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Engineers and Consultants
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www.gdsassociates.com

Agenda – October 20th Meeting

- Goals & Objective of the Audit Plan
  - Evaluation & Audit Operational Overview
- EDC Program Review
- TRM Review
  - Issues
  - Technical Review Committee
- Impact Evaluation Process
  - Architecture
  - M&V Protocols
  - Sampling & Uncertainty
  - Evaluation Process Summary
- Process Evaluation Process
  - Categories
  - Protocols
- Audit Activities
  - Impact
  - Process
  - Evaluation & Reporting
- EDC Reporting Requirements
- Evaluation Deadlines
- Summary & Next Steps

Part 1
Goals & Objectives of the Audit Plan

Overarching Purpose

Act 129 Mandate:

The EE&C Program shall include:

(2) An evaluation process, including a process to monitor and verify data collection, quality assurance and results of each plan and the program.

(3) An analysis of the cost and benefit of each plan submitted under subsection (B) in accordance with a total resource cost test approved by the Commission.

Objectives of Statewide Evaluation:

- Provide reasonable assurance that:
  - Measures are being properly installed and utilized and
  - Measures are obtaining claimed energy savings.
- Identify:
  - The cost-effectiveness of each plan;
  - Areas for improvement; and
  - Best practices that may be implemented on a going-forward basis.

Source: House Bill No. 2200, page 51

Evaluation Topics Addressed in Audit Plan

- M&V Protocols, metrics and data formats;
- Impact evaluation procedures;
- Process evaluation procedures;
- Required reporting formats;
- Data management and quality control guidelines;
- Criteria the Statewide Evaluation Team will use to review and comment on EDC evaluations and programs; and
- Description of how the Statewide Evaluator will audit the evaluations performed by the EDCs.

Source: PA PUC RFP for Statewide Evaluator , page 31

Roles & Responsibilities*

Statewide Studies:

Task and/or Deliverable	EDC	Contractor	PA PUC
Coordinated Statewide Market Assessments, Characterizations (e.g. Baseline studies)	XX		
Review and approval of Statewide Market Assessments, Characterizations and TRM updates		XX	XX
Statewide Market Potential Study for additional energy and load reductions after May 31, 2013		XX	
Annual updates to Technical Reference Manual (TRM)		XX	
Approval of TRM updates			XX
Develop and conduct net-to-gross studies	XX		
Coordinate the development of and approve the methodologies for EDC net-to-gross studies		XX	

Planning & Management:

Task and/or Deliverable	EDC	Contractor	PA PUC
EDC impact and process evaluation plans; including database and reporting protocols, survey templates, and schedules	XX		
Review and approval of EDC evaluation plans		XX	XX
Develop Statewide audit evaluation plan, including cost-effectiveness plan, verification approach (with sampling plan), and schedules		XX	
Review and approval of statewide audit evaluation plan			XX
Coordination of all EDC evaluation efforts	XX	XX	
Coordination of statewide impact and cost-effectiveness evaluation efforts		XX	

*as laid out in original RFP.

Roles & Responsibilities

Process Evaluation:

Task and/or Deliverable	EDC	Contractor	PA PUC
Program Process Evaluations	XX		
Customer and trade-ally satisfaction surveys and reports		XX	

Databases:

Task and/or Deliverable	EDC	Contractor	PA PUC
Design, implementation and maintenance of EDC primary program tracking database(s) with project and program data	XX		
Establishing and implementing quality control reviews of EDC program tracking databases		XX	
Statewide Data Management and Quality Control: Design, implementation and maintenance of statewide database of program, portfolio, EDC and statewide energy and demand savings and cost-effectiveness reporting; provide public web accessible database and reporting system		XX	
Approval of statewide database and reporting plan			XX

*as laid out in original RFP.

Roles & Responsibilities

Primary Data Collection & Impact Analyses:

Task and/or Deliverable	EDC	Contractor	PA PUC
First year primary data collection and site baseline and ex-post verification for EE projects	XX		
Persistence of savings analysis for custom measures: primary data collection	XX		
Analyses and documentation of project, program and portfolio gross and net energy and demand savings	XX		

Ind. Data Collection & Impact Analyses:

Task and/or Deliverable	EDC	Contractor	PA PUC
Quality control and due diligence Inspections of project sites and review of primary data and analyses, preparation of verified achieved versus claimed savings		XX	

Reporting:

Task and/or Deliverable	EDC	Contractor	PA PUC
EDC status reports to statewide evaluator on program implementation	XX		
Statewide evaluator status reports to Commission on program implementation		XX	
EDC quarterly and annual reporting of EE program and portfolio net and gross impacts, as applicable, and cost-effectiveness, and EDC progress in reaching targets	XX		
Statewide quarterly and annual report of program and portfolio results: net and gross impacts and cost-effectiveness and EDC progress in reaching targets		XX	
Review PUC evaluation Contractor's statewide and EDC quarterly report of EE program and portfolio results:			XX
Review EDC and PUC Contractor's Annual Report on EE Programs: net and gross savings impacts and cost-effectiveness and EDC progress in reaching targets			XX

*as laid out in original RFP.

Roles & Responsibilities

Best Practices:

Task and/or Deliverable	EDC	Contractor	PA PUC
Participation in at least semi-annual impact evaluation process review and improvement workshops as needed	XX	XX	XX
Preparation of best practices recommendations for improvements to impact evaluation processes	XX	XX	
Prepare best practices recommendations for program modifications and improvements	XX	XX	

Cost-Effectiveness Analyses:

Task and/or Deliverable	EDC	Contractor	PA PUC
EDC and participant cost reporting and EDC cost-effectiveness analyses	XX		
Review, audit and analysis of EDC and participant cost reporting; independent cost-effectiveness analyses, statewide analyses		XX	

EDC Plan Review:

Task and/or Deliverable	EDC	Contractor	PA PUC
Review of filed EDC plans and provide advice to Commission staff on ability of plans to cost-effectively meet targets		XX	
Review of EDCs' EM&V plans and provide advice to Commission staff on ability of plans to adequately measure energy savings		XX	

Other:

Task and/or Deliverable	EDC	Contractor	PA PUC
Prepare materials and reports in support of Commission analysis of efficiency programs		XX	
Organize and conduct periodic statewide workshops on evaluation results of EE programs		XX	

*as laid out in original RFP.

Part 1: Goals & Objectives
Straw Man: pg. 1-2; RFP; contract scope of work

Goals & Objectives of the Audit Plan

Issues:

- Understanding roles & responsibilities
- Data requirements for conducting a meaningful audit and assessment
- Ensuring quality, standardized information and data collection practices
- Identifying areas for program and EM&V improvements
- Working within the legislative confines

Coming Attractions:

- EDC Written Comments
  - October 23rd
- First Draft of Audit Plan
  - November 2nd
- Final Version for Approval
  - December 2nd

Part 2
EDC EE&C Plan Review

Programs

Residential:

- Energy Efficiency Behavior and Education
- Energy Star and High Efficiency Appliance
- Appliance Turn-In/Recycling
- CFL Rewards
- Home Performance/Home Audits/Whole-Building/Weatherization
- HVAC Efficiency
- Solar/Renewable Rebates
- New Construction
- Low-Income Home Performance Check-up Audit/Appliance Replacement/Weatherization
- Low-Income Joint Utility Usage Management
- Low-Income Room AC Replacement
- Efficiency Rewards Rate
- Super Peak Time of Use (TOU)
- Home Energy Incentives
- Multifamily Housing
- Direct Load Control

Commercial / Industrial:

- Energy Audits and Assessments
- HVAC Efficiency/Tune-up
- Lighting Efficiency
- Equipment Rebates/Prescriptive
- Custom Technology Applications
- New Construction
- "Performance Contracting"
- Government (State and Local)/Institutional (Schools)
- Government/Non-Profit Lighting Efficiency
- Federal Facilities
- Street and Traffic Lighting Efficiency
- Federal Facilities
- Street and Traffic Lighting Conversion
- Programmable Controllable Thermostat
- Pay Ahead (Smart) Service Rate
- Motors and Drives
- Custom Application
- Customer Load Response
- Distributed Generation
- Direct Load Control
- Contracted Demand Response
- Critical Peak Rebate (CPR) Rate
- Time of Use (TOU) w/ Critical Peak Pricing Rate
- Hourly Pricing Option (HPO) Rate
- Renewable Resources
- Permanent Load Reduction
- Conservation Voltage Reduction

EDC Savings Summary*

		Allegheny	PECO	PP&L	Duquesne	Penn Power	Met Ed	Penelec
PROGRAM ENERGY SAVINGS, Mwh								
High-Impact Programs								
Residential	CFL's	124,859	290,297	277,531	--	6,166	17,986	23,661
Residential	HVAC & Appliances	70,680	123,514	29,708	122,846	22,894	77,634	76,489
C&I/Gov	HVAC & Lights	271,648	489,804	708,344	279,254	64,130	173,671	203,800
	Total	**467,087**	**903,615**	**1,015,583**	**402,100**	**93,190**	**269,090**	**302,950**
Percent of Mandated Energy Savings		**74%**	**76%**	**89%**	**95%**	**65%**	**60%**	**70%**
PROGRAM DEMAND REDUCTION, Mw								
High-Impact Programs								
Residential	HVAC & Appliances	27	5	5	59	0	24	14
Residential	Direct Load Control	10	61	19	0	3	30	28
C&I/Gov	HVAC & Lights	53	105	134	66	23	58	53
C&I/Gov	Demand Response/ TOU Rates	63	178	108	11	--	--	--
	Total	**153**	**349**	**264**	**136**	**32**	**112**	**95**
Percent of Mandated Demand Reduction		**97%**	**98%**	**89%**	**120%**	**72%**	**94%**	**88%**

Note: Duquesne does not disclose Residential CFL energy impact in it's Plan. Penn Power, Met-Ed & PennElec do not disclose values for demand impact from demand response and TOU rates.

*According to pending EE&C plans submitted Summer 2009.

Highlights - EDC EE&C Plans*

- CFL's have the largest impact on MWh savings of any single energy efficiency measure in any rate class.
- HVAC upgrades and lighting retrofits together have the largest impact on both energy and demand in all EDC Plans.

*According to pending EE&C plans submitted Summer 2009.

EDC EE&C Plan Review

Issues:

- Ensuring that EDCs meet the energy & demand savings targets
- Ensuring that plans adequately address the demands of the legislature including all goals and saving stipulations
- Ensuring that the M&V plans of each EDC will produce the necessary data within a certain confidence level for evaluations
- Ensuring that plans will lead to quality standardized results
- Currently, some areas of EE&C Plans need further clarification

Coming Attractions:

- Approval of plans by the Commission
- Highlighting areas of EDC plans that need clarification
- Addressing areas of the plans that need more detail or depth

Part 3
TRM Review

TRM Review - Overview

Measure Types:

- Deemed Savings
- Partially Deemed Savings
- Custom

Additional Requirements:

- Partially Deemed Measures
  - Not all variables are deemed values in TRM
  - Discuss measurements that need to be take by EDCs
- Custom Measures
  - Not all variables are deemed values in the TRM
  - Discuss M&V processes necessary to validate savings

TRM Management Process

Key Functions

- Update
  - New Measures
  - Tables
- Clarify
  - Formulae
  - Definitions
  - Variables
  - Measurement
- Apply
  - References
  - Proper Use

Update Process

- Collaborative
  - Formal, Interested Parties
  - Complete by 12/31
- Technical Review Committee
  - Formulae
  - Definitions
  - Variables
  - Measurements
  - Ongoing

Technical Review Committee

- Clarify and Interpret TRM as Written
- Recommend Prospective Improvements to TRM
- Provide Guidelines for New/Custom Protocols
- Important to Begin Meetings Immediately

Priority Issues for Technical Review Committee

- C&I Lighting "EFLH" Definition
- C&I Lighting Hours of Use Grouping
- C&I Lighting 1995-1999 T-12 Magnetic Assumption
- Updating the Lighting Table 12 (TRM)
- Data Requirements for Lighting Files
- C&I VFD Equation
- Reference document applicability
- New TRM Protocol review and interim approval
- Custom Measure Protocol Guidance
- Role of Field Inspections, Pre and Post

Lighting Straw Man for Technical Review Committee

- E.g., of Lighting Levels of Rigor

Category	Project Size	Program M&V Activities	Evaluation of Sample Activities
1	>400,000 kWh >100kW	1. Detailed Audit 2. Group Hours of Use 3. Log Hours Groups 4. Use Pre/Post tables	1. Verify Pre and Post Counts 2. Log Post Hours of Use 3. Use Pre/Post Tables 4. Calculate Realization Rate
2	<400,000kWh <100kW	1. Detailed Audit 2. Group Hours of Use 3. Estimate Hours of Use 4. Use Pre/Post Tables	1. Verify Pre and Post Counts 2. Log/Verify Post Hours of Use 3. Use Pre/Post Tables 4. Calculate Realization Rates
3	<80,000kWh <20kW	1. Post Counts 2. Group Hours of use 3. Estimate Hours of Use 4. Use Deemed Savings tables	1. Verify Post Counts 2. Verify Post Hours of Use 3. Use Deemed Savings Tables 4. Calculate Realization Rate

TRM Review

Issues:

- TRM – annual updates for clarifications, inconsistencies, applicability, and confidence
- Custom Measures – ensuring credible savings

Coming Attractions:

- Technical Review Committee Meeting
- TRM updates to be submitted for approval in December

Part 4

Impact Evaluation Process:

A. Architecture

B. M&V Protocols

   1) TRM

   2) Custom Measures

C. Sampling & Uncertainty

D. Evaluation Process Summary

Part 4A: Impact Architecture
Straw Man: pg. 3-4; 18-9

Impact Evaluation Architecture

Level	Description	Requirements / Discussion Points
1. Protocol	PA PUC approved protocol	1. TRM clarity 2. TRM applicability 3. Unspecified protocols
2. M&V Plan • Deemed Savings • Partial Deemed • Custom/Unspecified	Protocol compliant plan submitted by EDCs, Reviewed by SWE • TRM M&V Specified • Open Variables • Not in TRM	1. Complete M&V Plans 2. Define Process for Approval 3. Define Data/M&V Requirements
3. Reported Impact	EDC Reports Total Program Savings	1. Application and participant M&V data used 2. Realization Rate calculated from this base
4. EDC Impact Evaluation	EDC Evaluation Contractor samples program data and calculates Realization Rate with approved EM&V protocols	1. Statistical Sample of participants analyzed 2. Field engineering and utilization of detail 3. Calculation of Realization Rate
5. Audited Impact	SWE samples evaluation and provides estimate of accuracy of reported savings and Realization	1. Statistical Sample of Impact Evaluation files 2. Site visits and field verification 3. Recommendations to adjust Realization Rates

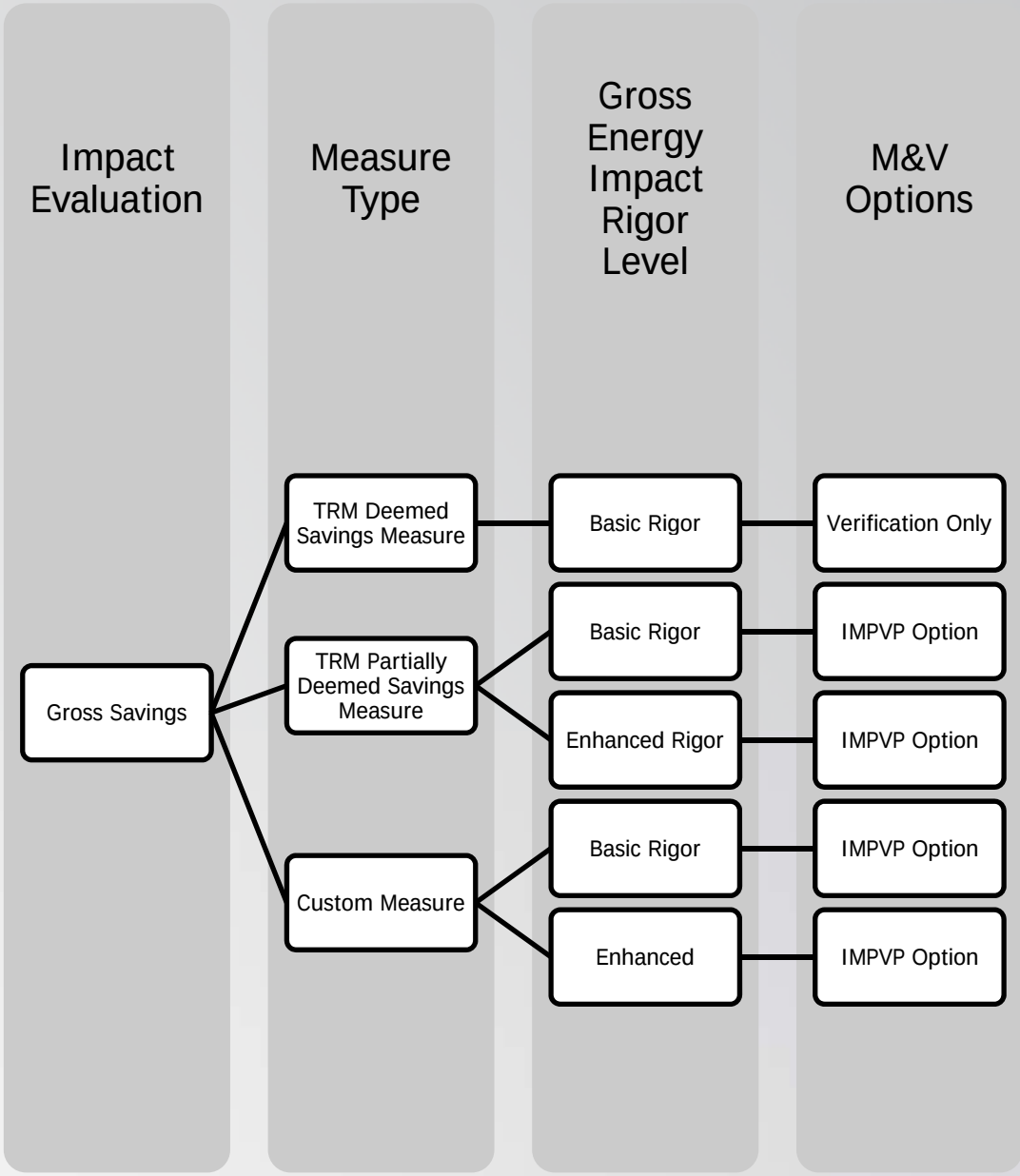
M&V Protocols

Categories	Description	Examples	Assumptions	Quantification Required
TRM Deemed Savings	Deemed kW and kWh	CFL's Appliances	Baseline, Hrs, Impact Baseline, Hrs, Impact	Number, Type Number, Type
TRM Partially Deemed	Savings Algorithms with Open Variables	C&I Lighting C&I VFD	Baseline, Impact Impact?, Base Hours?	Number, Type, Hrs HP, Load Factor
Custom Measures	All Other, Unspecified	Mixed Lighting Other VFD EMS, Controls		Undefined Undefined Undefined

- Key Issues in Impact Evaluation
  - Some areas of confusion need to be addressed
  - Open variables need measurement and verification
  - Field verification of complete data files important

Savings Protocol Overview

- Process for selecting parameters for impact evaluation
- Each "box" or "option" to be defined in EM&V and Audit Plans



Gross Energy Evaluation Rigor Levels

Rigor Level	Minimum Allowable Methods for Gross Energy Evaluation
Basic	1. **Verification** for TRM Deemed Measures - verification of number of installations, stipulated operating hours and other assumptions and inputs to the deemed savings estimates specified in the TRM. Sampling according to the sampling and uncertainty protocol. 2. **Simple Engineering Methods** with M&V equal to IPMVP Option A for TRM Partially Deemed Measures. Verification of appropriate application of the TRM savings algorithms. Spot measurements and other site specific stipulations where subscribed by the TRM. Sampling according to the sampling and uncertainty protocol.
Enhanced	1. Retrofit Isolation Engineering methods as described in IPMVP Option B. 2. **Building energy simulation models** that are calibrated as described in IPMVP Option D requirements in the M&V Protocols. If appropriate, may alternatively use a process-engineering model (e.g., AirMaster+) with calibration as described in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol. 3. **Retrofit isolation engineering models** as described in IPMVP Option B requirements in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol.

[1] Post-retrofit only billing collapses the analysis from cross-sectional time-series to cross-sectional. Given this, even more care and examination is expected with regard to controlling for cross-sectional issues that could potentially bias the savings estimate.
[2] The overall goal of the Direct Impact Protocols is to obtain reliable net energy and demand savings estimates. If the methodology directly estimates net savings at the same or better rigor than the required level of rigor, then a gross savings and participant net impact analysis is not required to be shown separately.

Source: State of California PUC, California Energy Efficiency Evaluation, April 2006

Part 4B: M&V Protocols
Straw Man: pg. 8-11; 15-19

M&V Options

M&V Option	How Savings are Calculated	Typical Applications
Option A: Partially Measured Retrofit Isolation Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied; separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameter(s) may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Careful review of ECM design and installation will ensure that stipulated values fairly represent the probable actual value. Stipulations should be shown in the M&V Plan along with analysis of the significance of the error they may introduce.	Engineering calculations using short term or continuous post-retrofit measurements and stipulations.	Lighting retrofit where power draw is measured periodically. Operating hours of the lights are assumed to be one half hour per day longer than store open hours
Option B: Retrofit Isolation Savings are determined by field measurement of the energy use of the systems to which the ECM was applied; separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Engineering calculations using short term or continuous measurements	Application of controls to vary the load on a constant speed pump using a variable speed drive. Electricity use is measured by a kWh meter installed on the electrical supply to the pump motor. In the base-year this meter is in place for a week to verify constant loading. The meter is in place throughout the post-retrofit period to track variations in energy use.
Option C: Whole Building Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.	Multifaceted energy management program affecting many systems in a building. Energy use is measured by the gas and electric utility meters for a twelve month base-year period and throughout the post-retrofit period.
Option D: Calibrated Simulation Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-uses metering.	Multifaceted energy management program affecting many systems in a building but where no base-year data are available. Post-retrofit period energy use is measured by the gas and electric utility meters. Base-year energy use is determined by simulation using a model calibrated by the post-retrofit period utility data.

Source: State of California PUC, California Energy Efficiency Evaluation, April 2006

M&V Activities

- M&V activities include data collection, verification, monitoring and analysis associated with the calculation of gross energy and peak demand savings from individual customer sites or projects.
- The M&V activities will lead to project/site specific savings in a quantity defined by the sampling and uncertainty protocols.
- Project/site specific findings are then extrapolated to assess the overall savings of the program as a whole or a program component across the portfolio of programs using a *realization rate*

$$\textit{Realization Rate} = \frac{\textit{Evaluation Verified Savings}}{\textit{Program Reported Savings}}$$

M&V Information Flow Diagram

Step 1: Determine Measure Type

Step 2: Select Rigor Level

Step 3: Select Sampling & Uncertainty Protocols

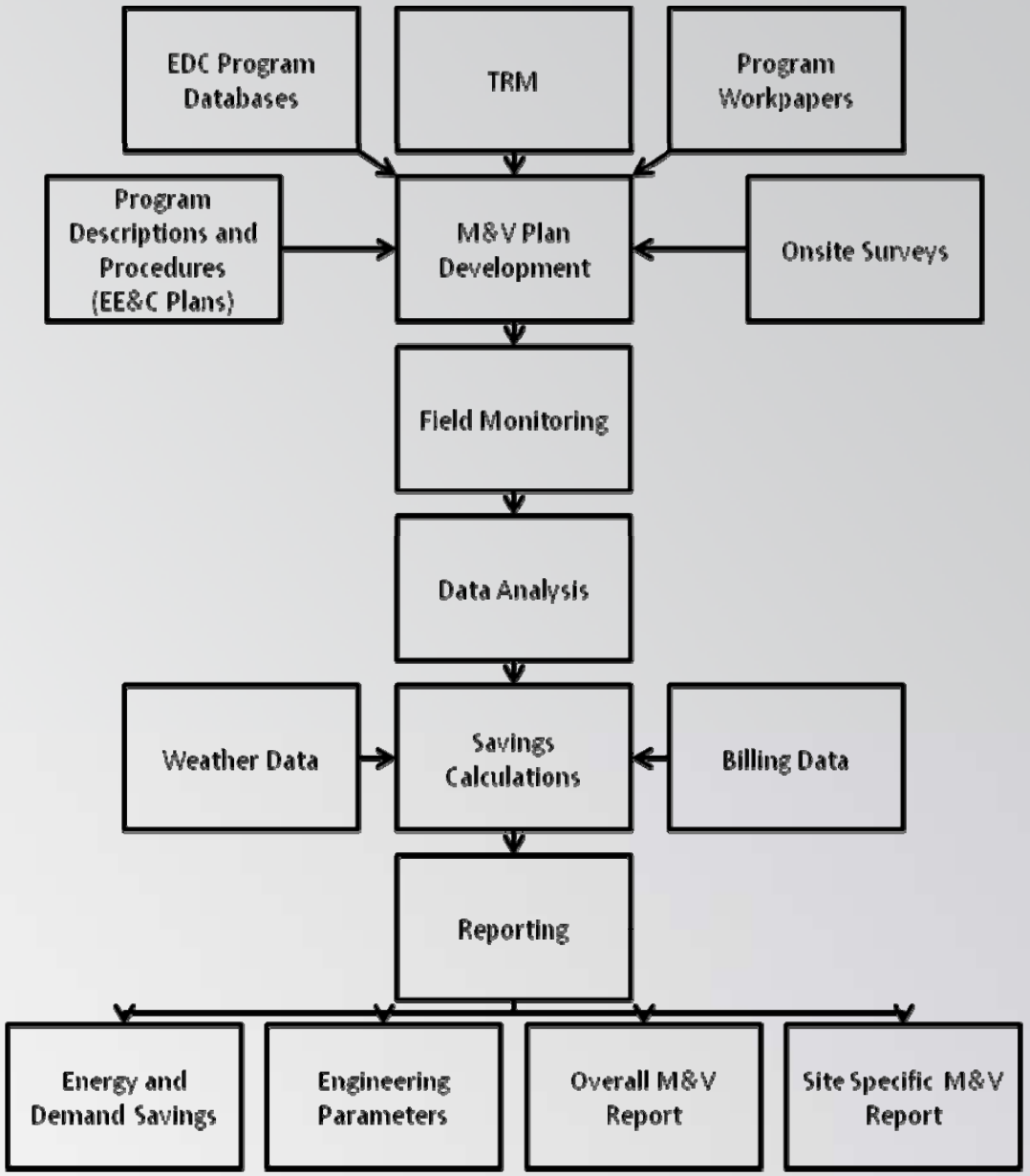
Step 4: Select IPMVP Option

Step 5: Conduct M&V Activities

Step 6: Analyze Data

Step 7: Determine Savings

Step 8: Report Results



Part 4B: M&V Protocols
Straw Man: pg. 8-11; 15-19

Realization Rates & M&V (1/2)

Residential	M&V	EDC Reported	Evaluation Action[*1]	Evaluation Action[*2]	Given	Given Source
CFL	Count	Records	Audited Records	TBD	Hours of Use (3 X 365)	Energy Star Calculator
	Watts per	Records	Audited Records	TBD	Base watts, CFL X 4	"Data Gathering", TRM p26
					CF (Coincedence Factor)	RLW Study[3]
					ISR (In Service Rate)	NMR Study[4]
ES Indoor Fixture	Count	Records	Audited Records	TBD	Hours of Use (2.6 X 365)	NMR Study[4]
					Savings, watts, (48.7)	NMR Study[4]
					ISR (In Service Rate)	NMR Study[4]
					CF (5%)	EV TRUM[5]
ES Refrigerator	Count	Records	Audited Records	TBD	Savings kWh per Type	Table 7 TRM p23
	Type	Records	Audited Records	TBD	Savings, kW, (.0125 All)	Energy Star Calculator
					CF (1.0)	"Included" per TRM

Notes

1 Accounting Type Audit of EDC Records and Source Documentation
2 Engineering M&V of Sample of Participants
3 RLW Analytics, "Development of Common Demand Impacts for EE Measures/Programs for the ISO Forward Capacity Markets
4 Nexus Market Research, "Impact Evaluation of the Massachusets, Rhode Island and Vermont 2003 Residential Lighting Programs"
5 Efficiency Vermont. Technical Reference User Manual:Measure Savings Algorithms and Cost Assumptions (July 2008)

Realization Rates & M&V (2/2)

C&I	M&V	EDC Reported	Evaluation Action[*1]	Evaluation Action[*2]	Given	Given Source
Prescriptive Lighting[6]	Count	Records	Audited Records	Field, Post	Savings watts	Table 12, TRM p38
	Type[7]	Records	Audited Records	Field, Post	CF(Unspecified Reference)	TRM p36, "JCPL"
	Use (EFLH)	Records	Audited Records	Field, Post		
Generic Custom Measure	Pre Watts	Records	Audited Records	Field, Pre	Guidelines	Pa PUC, SWE
	Post Watts	Records	Audited Records	Field, Post	Generic Protocols	IPMVP
	Pre LF, Hrs	Records	Audited Records	Field, Pre	Engineering Standards	
	Post LF, Hrs	Records	Audited Records	Field, Post		

Notes

6 Must Distinguish between applicability of Prescriptive Lighting, Lighting Controls, Fluorescent Lighting (super T-8) and Custom

7 Tables have limited lamp ballast types, some use averages of NLO and RLO ballasts. May impacts 20% Power Density application.

Uncertainty

Factors Affecting Savings Performance:

- Weather
- Occupancy level/Schedule
- Installed equipment intensity
- User demand
- Ability of the measure, as designed, to achieve the intended savings
- Measure implementation effectiveness
- Operator behavior relative to specifications
- Operator behavior relative to non-ECM equipment usage
- Equipment deterioration
- Equipment life

Savings Evaluations Uncertainties:

- Instrumentation Error
- Modeling Error
- Sampling Error
- Planned and Unplanned assumptions

Improving Accuracy:

- Reduce Biases
  - Use better information or
  - Use measured values stipulated values
- Reduce Random Error
  - Increase the sample sizes,
  - Use a more efficient sample design or
  - Apply better measurement techniques.

*In most cases, improving accuracy by any of these means increases M&V cost.

Balancing Uncertainty & Cost

Cost Factors:

- IPMVP Option selected
- Measure No., complexity and interaction
- No. of energy flows across the boundary isolating measure during analysis
- Level of detail and effort associated with establishing base-year conditions
- Amount and complexity of the measurement equipment (design, installation, maintenance, calibration, reading, removal)
- Sample sizes
- Amount of engineering required to make and support the stipulations
- No. and complexity of independent variables in mathematical models
- Duration of metering and reporting activities
- Accuracy requirements
- Savings report requirements
- Process of reviewing or verifying reported savings
- Experience and professional qualifications of the people conducting the savings determination

Unique Elements of M&V Costs:

- Option A
  - No. of measurement points
  - Complexity of stipulation
  - Frequency of post-retrofit inspection
- Option B
  - No. of measurement points
- Option C
  - No. of meters
  - No. of independent variables needed to account for most of the variability in energy data
- Option D
  - No. and complexity of systems simulated
  - No. of field measurements needed to provide input data
  - Skill of profession simulator in achieving calibration

Sampling Size and Precision

Information to Determine Required Sample Size:

- Population
- Sample design
  - Simple Random,
  - Stratified Random,
  - Two-stage, etc.
- Assumptions and related documentation upon which the initial sample size calculations are to be based
  - Coefficient of variation for key inputs
  - Specified statistical power,
  - Effect size confidence level and alpha level, etc.
- Details pertaining to initial samples sizes calculations
- Achieved precision around program-level gross and net impacts
- Expected confidence intervals
- Details pertaining to thee estimation of precision based on achieved
- Response rate; attribution and any suspected non-response bias and efforts to be addressed

Sample Size Options*

Option	How May Are Measured & Resulting Precision of Estimates	Rank Order of Contribution to Defensibility	Relative Cost
Census:	**Measure entire population.** Statistical precision is not applicable because you are counting every outcome and, therefore, have a full rather than partial enumeration	Highest ↓	Usually Highest
Sample : *Probability Sample*: Simple random and stratified random	**Measure a subset of the population.** Probability of a unit entering the sample is known. Sampling precision depends on the number of items, e.g., participants measured. The more measured, the better the precision.		Medium. The cost will increase with the sample size.
Systematic: Any non-random method of sampling	**Measure a non-randomly selected subset of the population.** Probability of selection unknown. Statistical precision, no applicable. Carefully selected representative samples are sometimes clamed to have properties "similar to" probability samples.	↓ Lowest	Usually lowest

*__EERE Guide to Managing General Program Evaluation Studies: *Getting the Information You Need.*__ Prepared for the Office of Energy Efficiency and Renewable Energy (EERE), February 2006.

Balancing Sample Size & Cost

Must Consider:

- Acceptable Confidence Level
  - Basic – 90%
  - Enhanced – 90%
- Acceptable Precision Interval
  - Basic – ±30%
  - Enhanced – ±10%
- Expected Variation
  - Typically – 90/10
- Population Size
  - EDC – Program participants
  - SWE – Impact evaluation sample

Part 3D: Evaluation Process Summary
Straw Man: 11-23

Gross Savings Protocols

Measure Type:	Basic Rigor Level:	Enhanced Rigor Level:
Appliances	·Verification of TRM inputs (type of unit, energy source, usage, location)	·Verification of TRM inputs. ·Spot measurements (kW). ·Short term metering (kW, operating hours).
CFL Rewards/Give Away	·Verification of quantity based on invoices for bulbs purchased by category (wattage, size etc.). ·Predefined operating hours based on TRM.	·NA
Weatherization, Envelope Improvements	·Verification of measure installation. ·Software simulation for verifying energy savings.	·Verification of measure installation. ·Software simulation for verifying energy savings.
Residential HVAC Efficiency	·Verification of measure installation (quantity, type, efficiency). ·Baseline efficiency defined by TRM (baseline efficiency equals efficiency of old equipment for early replacement; for end of life replacement and new construction baseline efficiency equals efficiency of standard equipment compliant with code). ·New equipment efficiency from manufacturers catalog data. ·Stipulated operating hours (TRM defined, defined by baseline studies or customer reported)	·Verification of measure installation (quantity, type, efficiency). ·Pre and post installation site visits to verify efficiency levels. ·Baseline efficiency equals efficiency of old equipment for early replacement; for end of life replacement and new construction baseline efficiency equals efficiency of standard equipment compliant with code). ·Short term metering (pre or post) to calculate EFLH.

Measure Type:	Basic Rigor Level:	Enhanced Rigor Level:
Residential Lighting	·Verification of measure installation (fixture quantity, type). ·Stipulated operating hours (TRM defined)	·NA
C&I Lighting	·Verification of measure installation (fixture quantity, type). ·Pre and post fixture types and performance. ·Operating hours (TRM defined, undefined).	·Verification of measure installation (fixture quantity, type). ·Pre and post fixture types and performance. ·Short term metering to log operating hours and stipulated categories.
C&I HVAC Efficiency	·Verification of measure installation (quantity, type, efficiency). ·Baseline efficiency defined by TRM (baseline efficiency equals efficiency of old equipment for early replacement; for end of life replacement and new construction baseline efficiency equals efficiency of standard equipment compliant with code). ·New equipment efficiency from manufacturers catalog data. ·Stipulated operating hours (TRM defined, defined by baseline studies or customer reported)	·Verification of measure installation (quantity, type, efficiency). ·Pre (where applicable) and post installation site visits to verify baseline and retrofit equipment information. ·Short term or continuous metering (kW) for a minimum of three weeks to calculate pre and post energy use.

Impact Evaluation Process

Issues:

- Architecture – understanding roles & responsibilities
- M&V Protocols – establishing standard methods for verifying savings
- Sampling & Uncertainty - balancing assurance with costs

Coming Attractions:

- More thorough discussion of M&V expectations
- M&V recommendations by program based on expected impact

Part 5
Process Evaluation Process & Protocols

Process Design – Research Objectives

Program Design

- Program design, design characteristics and design process;
- Program mission, vision and goal setting and its process;
- Assessment or development of program and market operations theories and supportive logic models, theory assumptions and key theory relationships - especially their causal relationships; and
- Use of new practices or best practices.

Program Administration

- Program oversight and improvement process;
- Program staffing allocation and requirements;
- Management and staff skill and training needs;
- Program information and information support systems; and
- Reporting and the relationship between effective tracking and management, including both operational and financial management.

Process Design – Research Objectives

Program Implementation & Delivery

- Description and assessment of the program implementation and delivery process;
- Quality control methods and operational issues;
- Program management and management's operational practices;
- Program delivery systems, components and implementation practices;
- Program targeting, marketing and outreach efforts;
- The level of financial incentives for program participants;
- Program goal attainment and goal-associated implementation processes and results;
- Program timing, timelines and time-sensitive accomplishments; and
- Quality control procedures and processes.

Market Response

- Customer interaction and satisfaction (both overall satisfaction and satisfaction with key program components and including satisfaction with key customer-product-provider relationships and support services);
- Customer or participant energy efficiency or load reduction needs and the ability of the program to provide for those needs;
- Market allies interaction and satisfaction;
- Low participation rates or associated energy savings;
- Market allies' needs and the ability of the program to provide for those needs;
- Reasons for overly high free-riders or too low a level of market effects, free-drivers or spillover; and
- Intended or unanticipated market effects.

Process Design – Evaluation Activities

- Interviews and surveys with an EDC's, designers, managers and implementation staff (including contractors, sub-contractors and field staff);
- Interviews and surveys with trade allies, contractors, suppliers, manufacturers and other market actors and stakeholders;
- Interviews and surveys with participants and non-participants;
- Interviews and surveys with technology users;
- Interviews and surveys with key policy makers and public goods charge stakeholders;
- Observations of operations and field efforts, including field tests and investigative efforts;
- Operational observations and field-testing, including process related measurement and verification efforts.
- Workflow, production and productivity measurements;
- Reviews, assessments and testing of records, databases, program-related materials and tools used;
- Collection and analysis of relevant data or databases from third-party sources (e.g., equipment vendors, trade allies and stakeholders and market data suppliers); and
- Focus groups with participants, non-participants, trade allies and other key market actors associated with the program or the market in which the program operates.

Process Evaluation Process & Protocols

Issues:

- Overlap between information collected in the process, market effects and impact evaluations so coordination is a must to reduce redundancy
- Outcome of the Process Evaluations should address areas for improvement and identify best practices on a going-forward basis
- Additional studies needed

Coming Attractions:

- Develop a minimum set of standards (Roadmap) for process evaluation across the EDC's portfolio's while allowing for the necessary flexibility and control for program administration and process evaluation management
- The standards will include a roadmap for the following:
  - Process Evaluation Activities
  - Skills
  - Timing

Part 6
Audit Activities

Audit Objectives

- Audits of building, equipment and processes to determine the cost-effectiveness of energy efficiency and conservation measures using nationally recognized tools and certification programs; and

- Independent inspections of completed energy efficiency and conservation measures completed by third-party entities to evaluate the quality of the completed measure.

Potential Audit Activities

- Maintaining an evaluation and management database.
- Collecting and analyzing verification data.
- Conducting random and limited spot verification of EDC EM&V measurements and data.
  - Verification of installations
  - Metering equipment for usage
- Auditing EDC survey instruments.
- Acquiring and verifying data from EDCs.

Audit Activity Objectives

Research Design:

- Research questions are well formulated and relevant.
- Indicators are credible as measures of the outputs and outcomes being evaluated.
- The research design has validity.
- For statistical methods, the degree to which relationships between indicators, tests of significance, and confidence intervals for sample estimates, were built into the analysis.
- Research demonstrates understanding of previous related studies.
- The data collection and analysis methods are credible.

Data Collection:

- Data and assumptions are sound.
- All planned data were collected, or if some values are missing, how they were treated.
- Data collected by trained professionals using appropriate equipment.
- If a survey was conducted, non-response is accounted for.
- Data collection methods were actually implemented as planned, or if revisions were required by circumstances, they were appropriate and the reasons for the revisions are documented.
- Collected data are provided and their layout documented.

Audit Activity Objectives

Analysis:

- The analysis methods were actually implemented as planned, or if revisions were required by circumstances, they were appropriate and the reasons for the revisions are documented.
- The documentation of the methodology is accurate, understandable, and reasonable.

Reporting:

- The report outline draft is appropriate, presents study findings and documents all methods and assumptions.
- The draft findings and recommendations in the evaluation report follow logically from the research results and are explained thoroughly.
- The report presents answers to all of the questions asked.

Impact Evaluation Audit Tasks

- Review current program procedures for calculating energy savings. Note compliance with M&V procedures as addressed in the TRM and Audit Plan.
- Review Project Files for:
  - Compliance with program procedures and M&V guidelines;
  - Cross participation in other programs; and
  - Documented savings at the measure level.
- Conduct on-site surveys and telephone surveys for data collection to verify equipment installation and operation.
- Review realization rates and application to EDCs reported savings.
- Prepare written report of activities and findings.

Auditable Activities: Impact Evaluation

Site Inspections

- Training of site.
- Drawing of random sample of sites.
- Development of database and site inspection forms.
- Performing on-site audits to verify data collected by EDCs.

Savings Regression Analyses

- Ensuring use of an adequate amount of pre and post-bill summaries.
- Checking the accuracy of data entry.
- Reviewing any statistical analyses performed on the data.
- Checking for normalization of data for such factors as weather and production rates.

Auditable Activities: Impact Evaluation

TRM and Deemed Savings Formulae

- Verify correct use of stipulated data and formulae.
- Audit installation verification activities.
- Review realization rate estimates.

Engineering Models & Simulations

- Review model or simulation assumptions.
- Verify models and simulations are behaving as intended.
- Check to ensure that model inputs accurately reflect the climate and population of the particular circumstance.
- Check for normalization of data.
- Verify that the savings estimates produced appropriately reflect reality.

Process Evaluation Audit Tasks

- Assess Appropriates of:
  - Program design,
  - Participation procedures, and
  - Application and payment processing activities.
- Accuracy, consistency, and completeness of program records.
- Effectiveness of
  - Incentives,
  - Marketing and
  - Internal communications.
- Participant satisfaction with programs.
- Opportunities for process improvement.
- Comparison to best practices.

Auditable Activities: Process Evaluation

- Review interview and survey materials.
- Observe operations and field efforts.
- Review workflow, production and productivity measurements.
- Review program-related materials and tools.

Audit Activities

Issues:

- Audit EDC activities at a level sufficient to assure program savings and performance statistics.
- Audit and evaluate with the intent of identifying best-practices and highlighting areas of improvement.
- Ensure that the PBF funds are used efficiently and effectively for the greater benefit of the state.

Coming Attractions:

- Actual audit specifications (type, quantity, rigor, etc.) to be determined based on EM&V plans and M&V activities
- Audit activities assigned to specific EM&V protocol "bunches"

Part 7
EDC Reporting Requirements

Residential Reporting Requirements

- EDC incentive ($)
- Application date
- Close date
- Installation date
- Project numbers
- Customer name, address, phone, email
- For each program, kWh savings by time period (winter, summer, peak and off-peak)
- Number of measures installed by type for each unique “project”, and the basis for the overall kWh and kW savings
- For each measure, basis for per unit kWh and kW savings
- For each measure installation, provide any available information on measure operating hours
- For each measure installation, provide whether the measure in an “early replacement” measure or “replace on burnout” measure
- Utility costs by cost category by program
- Participant costs
- Other data as required

C&I / Gov. Reporting Requirements

- EDC incentive ($)
- Application date
- Close date
- Installation date
- Project numbers
- Customer name, address, phone, email
- EDC account number
- Customer sector
- NAICS code
- For each program, kWh savings by time period (winter, summer, peak and off-peak)
- Number of measures installed by type for each unique “project”, and the basis for the overall kWh and kW savings
- For each measure, basis for per unit kWh and kW savings
- For each measure installation, provide any available information on measure operating hours
- For each measure installation, provide whether the measure in an “early replacement” measure or “replace on burnout” measure
- Utility costs by cost category by program
- Participant costs
- Other data as required

EDC Reporting Requirements

Issues:

- Ensuring that the appropriate and necessary information is collected and provided.
- Review programs not in TRM for data requirements.

Coming Attractions:

- Complete list of reporting requirements.
- Address reporting requirements that may be unique to a particular program or measure.
- Develop method and schedule for EDC data transfer to GDS.

Part 8
Evaluation Deadlines

Firm Deadlines

Deadline:	Task:
July 15	EDC provides its Annual Report to the Commission.
Aug. 15	The Statewide Evaluation Team provides a draft annual report on each EDC plan to the Director of CEEP and the EDCs.
Aug. 30	EDCs provide comments on the draft annual report to the Director of CEEP.
Sept. 15	Commission Staff reviews the draft annual reports and EDC comments and provides revisions to annual reports to the Statewide Evaluation Team.
Oct. 15	The Statewide Evaluation Team provides a final annual report on each EDC plan to the Director of CEEP.

Part 9
Wrap-Up & Next Steps

"Take-Aways" from Today

- Audit Plan currently in "Straw Man" State.
- Further work will be done to more clearly outline guidelines and requirements.
- Greater linkage between programs/measures and EM&V expectations to be provided in next draft.
- More thorough interpretation of the TRM and its applicability to be provided in next draft.
- Much attention needs to be paid to the TRM update and Technical Review Committee.
- The Audit Plan development is a collaborative process – your comments and concerns are appreciated and considered.
- Audit Plan is a living document that will be updated to reflect any changes to program plans and evaluation requirement.

Next Steps

Deadline:	Task:
Nov. 1	Audit Plan – Complete Draft for Review
Nov	Technical Review Working Group – TRM Review
Dec. 2	Audit Plan – Final Document for Approval