Group DR13 – 7.17.12



A total of 23,573 participants were included in the program, all of whom had smart meter capability. The evaluation contractor selected a sample size of 250 participants to conduct ex-post savings estimates and dissemination of data, as the program implementer did not distinguish between total program duration and the top 100 hours of the summer. As this program was centered on voluntary participant behavior, it provided no direct load interruption from a single source and thus there was no operability adjustment. The SWE believes that the analyses performed by the evaluation contractor provide the most accurate representation of the savings for the end-use customer.

F.6.7.2 Non-Residential

In its PY4 annual report, West Penn Power estimated 94.02 MW of gross reported peak demand reduction across the top 100 hours from its C&I LC program. This estimate represents approximately 60% of West Penn Power's Phase I peak demand reduction target of 157 MW. The evaluation contractor calculated a realization rate of a fraction under 100%, providing the EDC with an associated verified savings of 93.60 MW.

The 2012 PA TRM states that "Hourly peak load reductions from demand response (DR) measures for Direct Load Control (DLC) and Load Curtailment (LC) will be determined in accordance with PJM measurement & verification protocols, related business rules, protocol approval processes and settlement clearing due diligence practices."[594] In order to verify that CBL and the associated load impacts were calculated as specified in the TRM, the SWE requested detailed customer information for five of the largest customers in West Penn Power's LC program. The requested items were:

[594] 2012 PA TRM, p. 302.

- The claimed peak load reduction for each hour that the site participated in a West Penn Power curtailment event.
- Interval load data from June 1, 2012 to September 30, 2012, as well as any additional interval load data used to determine the CBL.
- The CBL method used to estimate the load that would have been observed in the facility absent intervention from the West Penn Power program.
- PJM event dates and hours excluded from the CBL calculation as allowed by the TRM.[595].
- The evaluation contractor's verification calculations and notes.

Separate analyses conducted by the EDC, the evaluation contractor, and the SWE revealed several differences in savings calculations. The discrepancies are summarized in Table F-124 and discussed in more detail below.

Table F-124: West Penn Power Savings Calculations for Its Five Largest Customers

Site		Savings Reported by Utility	Savings Calculated by Evaluation Contractor	Savings Calculated by Statewide Evaluator
WP-0006637924	Savings (MW):	413.13	419.36	372.66
	CBL Type:	3-day type	3-day type	3-day type
	Event Hours:	91	91	91
WP-0006983009	Savings (MW):	4,559.13	4,045.29	3,379.05
	CBL Type:	Custom	ADM Cust. (3/2)	Custom
	Event Hours:	79	73	82
WP-0007272276	Savings (MW):	779.51	644.23	471.82
	CBL Type:	3-day type	ADM Cust. (3/2)	Custom
	Event Hours:	44	63	40
WP-0007128684	Savings (MW):	224.81	227.22	154.27
	CBL Type:	3-day type + SAA	ADM Cust. (168)	3-day type
	Event Hours:	103	54	55
WP-0007176309	Savings (MW):	242.73	522.56	251.61
	CBL Type:	3-day type + SAA	3-day type	3-day type + SAA
	Event Hours:	63	72	63

Overall, there were inconsistencies in how many event hours were evaluated. Thorough review of supplied documents revealed that the EDC discounted all event hours producing negative savings by

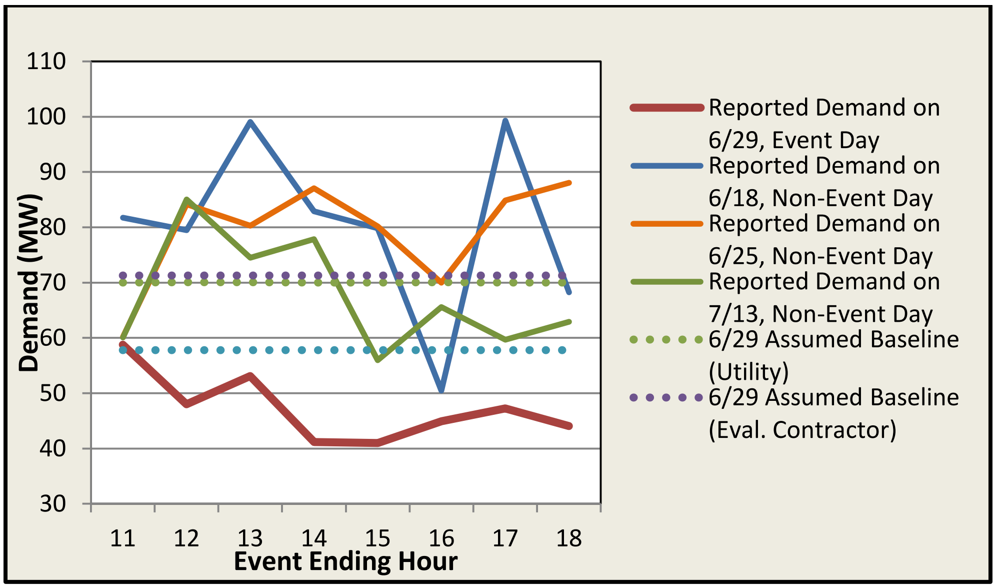
[595] ibid.

zeroing them out. The additional hours shown by the evaluation contractor all had negative savings associated with them. For example, in WP-0007272276 the EDC included only 44 hours whereas the evaluation contractor included 63. Over the 19 omitted hours, the evaluation contractor showed a demand increase of 117.552 MW over the calculated baseline. Inclusion of negative load reduction by the evaluation contractor helps cancel out “noise” in the data that occurs due to natural variations in customer behavior. To attribute this “noise” to the program when the load is below the baseline and to dismiss it when load is above the baseline produces a biased estimate of program impacts. The SWE believes that the rectification of this by the evaluation contractor provides a more accurate estimate of program impacts during the top 100 hours.

Event hours were also affected by the introduction of the voluntary reduction program. Customers often began to reduce load prior to the beginning of an event, and ramped load back up gradually at the conclusion of the event. The EDC included these supplemental reductions in its impact analyses for all hours included in the top 100 hours. Using this approach provided the EDC with load reductions during the top 100 hours where events were not specifically called, and affected the calculation of the SAA for the customers who used this CBL method. However, as the EDC paid the customers for these reductions, the SWE is comfortable with their inclusion in the savings calculations.

Other discrepancies arose in the selection of a customer baseline. The Operating Agreement of PJM Interconnection allows for selection of an alternative customer baseline methodology in the event that the standard calculated baseline does not accurately reflect the end-use customer's consumption pattern. Per the Operating Agreement, the alternative customer baseline is to be agreed on between the customer and PJM at the time of registration. Three departures were found from this caveat where the evaluation contractor used custom baselines for analyses, as can be seen in WP-0007272276. Figure F-56 shows the customer's demand on several non-event days as well as the unique baselines calculated by the EDC, the evaluation contractor, and the SWE.

Figure F-56: Reported Demand and Assumed Baselines for WP-0007272276



The SWE is confident that the baseline proposed by the evaluation contractor was calculated without bias and presents the most realistic savings for this end-user's volatile load pattern.

Despite the differences noted, the SWE believes that the analyses performed by the evaluation contractor represent the most accurate savings for the end-use customer. All deviations from expected values and methodologies were well documented and are agreeable to the SWE. The realization rate of 100% is readily accepted by the SWE.

F.7 Audit Activity Detail: Total Resource Cost Test

The following sections discuss the SWE audit of each EDC's TRC test model for PY4.

F.7.1 Duquesne

Table F-125 summarizes the TRC benefit-cost ratios for Duquesne's PY4 portfolio and individual programs. The PY4 portfolio total is noted at the top of the table. For reporting purposes, Duquesne incorporated demand response (DR) costs and impacts into each customer's appropriate sector.

Table F-125: Duquesne PY4 Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
Duquesne PY4 Total	**$140,269,000**	**$48,029,000**	**2.9**
Residential Energy Efficiency	$21,686,000	$6,473,000	3.4
Residential School Energy Pledge	$276,000	$90,000	3.1
Residential Appliance Recycling	$2,835,000	$1,276,000	2.2
Residential Low-Income EE	$5,846,000	$2,209,000	2.6
Commercial Sector Umbrella	$14,344,000	$913,000	15.7
Office Buildings, Small	$3,603,000	$1,549,000	2.3
Office Buildings, Large	$26,992,000	$7,861,000	3.4
Retail Stores	$13,559,000	$5,705,000	2.4
Public Agency/Non-Profit/Edu.	$18,263,000	$8,383,000	2.2
Healthcare	$9,358,000	$3,308,000	2.8
Industrial Sector Umbrella	$50,000	$55,000	0.9
Mixed Industrial	$9,257,000	$2,703,000	3.5
Chemicals	$2,816,000	$1,031,000	2.8
Primary Metals	$10,726,000	$4,606,000	2.4
Residential Demand Response	$6,000	$1,101,000	0.0
Large Curtailable Demand Response	$149,000	$763,000	0.2

*For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.

F.7.1.1 Assumptions and Inputs

The Duquesne TRC model was the most granular of the TRC models reviewed by the SWE Team for PY4. The SWE was able to verify the savings and other measure attributes at the program level for all measures with ease. All inputs were found to be transparent and applied correctly.

In Duquesne's model, costs and benefits were calculated at the measure level for each record in the project management reporting system (PMRS) database, Duquesne's data tracking and reporting system. Administrative costs were allocated to each measure, and costs and benefits were then aggregated before calculating the TRC ratio. Duquesne used a weighted average cost of capital, or discount rate, of 6.90% to discount program benefits and costs. This rate was used to compare the net present value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Discount rates varied among the EDCs, with Duquesne using the lowest rate of any of the EDCs in PY4 TRC calculations. Accordingly, Duquesne presented the highest TRC ratios of all of the EDCs in PY4. However, Duquesne also used the lowest line loss factor (LLF), only 6.9%, for both energy and demand calculations. This was offset by comparatively low administrative costs and high avoided energy values.

An effective useful life (EUL) was assigned to each measure in Duquesne's TRC model. Most measure lives used in the model were able to be verified in the 2012 TRM, using both Appendix A and the measure-specific sections. The TRC model assigned measure lives for measures not specified in the TRM, but a reference source was not provided. The SWE Team examined several of these values and found them to be reasonable, but it requests that Duquesne provide some insight into how these values were determined.

Incremental costs were also applied at the measure level in Duquesne's TRC model. The measure unit cost of the base case was subtracted from the measure unit cost of the efficient case, to return an incremental cost per unit of the measure. The Duquesne TRC model contained several tabs that provided these incremental cost calculations. Sources were cited for all measure costs, most of which came directly from either the TRM or project invoices, with supplemental data from the California Database for Energy Efficient Resources (DEER) and private cost studies when otherwise unavailable.

The energy and demand impacts used in the TRC analysis were drawn from the PMRS tracking database, which used TRM-specified values and equations to assign ex-ante annual savings values to completed measures. The TRC analysis was based on ex-post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts. The industrial realization rates were applied to the Industrial Umbrella, Mixed Industrial, Primary Metals, and Chemical Products programs, and the commercial realization rates were applied to the other non-residential programs in Duquesne's portfolio.

F.7.1.2 Avoided Costs of Energy

Duquesne's TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2009 through 2023 under four different load conditions: summer on-peak, summer off-peak, winter on-peak, and winter off-peak. Each measure in Duquesne's portfolio is assigned to an end-use load shape most correlated with the affected equipment. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The use of specific end-use load shapes makes the TRC findings more realistic because measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods. The avoided costs, however, need to be updated annually so as not to be summing avoided energy benefits accrued in the past (i.e., since PY4 is for projects completed in 2012–2013, the avoided cost of energy table should be for years 2012 through 2026.)

F.7.1.3 Avoided Cost of Capacity

Duquesne's TRC model did not assign a separate value ($/kW) to the cost of adding generation capacity. Avoided costs of capacity were included in the avoided energy costs and were based on PJM reliable pricing model (RPM) auction prices. This was converted to cost per unit of energy saved based on

Duquesne's system load factor. Consequently, the demand savings attributed to a measure were not used in the cost-effectiveness calculations. Separate avoided cost of capacity assumptions and calculations were detailed specifically for Duquesne's DR programs. The assumptions were based off the PJM base residual auction results and the State of Market report for peak hours. The assumed value was multiplied by the ex-post demand savings for each project within the DR programs to determine the benefits incurred by the EDC from not having to expand capacity.

F.7.1.4 Conclusions and Recommendations

The Duquesne TRC model was very transparent, and all inputs were well documented and consistent with other documentation provided to the SWE for review. All previous recommendations were addressed in this year's TRC model. Moving forward, however, the SWE recommends that the avoided cost tables be updated to correspond to the current program year and the 15 subsequent years of savings.

F.7.2 PECO

Table F-126 summarizes the TRC benefit-cost ratios for PECO's PY4 portfolio and individual programs.The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with DR programs and conservation voltage reduction programs.

Table F-126: PECO PY4 Benefit-Cost Ratios Based on Verified Savings

	Avoided Cost	TRC Cost*	TRC
PECO PY4 Total	**$217,320,000**	**$211,732,000**	**1.0**
EE Programs Only	**$208,202,000**	**$128,275,000**	**1.6**
Smart Lighting Discounts	$13,147,000	$2,897,000	4.8
Smart Appliance Recycling	$2,810,000	$823,000	3.4
Smart Home Rebates	$15,292,000	$20,236,000	0.8
Low-Income EE Program	$20,099,000	$5,323,000	3.9
Smart Equipment Incentives - C&I	$75,909,000	$42,181,000	1.8
Smart Construction Incentives	$9,165,000	$4,670,000	2.0
Smart Equipment Incentives - GNI	$71,780,000	$52,145,000	1.4
Conservation Voltage Reduction	$0	$310,000	0.0
Residential Load Control	$2,618,000	$53,269,000	0.0
Commercial Direct Load Control	$82,000	$5,820,000	0.0
Permanent Load Reduction	$221,000	$2,694,000	0.1
Demand Response Aggregators	$5,409,000	$17,699,000	0.3
Distributed Energy Resources	$788,000	$3,665,000	0.2

*For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.

F.7.2.1 Assumptions and Inputs

Two TRC workbooks were submitted to the SWE for review, one using TRM verified savings data and the other using EDC proposed verified savings data. The workbooks functioned identically but used two different sets of savings inputs. The results of the two workbooks were the same across all programs, excluding the Smart Lighting Discounts and Low-Income Energy Efficiency programs, both of which saw higher TRC ratios using the EDC proposed verified savings than the TRM verified savings.

PECO updated the format of its TRC model this year to a more concise layout. Each workbook contained the following tabs:

- **Summary** – displays savings, benefits, costs, and TRC ratios per program
- **Assumptions** – details line losses and discount rate
- **Admin Costs** – summarizes the TRC costs at the program level
- **Avoided Costs** – calculates the avoided costs of capacity and energy over the next 17 years
- **Loadshapes** – specifies the distribution of run-time hours across the summer and winter on and off peak hours per measure, with sources for this information
- **Measure Data** – specifies the measure-specific assumptions (e.g., measure life and net-to-gross ratios) and calculates the TRC ratios per measure
- **Baseline Incandescent Info** – summarizes costs associated with incandescent lamps and calculates the value of avoided incandescent savings factor of per possible baseline measure

The SWE found this layout easy to understand and was able to verify the savings and other measure attributes at the program level for all measures with ease. The majority of inputs were found to be transparent and applied correctly, with minor exceptions that are further explained throughout this section. Minor curiosities were found in the TRC model with respect to number of units installed. Several line items showed fractions of units being installed where fractions seem counterintuitive (e.g., 5,071.25 traffic lights, 944,353.53 T8 lamps). The SWE requests clarification regarding the units being counted in these cases.

PECO’s TRC model used a weighted average cost of capital, or discount rate, of 7.60% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure’s lifetime to the upfront costs of installation and implementation. A variable factor called the “value of avoided incandescent” was applied to lighting measures where the efficient technology has a longer effective life than the incumbent technology. For example, in the case of CFLs, the participant will have to replace bulbs less frequently over the effective life of the measure and incur an equipment savings in addition to energy savings. This factor fluctuates given the baseline equipment and was calculated per specific baseline equipment type. An energy LLF of 7.1% was used for all programs, while the LLF for demand varied by sector and ranged from 10.0% to 16.1%.

An EUL was assigned to each measure in the PECO TRC model. Most measures listed in the model had associated measure lives provided in the TRM; however, PECO cited predominantly the PECO database and PECO EE&C plan even for measures that were specified in the TRM. For example, “Door Gaskets” can be found in Section 3.24 of the 2012 TRM, but PECO cited the PECO EE&C plan as the source of their measure life. In this and many instances the documents were consistent, with only one exception found. In PECO's model, the EUL associated with "Beverage Machine Controllers" was listed as 10 years, citing "PECO Database" as the source. Section 3.14 of the 2012 PA TRM deems an EUL of only 5 years for this measure. The SWE recommends that the TRM be used as the primary source for these values where available and that any departures be explained.

Incremental costs were also applied at the measure level in the PECO TRC model. The majority of the values came directly from the SWE cost database and PECO's EE&C plan. All incremental costs were applied correctly and in accordance with cited sources.

The energy and demand impacts used in PECO TRC's analysis were drawn from the tracking database which used TRM specified values and equations to assign ex-ante annual savings values to completed measures. The SWE Team compared the ex-ante impacts used in the TRC model with the PECO PY4 measure-level database extract for several measures and found perfect agreement between the participation counts, energy impacts, and demand impacts. Program impacts were adjusted by an applicable realization rate in the TRC analysis submitted that was based on ex-post verified savings. Realization rates were determined at the program level, and separate realization rates were applied to energy and demand impacts. The ex-post verified savings were extended over the effective measure life and summed, by year, for each program.

F.7.2.2 Avoided Costs of Energy

PECO's TRC model assigned a value ($/kWh) to the avoided cost of energy for each year from 2011 through 2027 under four different load conditions: summer on-peak, summer off-peak, winter on-peak, and winter off-peak. Each measure in PECO's portfolio was assigned to an end-use load shape most correlated with the affected equipment. The energy impacts of a given measure were divided across the four load conditions based on the associated load profile. The impacts under a given load condition were multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The use of specific end-use load shapes made the TRC findings more realistic because measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods. PECO's TRC model also assigned a value ($/kWh) to the avoided cost of transmission and distribution (T&D) for each year from 2011 through 2027. Avoided costs of T&D were applied for each sector: residential, small commercial, and large commercial. A weighted average was calculated for both small commercial and large commercial sectors based on the estimated sales from the SWE market potential study. Avoided T&D costs were escalated at 2% per year from PY 2013, or the start of Phase II. Avoided T&D costs were highest for the residential sector and lowest for the commercial and industrial (C&I) sector. The measure-level ex-post savings impacts were adjusted for line loss and then multiplied by the appropriate avoided energy cost stream to calculate avoided energy benefits.

F.7.2.3 Avoided Cost of Capacity

PECO's TRC model assigns a flat annual figure ($/kW) to the cost of adding generation capacity. A single value is used for the avoided cost of capacity for all programs and sectors. The PECO forecasted avoided costs of capacity figures increase steadily over the next 15 years and are the highest of any EDC for 2022, 2023, and 2024. Ex-post demand savings are adjusted for line loss and multiplied by the avoided capacity estimate to determine the financial benefit of demand impacts.

F.7.2.4 Conclusions and Recommendations

The PECO TRC model was very transparent. Most inputs were well documented and consistent with other documentation provided to the SWE for review, with only minor inconsistencies in the application of measure lives. The SWE recommends that measure life values in the TRM be used as the default values and that any departures from the TRM provide sufficient justification. Otherwise, the SWE Team feels that the PECO TRC model provided adequate detail regarding the determination of financial benefits from energy and demand impacts. Gross energy and demand impacts were consistent with reported figures and database extracts provided to the SWE for review. The use of end-use load shapes to determine on-peak and off-peak energy use by season associates larger avoided cost benefits with measures that reduce consumption during periods of high system load.

F.7.3 PPL

Table F-127 summarizes the TRC benefit-cost ratios for PPL's PY4 portfolio and individual programs. The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with DR programs.

Table F-127: PPL PY4 Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
PPL	**$659,319,000**	**$247,306,000**	**2.7**
EE Programs Only	**$653,376,000**	**$231,562,000**	**2.8**
Appliance Recycling	$20,920,000	$2,458,000	8.5
Custom Incentive	$64,299,000	$41,519,000	1.5
Efficient Equipment Incentive	$357,777,000	$150,293,000	2.4
EE Behavior & Education	$4,128,000	$450,000	9.2
E-Power Wise	$690,000	$117,000	5.9
Home Energy Assesment	$7,706,000	$3,892,000	2.0
HVAC Tune-Up	$126,000	-$27,000	-4.7
Renewable Energy	$816,000	$6,293,000	0.1
Residential Lighting	$188,042,000	$11,518,000	16.3
WRAP	$8,872,000	$7,008,000	1.3
Direct Load Control	$794,000	$7,473,000	0.1
Load Curtailment	$5,149,000	$8,271,000	0.6

*For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.

F.7.3.1 Assumptions and Inputs

PPL used a discount rate of 8.0% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. An energy LLF of 8.33% was used for residential and commercial projects, whereas 4.12% was used for industrial projects. A demand LLF of 4.0% was used for large C&I projects, and 7.7% was used for projects in all other sectors. Energy is lost steadily as it is carried along transmission and distribution lines as well as when voltage is stepped down, so line loss is a function of both line length and the voltage at which a customer is supplied power. Industrial customers are supplied at a higher voltage than commercial and residential customers and thus have less line loss.

An EUL was associated with each measure in PPL's portfolio in order to determine the number of years of savings to attribute to that measure. The SWE Team checked the measure lives in the PPL TRC model against the measure lives called for in Appendix A of the TRM and found no variances. The measure lives applied to custom measures not explicitly stated in the TRM were found to be reasonable, although they were not cited. For example, no measure life was specified in the 2012 TRM for chiller pipe insulation. PPL assigned a measure life of 13 years to this measure. While the SWE finds this value acceptable, the source of the data is unknown and therefore cannot be verified.

Incremental costs were applied at the measure level in PPL's TRC model. In previous years, several different methods were used to assign incremental costs to measures in the model. For Efficient Equipment programs, incremental costs were based on a mixture of engineering calculations and weather-adjusted figures from DEER or ENERGY STAR. The scope of the measures in the C&I Lighting program was larger than estimated in the PPL EE&C plan, so incremental costs were determined through an analysis of the project files and tracking data. Also in previous years, appendixes were provided in the annual report detailing these incremental cost calculations and sources. For PY4, however, the appendix detailing incremental cost was not included in the annual report. The model showed incremental costs per measure, but sources were not cited and calculations (where applicable) were not visible.

The PPL TRC analysis was based on ex-post verified savings, so measure impacts were adjusted by an applicable realization rate. Realization rates were calculated by program, sector, and stratum. Realization rates for demand impacts were calculated separately and were used to adjust the reported demand impacts prior to entering the TRC calculation.

The SWE Team reviewed the participant counts and found the energy impacts and demand impacts used in the PPL model to be consistent with the contents of the measure-level database extracts provided to the SWE for review once the realization rates were applied. Energy and demand impacts in the PPL database were calculated at the meter level, and an LLF was applied before calculating avoided cost benefits.

Due to the number and variety of measures in the C&I Lighting program, cost-effectiveness was modeled at the program level. Participation was determined by the number of distinct combinations of participant and measure. The ex-post savings value for each sector was divided by this participation figure to produce a per-unit figure for the TRC model. As specified in the TRM, a measure life of 15 years was used for the C&I Lighting program.

F.7.3.2 Avoided Costs of Energy

PPL's TRC model assigns a value ($/MWh) to the avoided cost of energy for each hour of each year from 2013 through 2027 for each sector: residential, small commercial, and large commercial. These hourly avoided energy costs are used in combination with a library of 8,760 load shapes to determine the annual avoided cost for each combination of end-use and sector. Each measure in PPL's portfolio is assigned to the end-use load shape most correlated with the affected equipment and the associated avoided cost value. The SWE Team feels that this is an excellent way to determine the actual avoided cost of energy for each measure because it quantifies the value of when a measure saves energy. Measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods.

F.7.3.3 Avoided Cost of Capacity

The PPL model assigns a flat annual cost ($/kW) to the cost of generation capacity for each year from 2013 to 2019. These values are multiplied by the gross demand savings of each measure to estimate the avoided cost of capacity. For 2020 and beyond, the avoided cost of energy in the PPL TRC model are based on the U.S. Energy Information Association (EIA) annual energy outlook forecast and are assumed to include capacity costs. Consequently, measures with lives beyond 2019 do not include a separate estimated avoided cost of capacity for those years.

F.7.3.4 Conclusions and Recommendations

PPL's programs are designed to produce impacts across sectors. However, avoided cost estimates, load profiles, and LLFs vary significantly between the residential and the C&I sectors. This variation was handled expertly in the TRC calculation workbooks, and TRC costs and benefits were calculated for each sector and for each program (across multiple sectors).

F.7.4 Met-Ed

Table F-128 summarizes the TRC benefit-cost ratios for Met-Ed's PY4 portfolio and individual programs. The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with demand response and demand reduction programs.

Table F-128: Met-Ed PY4 On-TRM Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
Met-Ed	**$140,832,000**	**$156,115,000**	**0.9**
EE Programs Only	**$136,646,000**	**$134,924,000**	**1.0**
Home Energy Audits & Outreach	$20,544,000	$5,258,000	3.9
Appliance Turn-In	$4,642,000	$970,000	4.8
Residential EE HVAC	$5,424,000	$4,289,000	1.3
Residential EE Products	$23,816,000	$8,257,000	2.9
New Construction	$896,000	$781,000	1.1
Behavioral Modification	$1,557,000	$597,000	2.6
Multiple Family	$391,000	$10,000	39.1
WARM	$1,170,000	$1,255,000	0.9
Small C&I Equipment	$22,640,000	$30,438,000	0.7
Large C&I Equipment	$31,281,000	$56,878,000	0.5
Streetlighting	$6,000	-$44,000	-0.1
Non-Profit	$431,000	$157,000	2.7
Remaining Government/Non-Profit	$23,848,000	$26,078,000	0.9
PJM Demand Response	$3,576,000	$4,594,000	0.8
Demand Reduction	$610,000	$16,597,000	0.0

*For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.

F.7.4.1 Assumptions and Inputs

FirstEnergy submitted two iterations of the Met-Ed TRC model in PY4. The first submittal used an off-TRM coincidence factor of 8% for CFL measures. The second one used the on-TRM value of 5%. This change caused a drop in the portfolio-level TRC ratio from 0.908 to 0.902, specifically causing slight degradations to the Multiple Family, Home Energy Audits and Outreach, and Residential EE Products programs. Many input fields in the second submittal were difficult to verify (specific instances are detailed throughout this section).

Met-Ed used a TRC discount rate of 7.92% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Discount rates varied among the EDCs because each company used what was filed in its original EE&C plans. An energy LLF of 11.0% and a demand LLF of 16.6% were used for all programs.

It is unclear how the effective measure lives used in the TRC calculations were derived. In previous iterations of the model, a weighted average of the effective lives of the measures within a program was calculated and rounded to the nearest year. In this model, information pertaining to measure lives was housed on two different tabs: Master TRC, which was where all the TRC calculations were performed, and BV Model, where measure-specific information (e.g., measure life, unit costs, etc.) was detailed to be used in TRC calculations. The measure-life data supplied in the BV Model were cited mainly from the PA TRM and the DSMore Michigan database and appeared to be accurate for each measure. Measure-life information on the Master TRC tab was input manually rather than referenced or formulated from the"BV Model tab. In many instances the information was not consistent between the two tabs, making it hard to understand how information was translated from one tab to the other. Some simple examples of such discrepancies are shown in Table F-129.

Table F-129: Inconsistent Measure-Life Data in Met-Ed TRC Model

Master TRC			BV Model		
Program	Stratum	Life	Program	Measure Name	Life
EE HVAC	Tune-Up	7	EE HVAC	CAC - Maintenance	7
EE HVAC	Furnace Fan + Tune-Up	7	EE HVAC	ASHP - SEER 15	12
EE HVAC	ASHP	12	EE HVAC	CAC - SEER 15	15
EE HVAC	CAC	14	EE HVAC	Furnace Fans	15
EE HVAC	Mini-A/C	14	EE HVAC	EE Ground-Source Heat Pump	15
EE HVAC	Solar	14	EE HVAC	Solar Water Heating	15
EE HVAC	Ground-Source Heat Pump	15			
EE HVAC	Mini-Heat Pump	15			
App. Turn-In	RAC	4	Res. App. Turn-In	Refrigerator/Freezer Recycling	8
App. Turn-In	Refrigerator/Freezer	8	Res. App. Turn-In	Room Air Conditioners	8
			Res. App. Turn-In LI	Refrigerator/Freezer Recycling	8
Low-Income	1	14	Low-Income	Low-Income WARM Program	15
			Low-Income	Low-Income WARM Program	5
			Low-Income	Low-Income WARM Lighting	6.4
			Low-Income	Low-Income WARM Smart Strip	5
			Low-Income	Low-Income Lighting-Low Usage	6.4
Streetlighting	SAL0	15	Governmental	Streetlighting	10

Notes were found in the calculator explaining that certain figures were weighted averages, but without the supporting data and calculations the SWE could not replicate these numbers.

The incremental costs used in the calculations on the Master TRC tab were also difficult to verify as they were entered manually rather than referenced or formulated off the BV Model tab. Incremental cost data on the BV Model tab were consistent with the original EE&C plans and DEER for each individual measure. However, it is unclear how these numbers are translated into the tab where calculations were performed. On the Master TRC tab, the incremental measure costs were multiplied by the weight of that measure in the program. Measure weighting within a program was a function of the quantity of that measure within a given rebate type.

The energy and demand impacts used in the Met-Ed TRC analysis were drawn from the tracking database, which used TRM specified values and equations to assign ex-ante annual savings values to completed measures. The TRC analysis was based on ex-post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

F.7.4.2 Avoided Costs of Energy

Met-Ed's TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2009 through 2028 for each sector -- residential, small commercial, and large commercial -- as well as each sector in specific seasons. The unit impacts are multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The use of specific end-use load shapes makes the TRC findings more realistic because measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods.

F.7.4.3 Avoided Cost of Capacity

The Met-Ed model assigned a flat annual figure ($/kW) to the cost of adding generation capacity. A single value was used for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex-post demand savings for each combination of program and sector to determine the benefits incurred by the EDC from not having to expand capacity.

F.7.4.4 Conclusions and Recommendations

As was recommended both inPY2 and PY3, the SWE recommends that future iterations of the Met-Ed TRC model include measure-level calculations of both measure life and incremental cost. This would provide further insight into the relative performance of measures within a program. Values that stray from expected TRM values should be transparent in their development so that calculations can be verified and replicated by the SWE.

F.7.5 Penelec

Table F-130 summarizes the TRC benefit-cost ratios for Penelec's PY4 portfolio and individual programs. The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with demand response and demand reduction programs.

Table F-130: Penelec PY4 On-TRM Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
Penelec	**$105,926,000**	**$42,827,000**	**2.0**
EE Programs Only	**$101,822,000**	**$37,521,000**	**2.7**
Home Energy Audits & Outreach	$17,929,000	$4,149,000	4.3
Appliance Turn-In	$5,342,000	$974,000	5.5
Residential EE HVAC	$2,959,000	$1,601,000	1.8
Residential EE Products	$23,116,000	$6,411,000	3.6
New Construction	$13,000	$239,000	0.1
Behavioral Modification	$1,006,000	$475,000	2.1
Multiple Family	$250,000	$19,000	13.2
WARM	$1,330,000	$1,553,000	0.9
Small C&I Equipment	$14,324,000	$5,435,000	2.6
Large C&I Equipment	$17,496,000	$5,042,000	3.5
Streetlighting	$797,000	$341,000	2.3
Non-Profit	$225,000	$240,000	0.9
Remaining Government/Non-Profit	$16,027,000	$10,774,000	1.5
PJM Demand Response	$3,673,000	$4,645,000	0.8
Demand Reduction	$431,000	$9,450,000	0.0

*For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.

F.7.5.1 Assumptions and Inputs

FirstEnergy submitted two iterations of the Penelec TRC model in PY4. The first submittal used an off-TRM coincidence factor of 8% for CFL measures. The second one used the on-TRM value of 5%. This change caused a drop in the portfolio-level TRC ratio from 2.060 to 2.043, specifically causing slight degradations to the Multiple Family, Home Energy Audits and Outreach, and Residential EE Products programs. Many input fields in the second submittal were difficult to verify (specific instances are detailed throughout this section).

Penelec used a TRC discount rate of 7.92% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Discount rates varied among the EDCs because each company used what was filed in its original EE&C plans. An energy LLF of 11.0% and a demand LLF of 21.2% were used for all programs.

It was unclear how the effective measure lives used in the TRC calculations were derived. In previous iterations of the model, a weighted average of the effective lives of the measures within a program was calculated and rounded to the nearest year. In this model, information pertaining to measure lives was housed on two different tabs: Master TRC, which is where all the TRC calculations were performed, and BV Model, where measure-specific information (e.g., measure life, unit costs, etc.) was detailed to be used in TRC calculations. The measure life data supplied in the BV Model came from mainly the PA TRM and the DSMore Michigan database and appeared to be accurate for each measure. Measure-life information on the Master TRC tab was input manually rather than referenced or formulated from the BV Model tab. In many instances the information was not consistent between the two tabs, making it hard to understand how information was translated from one tab to the other. Some simple examples of such discrepancies are shown in Table F-131.

Table F-131: Inconsistent Measure-Life Data in Penelec TRC Model

Master TRC			BV Model		
Program	Stratum	Life	Program	Measure Name	Life
App. Turn-In	RAC	4	Res. App. Turn-In	Refrigerator/Freezer Recycling	8
App. Turn-In	Refrigerator/Freezer	8	Res. App. Turn-In	Room Air Conditioners	8
			Res. App. Turn-In LI	Refrigerator/Freezer Recycling	8
Low-Income	1	13	Low-Income	Low-Income WARM Program	15
			Low-Income	Low-Income WARM Program	5
			Low-Income	Low-Income WARM Lighting	6.4
			Low-Income	Low-Income WARM Smart Strip	5
			Low-Income	Low-Income Lighting-Low Usage	6.4
Streetlighting	SAL1	15	Governmental	Streetlighting	10
Streetlighting	SAL0	15			
Streetlighting	SAL1	15			
Streetlighting	SAL2	15			
Streetlighting	SAL1	15			
Streetlighting	SAL1	15			
Streetlighting	SAL0	15			
Streetlighting	SAL1	15			
Streetlighting	SAL0	15			
Streetlighting	SAL0	15			
Streetlighting	SAL2	15			

Notes were found in the calculator explaining that certain figures were weighted averages, but without the supporting data and calculations the SWE could not replicate these numbers.

The incremental costs used in the calculations on the Master TRC tab were also difficult to verify as they were entered manually rather than referenced or formulated off the BV Model tab. Incremental cost data on the BV Model tab were consistent with the original EE&C plans and DEER for each individual measure. However, it is unclear how these numbers were translated into the tab where calculations were performed. On the Master TRC tab, the incremental measure costs were multiplied by the weight of that measure in the program. Measure weighting within a program was a function of the quantity of that measure within a given rebate type.

The energy and demand impacts used in the FirstEnergy TRC analysis were drawn from the tracking database, which used TRM specified values and equations to assign ex-ante annual savings values to completed measures. The TRC analysis was based on ex-post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

F.7.5.2 Avoided Costs of Energy

Penelec's TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2009 through 2028 for each sector -- residential, small commercial, and large commercial -- as well as each sector in specific seasons. The unit impacts are multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The use of specific end-use load shapes makes the TRC findings more realistic because measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods.

F.7.5.3 Avoided Cost of Capacity

The Penelec TRC model assigned a flat annual figure ($/kW) to the cost of adding generation capacity. A single value was used for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex-post demand savings for each combination of program and sector to determine the benefits incurred by the EDC from not having to expand capacity.

F.7.5.4 Conclusions and Recommendations

As was recommended both in PY2 and PY3, the SWE recommends that future iterations of Penelec's TRC model include measure-level calculations of both measure life and incremental cost. This would provide further insight into the relative performance of measures within a program. Values that stray from expected TRM values should be transparent in their development so that calculations can be verified and replicated by the SWE.

F.7.6 Penn Power

Table F-132 summarizes the TRC benefit-cost ratios for Penn Power's PY4 portfolio and individual programs. The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with demand response and demand reduction programs.

Table F-132: Penn Power PY4 On-TRM Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
Penn Power	**$43,119,000**	**$15,193,000**	**2.8**
EE Programs Only	**$41,141,000**	**$13,010,000**	**3.2**
Home Energy Audits & Outreach	$6,643,000	$1,466,000	4.5
Appliance Turn-In	$1,450,000	$271,000	5.4
Residential EE HVAC	$1,308,000	$906,000	1.4
Residential EE Products	$9,061,000	$2,537,000	3.6
New Construction	$350,000	$138,000	2.5
Behavioral Modification	$230,000	$123,000	1.9
Multiple Family	$27,000	$3,000	9.0
WARM	$0	$43,000	0.0
Small C&I Equipment	$10,946,000	$2,169,000	5.0
Large C&I Equipment	$7,683,000	$2,416,000	3.2
Streetlighting	$0	-$22,000	0.0
Non-Profit	$0	-$15,000	0.0
Remaining Government/Non-Profit	$3,443,000	$2,975,000	1.2
PJM Demand Response	$1,900,000	$2,088,000	0.9
Demand Reduction	$78,000	$95,000	0.8

**For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.*

F.7.6.1 Assumptions and Inputs

FirstEnergy submitted two iterations of the Penn Power TRC model in PY4. The first submittal used an off-TRM coincidence factor of 8% for CFL measures. The second one used the on-TRM value of 5%. This change caused a drop in the portfolio-level TRC ratio from 2.613 to 2.592, specifically causing slight degradations to the Multiple Family, Home Energy Audits and Outreach, and Residential EE Products programs. Many input fields in the second submittal were difficult to verify (specific instances are detailed throughout this section).

Penn Power used a TRC discount rate of 7.92% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Discount rates varied among the EDCs because each company used what was filed in its original EE&C plans. An energy LLF of 11.0% and a demand LLF of 14.2% were used for all programs.

As was found with Met-Ed and Penelec, it was unclear how the effective measure lives used in the TRC calculations were derived. In previous iterations of the model, a weighted average of the effective lives of the measures within a program was calculated and rounded to the nearest year. In this model, information pertaining to measure lives was housed on two different tabs: Master TRC, which was where all of the TRC calculations were performed, and BV Model, where measure-specific information (e.g., measure life, unit costs, etc.) was detailed to be used in TRC calculations. The measure-life data supplied in the BV Model came from mainly the PA TRM and the DSMore Michigan database and appeared to be accurate for each measure. Measure-life information on the Master TRC tab was input manually rather than referenced or formulated from the BV Model tab. In many instances the information was not consistent between the two tabs, making it hard to understand how information was translated from one tab to the other.

The incremental costs used in the calculations on the Master TRC tab were also difficult to verify as they were entered manually rather than referenced or formulated off the BV Model- tab. Incremental cost data on the BV Model tab were consistent with the original EE&C plans and DEER for each individual measure. However, iis unclear how these numbers were translated into the tab where calculations were performed. On the Master TRC tab, the incremental measure costs were multiplied by the weight of that measure in the program. Measure weighting within a program was a function of the quantity of that measure within a given rebate type.

The energy and demand impacts used in the FirstEnergy TRC analysis were drawn from the tracking database, which used TRM specified values and equations to assign ex-ante annual savings values to completed measures. The TRC analysis was based on ex-post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

F.7.6.2 Avoided Costs of Energy

The Penn Power TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2009 through 2028 for each sector -- residential, small commercial, and large commercial -- as well as each sector in specific seasons. The unit impacts are multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The use of specific end-use load shapes makes the TRC findings more realistic because measures that yield energy savings during periods with high energy costs are more cost-effective per kWh saved than are measures that produce savings during off-peak periods.

F.7.6.3 Avoided Cost of Capacity

The Penn Power TRC model assigned a flat annual figure ($/kW) to the cost of adding generation capacity. A single value was used for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex-post demand savings for each combination of program and sector to determine the benefits incurred by the EDC from not having to expand capacity.

F.7.6.4 Conclusions and Recommendations

As was recommended both in PY2 and PY3, the SWE recommends that future iterations of Penn Power's TRC model include measure-level calculations of both measure life and incremental cost. This would provide further insight into the relative performance of measures within a program. Values that stray from expected TRM values should be transparent in their development so that calculations can be verified and replicated by the SWE.

F.7.7 West Penn Power

Table F-133 summarizes the TRC benefit-cost ratios for West Penn Power's PY4 portfolio and individual programs. The portfolio total is noted at the top of the table. The "EE Programs Only" subtotal shows the total portfolio benefits and costs less those benefits and costs associated with the Conservation Voltage Reduction, Critical Peak Rebate, Customer Load Response, and Customer Resources Demand Response programs.

Table F-133: West Penn Power PY4 On-TRM Benefit-Cost Ratios

	Avoided Cost	TRC Cost*	TRC
West Penn Power	**$244,236,872**	**$160,986,594**	**1.5**
EE Programs Only	**$189,898,115**	**$100,037,420**	**1.9**
Appliance Turn-In	$5,199,538	$783,511	6.6
Residential EE Products	$25,063,194	$6,818,295	3.7
Residential EE HVAC	$5,859,411	$5,174,078	1.1
Residential Home Performance	$5,030,727	$1,490,483	3.4
Limited Income Energy Efficiency	$373,986	$534,753	0.7
Joint Utility Usage Management	$3,400,600	$3,673,581	0.9
Small C&I Equipment	$73,191,769	$44,378,033	1.6
Large C&I Equipment	$45,214,159	$11,589,284	3.9
Governmental & Institutional	$26,564,731	$25,595,402	1.0
Conservation Voltage Reduction	$47,677,831	$698,534	58.1
Critical Peak Rebate	$449,969	$698,534	0.6
Customer Load Response	$0	$32,757	0.0
Customer Resources DR	$6,210,957	$5,695,040	1.1

**For the purposes of this table, Phase I cumulative TRC costs for DR programs have all been input into PY4.*

F.7.7.1 Assumptions and Inputs

FirstEnergy submitted two iterations of the West Penn Power TRC model in PY4. The first submittal used an off-TRM coincidence factor of 8% for CFL measures. The second one used the on-TRM value of 5%. This change caused a drop in the portfolio-level TRC ratio from 1.521 to 1.517, specifically causing slight degradations to the Residential EE Products, Residential Home Performance, and Small C&I Equipment programs. Many input fields in the second submittal were difficult to verify (specific instances are detailed throughout this section).

West Penn Power used a TRC discount rate of 7.92% to discount program benefits and costs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Discount rates varied among the EDCs because each company used what was filed in its original EE&C plans. An energy LLF of 11.0% and a demand LLF of 20.0% were used for all programs.

As was found with Met-Ed, Penelec, and Penn Power, it was unclear how the effective measure lives used in the TRC calculations were derived. In previous iterations of the model, a weighted average of the effective lives of the measures within a program was calculated and rounded to the nearest year. In this model, information pertaining to measure lives was housed on two different tabs: Master TRC, which is where all the TRC calculations were performed, and BV Mode," where measure-specific information (e.g., measure life, unit costs, etc.) was detailed to be used in TRC calculations. The measure-life data supplied in the BV Model came from mainly the PA TRM and the DSMore Michigan database and appeared to be accurate for each measure. Measure-life information on the Master TRC tab was input manually rather than referenced or formulated from the BV Model tab. In many instances the information was not consistent between the two tabs, making it hard to understand how information was translated from one tab to the other.

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F.7.7.4 Conclusions and Recommendations

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