Revised

OCA STATEMENT NO. 3

2/26/19

1409

**BEFORE THE**
**PENNSYLVANIA PUBLIC UTILITY COMMISSION**

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|---|---|---|
| Application of Transource Pennsylvania, LLC for approval of the Siting and Construction of the 230 kV Transmission Line Associated with the Independence Energy Connection - East and West Projects in portions of York and Franklin Counties, Pennsylvania. | : | Docket No. A-2017-2640195<br>Docket No. A-2017-2640200 |
| Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Rice Substation in Franklin County, Pennsylvania is reasonably necessary for the convenience or welfare of the public. | : | P-2018-3001878 |
| Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Furnace Run Substation in York County, Pennsylvania is reasonably necessary for the convenience or welfare of the public. | : | P-2018-3001883 |
| Application of Transource Pennsylvania, LLC for approval to acquire a certain portion of the lands of various landowners in York and Franklin Counties, Pennsylvania for the siting and construction of the 230 kV Transmission Line associated with the Independence Energy Connection – East and West Projects as necessary or proper for the service, accommodation, convenience or safety of the public. | : | A-2018-3001881, *et al.* |

# DIRECT TESTIMONY OF GEOFFREY C. CRANDALL

**ON BEHALF OF**
**THE OFFICE OF CONSUMER ADVOCATE**

**SEPTEMBER 25, 2018**
**Supplemental/Revised February 26, 2019**

## I. QUALIFICATIONS

**Q. What is your name and business address?**

A. My name is Geoffrey C. Crandall. My business address is MSB Energy Associates, Inc., 6907 University Avenue #162, Middleton, Wisconsin 53562.

**Q. On whose behalf are you testifying today?**

A. I am testifying on behalf of the Office of Consumer Advocate ("OCA").

**Q. Please describe your background and experience in the field of gas and electric utility regulation.**

A. I am a principal and the Vice President of MSB Energy Associates, Inc. I have over 40 years of experience in utility regulatory issues, including resource planning, restructuring, mergers, fuel, purchase power and gas cost recovery and planning analysis, energy efficiency, conservation and load management impacts, program design and other issues. I have provided expert testimony before more than a dozen public utility regulatory bodies throughout the United States. I have provided expert testimony before the United States Congress on several occasions and have previously filed testimony in numerous cases before the Michigan Public Service Commission.

My experience includes over 15 years of service on the Staff of the Michigan Public Service Commission (Commission). In my tenure at the Commission, I served as an analyst in the Electric Division (Rates and Tariff section) involving rate cases, as well as fuel and purchase power cases. I also served as the Technical Assistant to the Chief of

Staff, supervisor of the energy conservation section (involving residential and commercial energy efficiency programs). I also served as the Division Director of the Industrial, Commercial and Institutional Division. In that capacity, I was Director of the Division that had responsibility for the energy efficiency and conservation program design, funding, and implementation of Michigan utility and DOE-funded private company implemented programs and initiatives involving Industrial, Commercial and Institutional gas and electric customers throughout Michigan.

In 1990, I became employed by MSB Energy Associates, Inc. and have served clients throughout the United States on numerous projects related to system planning, fuel, purchase power and gas cost recovery assessments, energy efficiency and load management program development, electric restructuring, customer impact analyses, and other issues. My vita is attached as Exhibit OCA 3-1.

## II. DIRECT TESTIMONY

**Q. What is the purpose of your testimony in this case?**

A. The purpose of my testimony is to assist the OCA in assessing the reasonableness of the Application of Transource Pennsylvania, LLC (Transource or Company) for Approval of the siting and construction of the 230kV Transmission Lines associated with the Independence Energy Connection both West and East Projects in portions of Franklin and York County. The focus of my testimony is the non-transmission alternatives to Transource's proposed Independence Energy Connection Project (IEC Project). OCA Witness Rubin is assessing the IEC Project in the context of Pennsylvania's laws and

policy objectives. OCA Witness Lanzalotta is assessing the need for the IEC Project and transmission alternatives to it. Together, we demonstrate that:

- The transmission constraints the IEC Project was chosen to alleviate are greatly diminished from when the IEC Project was conceived.
- The viability of the IEC Project is based in large part on a cost/benefit analysis that appears to have numerous, substantial flaws.
- The proposed greenfield construction of the IEC Project is inconsistent with the public Policy of PA.
- If necessary, transmission alternatives exist that should be considered in light of their substantially reduced environmental and economic impacts to PA.
- There are also non-transmission alternatives that could address the load requirements in the MD-DC-VA area and reduce any congestion levels that currently exist in the Project area and without the impact on land, the environment and communities that have been identified in the public input hearings and site views.

These concerns and issues involve the following:

- Non-transmission alternatives including energy efficiency programs, demand response, distributed generation, solar, wind resources in the areas where higher (Locational Marginal Prices)[1] LMP's are projected due to congestion.

[1] Locational Marginal Price is defined by PJM as the "marginal price for energy at the location where the energy is delivered or received. It is expressed in $/MWh. LMP Is a pricing approach that addresses Transmission System congestion and loss cost, as well as energy cost."

- We have identified resources that are available in the transmission-constrained areas, which impact the economics of IEC Project.
- In our review of PJM's model outputs, which PJM used to select the IEC Project, we have determined that transmission congestion and higher electric prices as modeled occur not only at time of peak, but also deeper into the intermediate and base load levels. As such, the constraints as modeled could occur many hours each year. The actual hours of constraint, however, have declined substantially since the time the IEC Project was approved.
- Energy efficiency, distributed generation (including combined heat and power - CHP) and renewable resources have the potential to materially reduce the transmission congestion and thus the electricity prices in the DC-MD-VA areas.
- Energy efficiency resource potential is present both East and South of PA and has not been adequately accounted for in the PJM forecast.
- Renewable resources, especially solar (Photo Voltaic) PV and wind are also available in the IEC Project area. These resources were not given due consideration in the PJM forecast.
- Other distributed generation resources are site and process specific but have been estimated by Federal Government sources and may also have a material impact on the economic viability and need for the IEC Project.
- In this testimony I provide an assessment of whether or not energy efficiency, renewable energy and distributed generation resources would be available to substantially affect the need for and reduce the benefits of the proposed transmission project.

We have assessed non-transmission alternatives focusing primarily on Maryland, Virginia and the District of Columbia that would reduce the need for the IEC Project.

**Q. Why did you select the District of Columbia, Maryland and Virginia as the three states that would primarily benefit from completion of the IEC Project?**

A In response to OCA-II-14, PJM provided OCA with a chart that depicts the areas served by Baltimore Gas & Electric Company, Dominion Power Company and Potomac Electric Power Company as serving customers who are most likely to benefit significantly assuming the project is completed. It is possible that there may be minimal benefits to Pennsylvania electricity consumers served by Duquesne Light Company and West Penn Power Company. However, the benefits are expected to be miniscule.

**Q. Could you describe the proposed IEC Project?**

A. This is a project that PJM selected in conjunction with their 2014/2015 RTEP Long Term Proposal Window Statement. The stated purpose of the project, according to the Company's filed testimony and discovery responses, is to alleviate transmission congestion not for reliability enhancement purposes, but rather to move power more freely East and South of Pennsylvania and thereby improve market efficiencies.

**Q. What would need to be acquired and constructed in order to get the project operational?**

A. It would require forty-five miles of 230 kV (double-circuit, located mostly in Pennsylvania) lines, support structures and several substations. For a more complete description of the IEC Project see Witness Lanzalotta's testimony on page 5.

**Q. What is congestion?**

A. The term "congestion" as defined by PJM (see: www.pjm.com/en/Glossary) as a condition that arises on the transmission system when one or more restrictions prevent the economic dispatch of electric energy from serving load.

## DETERMINATION OF DESIGN TARGETS FOR NON-TRANSMISSION ALTERNATIVES

**Q. The proposal in this case is to construct additional transmission to address the identified transmission congestion. Is construction of transmission the only solution?**

A. No. Depending on the facts, other non-transmission alternatives can be employed to materially affect the congestion levels at issue here and thus also materially impact the need to build new transmission infrastructure.

**Q. What non-transmission alternatives to the IEC Project have you considered?**

A. I have considered expanded end-use energy efficiency measures, expanded demand response programs, expanded renewable resource programs, and expanded distributed resource programs.

**Q. Why are these measures, programs and actions appropriate alternatives to the proposed IEC Project?**

A. The IEC Project is represented as and considered to be a market efficiency project, as affirmed by the Company and PJM in their filed testimonies. Simply put, according to PJM, the transmission network on the AP South Reactive Interface is constrained, preventing generation resources from being dispatched in economic order under certain conditions. PJM would like to dispatch all of its generation resources in economic dispatch order to minimize overall production costs.

Transmission constraints sometimes limit the amount of power that can be taken from lower-cost resources, and instead cause PJM to dispatch higher-cost generation resources to serve the load. The price differential between the higher- and lower-cost generation resources, together with the amount of generation which is dispatched out of economic order and the frequency/duration of time during which the generation is dispatched out of economic order determines the significance of the market inefficiency.

PJM's solution is to seek a more balanced transmission network to reduce market inefficiency. PJM's preferred solution here is to build more transmission lines to reduce the transmission constraints and thus enhance the efficiency of the electricity market. This is neither the only solution, nor in this case, the best solution.

Market inefficiency occurs when the loads on the constrained side (higher cost generation) are greater than the capacity of the transmission network to carry power from the lower cost side (lower cost generation). Thus, reducing load on the constrained side will mitigate the constraint and the degree of market inefficiency.

Additionally, if sufficient lower cost resources can be added to the constrained side, they may mitigate or eliminate the constraint altogether. Thus, for example, siting low cost generation on the constrained side will mitigate or alleviate the constraint and thereby reduce market inefficiency to a certain degree.

A caution to the differential cost of generating resources is that over time, generators on the lower cost side may be retired, may face higher fuel costs, or may face higher maintenance costs. Thus, today's market inefficiency may be reduced or eliminated if the electricity prices at the lower cost side increase.

For purposes of this analysis, I focused on those resources that would reduce the load on the higher cost side of the constraint or reduce the cost of generation on the higher cost side of the constraint.

**Q. Is the IEC Project a market efficiency project?**

A. Yes. Witness McGlynn in his direct testimony, page 16, lines 7-9 unequivocally states, "IEC Project was deemed necessary under the RTEP market efficiency analysis." In addition, see Exhibit OCA-3-2 (PJM response to OCA XIII-09) and PJM's response to OCA XIII-01. PJM clearly indicates that the IEC Project is a market efficiency project, "PJM analysis determined that IEC Project is needed as a market efficiency project..."

The project addresses a market efficiency issue in which power costs on the constrained side may be higher as a result of the congestion but there is ample generation available and deliverable to serve the load although not strictly in order of lowest cost economic dispatch.

**Q. Please describe the AP South Reactive Interface constraint?**

A. The AP South Reactive Interface consists of four 500 kV transmission lines originating in the west near Mt. Storm, West Virginia, and terminating in Doubs (Maryland) and Meadow Brook (Virginia) to the east and Valley (Virginia) to the south. Generally speaking, under certain circumstances these four transmission lines limit the ability to transfer lower cost power available at the west end of the AP South Reactive Interface to load areas of higher cost power to the east and south. The lower-cost generation can be located in many parts of the PJM footprint (not necessarily at the western terminus of the AP South Reactive Interface), but it flows to the western terminus of the AP South Reactive Interface via the transmission network. Its ability to flow to the east and south from there is constrained at certain times by the capacity of the four transmission lines. PJM responses to OCA-IX-01 and OCA-XXI-01.

**Q. Does the AP South Reactive constraint result in higher costs all of the time?**

A. No. The constraint, and therefore the higher costs, exists only under certain conditions. PJM determines the AP South Reactive Interface limits to ensure safe and reliable operation. According to Witness McGlynn Statement 3, page 25, lines 16-20, "If the flows across the interface are expected to exceed the established limits, PJM will direct

higher cost generation in Maryland and Virginia to increase output, while lower cost generation output will be reduced in other parts of PJM to prevent the flows across the interface from exceeding the established limits." The conditions, which determine the limits, can change over time, and with them, the severity of the constraint and the magnitude of the congestion cost.

**Q. Witness McGlynn testified that the primary goal of the 2014/2105 Long Term Proposal window was to "solicit proposals to reduce congestion on the AP South Reactive Interface, which is one of the most historically congested flowgates in PJM". According to State of the Market Reports by PJM's market monitoring unit, Monitoring Analytics, the congestion cost on the AP South Interface totaled approximately $800 million from 2012 through 2016. Is the $800 million indicative of the future congestion costs associated with the AP South Reactive Interface?**

A. No. When PJM solicited proposals to address the congestion costs associated with the AP South Reactive Interface, the amount of time congestion was a factor was much higher than it has been since 2015.

From 2008 through 2014, the AP South Reactive Interface ranked number one in PJM for congestion costs. This constraint was responsible for approximately one-fourth of PJM's total system-wide congestion costs, an average of $307 million per year. Beginning in 2015, the congestion cost dropped dramatically, averaging $31 million per year over the 2015-2017 period, which was less than 3% of PJM's total system-wide congestion costs over the 2015-2017 period. Current congestion costs are about a tenth of the congestion

costs at the time PJM issued its 2014-2015 Long Term Proposal window from which the IEC Project was selected.

Similarly, the congestion event hours on the AP South Reactive Interface also dropped precipitously beginning in 2015. The day ahead (Defined as a forward market in which PJM market participants buy and sell energy bids. Results are financially binding and are posted by 1:30 p.m. on the day before) congestion hours over the 2008-2014 period averaged 4,259[2] hours per year at the AP South Reactive Interface. This dropped to an average of 1,225-day ahead congestion hours per year for the 2015-2017 period.

The same pattern exists for the real time (defined as the real time energy market in which clearing prices are calculated every five minutes based on actual system operations constrained economic dispatch) event hours on the AP South Reactive Interface. The real time congestion event hours averaged 946 hours per year for the 2008-2014 period. This dropped to an average of 43 real time congestion hours per year for the 2015-2017 period.

[2] There are 8,760 hours in a year.

Table 1

**AP South Reactive Interface Historical Congestion**

From Monitoring Analytics Reports

| | Cost Millions $ | % of Annual PJM Total Congestion Cost | Rank PJM | Event Hours Day Ahead | Event Hours Real Time |
|---|---|---|---|---|---|
| 2008 | $ 558.0 | 26.0% | 1 | 3,572 | 1,016 |
| 2009 | $ 206.5 | 29.0% | 1 | 3,501 | 604 |
| 2010 | $ 420.2 | 30.0% | 1 | 4,622 | 1,516 |
| 2011 | $ 238.9 | 24.0% | 1 | 4,111 | 1,013 |
| 2012 | $ 68.5 | 12.9% | 1 | 2,586 | 351 |
| 2013 | $ 169.1 | 25.0% | 1 | 6,330 | 1,138 |
| 2014 | $ 486.8 | 25.2% | 1 | 5,090 | 981 |
| 2015 | $ 56.2 | 4.1% | 6 | 1,285 | 42 |
| 2016 | $ 16.8 | 1.6% | 11 | 1,076 | 14 |
| 2017 | $ 21.6 | 3.1% | 6 | 1,315 | 74 |

| | | | |
|---|---|---|---|
| 2012-2016 | $ | 797.4 | Witness McGlynn's $800 million congestion cost reference |
| 2008-2014 | $ | 306.9 | Average annual congestion cost in period that APS constraint was No. 1 ranked |
| 2012-2014 | $ | 241.5 | Average annual congestion cost |
| 2015-2017 | $ | 31.5 | Average annual congestion cost |

Table 1 summarizes the congestion information from the Monitoring Analytics annual reports.

**Q. How did the dramatic decline in congestion event hours affect your analysis of non-transmission alternatives?**

A. First, the decline in the number of congestion event hours and the congestion costs reduces the severity of the problem and the benefits derived from resolving the problem. In other words, the amount of money that could or should be invested to resolve the congestion problem is greatly reduced. That would apply to transmission as well as non-transmission alternatives.

Second, non-transmission alternatives are frequently time dependent. As such, the narrowing of the number of congestion event hours would probably limit the non-transmission resources available to address these congestion events.

**Q. Reducing the number of congestion event hours would clearly reduce the severity of the congestion, and thus the need for the project. Please explain how reducing the number of congestion hours could affect the viability of potential non-transmission resources?**

A. The non-transmission alternatives I have analyzed consist of energy efficiency, demand response, and distributed generation resources (e.g., renewable energy and combined heat and power (CHP)). It is important to know when the congestion events can occur in order to identify the resources that are available at those times. For example, if the constraint occurs during the off-peak winter hours, it would not make sense to focus on air conditioner efficiency programs, or air conditioner demand response programs. For an off-peak winter constraint, lighting and space heating efficiency programs may be viable, along with wind generation and CHP. For summer on peak congestion hours, air conditioner efficiency and demand response programs, solar photovoltaic's and CHP may be a better fit.

Generally speaking, the more the annual congestion hours, the larger the portfolio of non-transmission alternative resources are available. Thus, the reduction in reported congestion hours shown in Table 1 would be expected to reduce the non-transmission alternative resources available. In addition, the fewer the hours of congestion, the more precisely they should be characterized to ensure that the alternative resources selected are

likely to be available at those times. Stated differently, if the congestion occurs 6,000 hours per year, a larger set of non-transmission resources will contribute to reducing congestion than if congestion occurs 60 hours per year.

**Q. Did Transource or PJM provide you with a useful characterization of when congestion events are likely to occur?**

A. No. They did not narrow it down by season, month, week, or hour of day. In response to OCA-XIII-01, Witness McGlynn stated that "Power flow on the lines that comprise the AP South reactive Interface can vary by hour, day, month and season.... AP South Reactive Interface constraints can be seen at any hour of the operating day (24-hour period) at any point during the year."

In response to OCA-XXI-03, Witness McGlynn further clarified it is theoretically possible to have constraints occur any time of day or time of year, and that he was not suggesting that there is an equal probability that a constraint can occur in any hour of the year.

Even though the actual hours of congestion have dropped dramatically, Transource and PJM repeatedly indicated that the congestion could occur any time of day, any day of the year. In effect, any non-transmission alternative resource may contribute to mitigating the potential for congestion, irrespective of when the resource is available, because the congestion can occur at any time.

**Q. What were your design targets for the non-transmission alternatives?**

A. I looked for resources that could be located to the east and south of the AP South Reactive Interface, generally northern Virginia, Maryland and District of Columbia. I looked for any resource available any time of day or year, but considered those resources available between 7AM and 10PM to be typically more valuable as an alternative to the IEC Project.

## END-USE ENERGY EFFICIENCY MEASURES & RENEWABLE RESOURCES

**Q. Before you continue could you first explain what energy conservation, energy efficiency, demand response, renewable energy resources are and why they are relevant to the proposed IEC Project?**

- Energy Conservation (EC) can be defined as the reduction in the amount of energy consumed in process or system, or by an organization or society, through economy, elimination of waste, and rational use.

- Energy efficiency (EE) can be defined as a percentage of total energy input to a building, machine or equipment that is consumed in useful work and not wasted as useless heat. This definition pertains to homes, businesses, cooled air and heated water and a multitude of end uses and generally means to do more with the same or a lesser amount of energy without amenity loss. New Home construction, high efficiency lighting, air conditioning, and refrigerators are all examples of commonly employed strategies to promote energy efficiency.

- Demand Response (DR) can be defined as a means for consumers to impact the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Methods of engaging customers in demand response efforts include time-sensitive rates such as critical peak pricing, real time pricing, time-of-use pricing, variable peak pricing, critical peak rebates and other options.

- Renewable Resources:

  - Solar: Solar resources can be either utility scale or small scale and typically customer owned. Solar cells are used to generate electricity from sunlight. It is a device that converts light energy into electrical energy. Solar energy is a flexible energy technology, which can be built as distributed generation (located at or near the point of use) or as a central-station, utility-scale solar power plant (similar to traditional power plants). Both of these methods can also store the energy they produce for distribution after the sun sets using storage technologies.

  - Wind Energy Resources can be defined as wind power, a widely applied and accepted renewable energy resource. Historically, wind power in the form of windmills has been used for centuries for such tasks as grinding grain and pumping water. Modern commercial wind turbines produce electricity by using rotational energy to drive an electrical generator. Wind energy can also be stored using battery storage technologies and distributed after the wind dissipates.

- Renewable energy storage is typically referred to as Battery Storage. It is a device that reserves energy for later consumption and is charged by a connected solar or wind system. The stored electricity can be consumed after sundown, the wind dissipates, during energy demand peaks, constrained/congested transmission conditions or during a power outage.

**Q. Did PJM analyze and assess increased energy efficiency resource strategies as a potential non-wires alternative in assessing the economic viability of the IEC Project?**

A. Not that I am aware of. See Exhibit OCA-3-3 wherein the Company response to OCA's discovery question OCA-IV-24 was that "The Company lacks information to form a belief about the conduct of other electric utilities. The Company further states that levels of energy efficiency, demand responses, wind resources, solar resources and other distributed energy resources are assumptions incorporated into PJM's RTEP at the start of the RTEP process cycle pursuant to PJM's Operating Agreement, Schedule 6, 1.5.3."

However, in my review of the analytics that were done when PJM was considering the various congestion reduction projects, I saw no evidence that PJM assessed the need for the IEC Project with and without significantly increased levels of energy efficiency resources e.g., commercial lighting in the congested zones.

Q. **Did PJM analyze and assess increased solar and wind renewable resources (in combination with storage systems) as a potential non-wires alternative in assessing the economic viability of the IEC Project?**

Not that I am aware of. See Exhibit OCA-3-3 wherein the Company response to OCA's discovery question OCA-IV-24 was that "The Company lacks information to form a belief about the conduct of other electric utilities. The Company further states that levels of energy efficiency, demand responses, wind resources, solar resources and other distributed energy resources are assumptions incorporated into PJM's RTEP at the start of the RTEP process cycle pursuant to PJM's Operating Agreement, Schedule 6, 1.5.3." However, in my review of the analytics that were done when PJM was considering the various congestion reduction projects, I saw no evidence that PJM assessed the need for the IEC Project with and without significantly increased levels of distributed resources e.g., Utility scale wind resources in the congested zones.

Q. **Did PJM analyze and assess increased Distributed Generation resource strategies as a potential non-wires alternative in assessing the economic viability of the IEC Project?**

A. Not that I am aware of. See Exhibit OCA-3-3 wherein the Company response to OCA's discovery question OCA-IV-24 was that "The Company lacks information to form a belief about the conduct of other electric utilities. The Company further states that levels of energy efficiency, demand responses, wind resources, solar resources and other distributed energy resources are assumptions incorporated into PJM's RTEP at the start

of the RTEP process cycle pursuant to PJM's Operating Agreement, Schedule 6, 1.5.3." However, in my review of the analytics that were done when PJM was considering the various congestion reduction projects, I saw no evidence that PJM assessed the need for the IEC Project with and without significantly increased levels of distributed generation resources.

**Q. Did PJM include state energy efficiency or renewable resource mandates and requirements in conducting its analysis to approve the IEC Project?**

A. No. OCA XIII-14 indicated that PJM had not conducted studies to identify the impact of existing or imminent state-approved utility programs for energy efficiency, demand response, CHP or renewable resources as it relates to the need for the IEC Project. See Exhibit OCA-3-4

**Q. Is information available regarding the potential for Energy Efficiency and Renewable resources in Virginia?**

A. Yes. The Virginia General Assembly earlier this year, adopted a law that encourages the increased reliance on renewable energy and energy efficiency resources by passing the Grid Transformation and Security Act of 2018 (the "GTSA"), which became effective in March 2018. The new law finds that up to an additional 5,000 MW of utility-scale electric generating facilities powered by solar and wind energy is in the public interest, and in addition finds that an additional 500 MW of non-utility scale solar or wind generating facilities, including rooftop solar installations are in the public interest.

The GTSA also encourages increased demand-side management programs to help customers conserve energy and reduce system peak loads. This law will cause the implementation of energy efficiency and demand response programs capable of reducing customers' overall annual energy usage by 805 gigawatt-hours (GWh) and system peak demand by 304 MW by 2033.

The GTSA requires Virginia Power Company (Dominion) to commit at least $870 million to implement energy efficiency programs for the period beginning July 1, 2018, and ending July 1, 2028, which includes Virginia Power's existing energy efficiency programs.

**Q. Why is the passage of the GTSA in Virginia relevant to the IEC Project?**

A. It is relevant for several reasons.

- Virginia is in the target zone for locating alternative non-transmission resources that would unload the congested transmission lines of the AP South reactive Interface. GTSA will reduce the load in Virginia, and thus will tend to mitigate congestion levels on the AP South Reactive Interface, which would reduce the projected market inefficiency. Accordingly, the implementation of GTSA will reduce the purported benefits (and need for) the IEC Project.

- The largest beneficiary of the IEC Project, as modeled by PJM, is Dominion, which is also the largest electric distributor in Virginia. In 2016, Dominion sold or distributed 68% of the electricity consumed in Virginia. Being the largest

beneficiary of the IEC Project means that Dominion is the zone most adversely affected by the congestion – it faces the highest duration and/or magnitude and/or price differentials due to transmission congestion. This means actions reducing loads at Dominion will relieve the congestion on the AP South Reactive Interface. Because of Dominion's dominance as an electricity supplier in Virginia, a statewide action such as GTSA will have a profound impact on Dominion.

- The GTSA is proof that States and utilities in the PJM footprint are serious about energy efficiency and renewable energy and are taking actions to achieve more of it. Energy efficiency and renewable energy are not merely potentials, but will be profoundly affecting the loads and load shapes PJM will attempt to serve.

- The impacts of the GTSA on reducing load in the target area and relieving transmission congestion were not considered by PJM, neither when the IEC Project was selected nor in any of the re-evaluations, including the one most recently presented to the TEAC on September 13, 2018.

Q. How much would you expect GTSA to reduce Dominion's forecasted loads?

A. With 68% of Virginia's load in Dominion's service territory, I would expect about 68% of the GTSA targets to be achieved in Dominion's service territory. Dominion's load would be reduced by 206 MW and 545 GWH/year as a result of energy efficiency and 3,723 MW as a result of renewable energy. Using a conservative assumption that on average wind and solar generation has a capacity factor of 20%, the renewable energy

sources would reduce Dominion's annual energy needs by 6,523 GWH. These are significant reductions.

Q. **Has the District of Columbia undertaken an assessment of energy efficiency and renewable resources in the District of Columbia?**

A. Yes. The District of Columbia's Department of the Environment conducted an analysis wherein they quantified the economic energy efficiency potential in the District of Columbia to be 5,537,521 MWh/yr in 2022. In addition the District of Columbia's Department of the Environment estimated that there is a technical potential of 2,498,000 MWh/year for rooftop PV and Urban Utility scale PV potential in the District of Columbia.

**Q. Why is this activity in the District of Columbia relevant to the IEC Project?**

A. It is relevant for several reasons.

- The District of Columbia is in the target zone for locating alternative non-transmission resources that would unload the congested transmission lines and thus will tend to mitigate congestion levels on the AP South Reactive Interface. Efforts to reduce the load in the District of Columbia and mitigate congestion would reduce the projected market inefficiency. It would reduce the purported benefits of the IEC Project.

- The second largest beneficiary of the IEC Project, as modeled by PJM, is PEPCo, which is also the largest electric distributor in the District of Columbia. In 2016, PEPCo sold or distributed 58% of the electricity consumed in DC. Being the

second largest beneficiary of the IEC Project means that PEPCo is adversely affected by the congestion. Actions reducing loads at PEPCo will relieve the congestion on the AP South Reactive Interface.

- The District of Columbia City Council recently determined that by 2032 half of the electric energy used in the District of Columbia should be supplied by solar photovoltaics. With electric sales in the District in 2016 being nearly 20,000 GWH, half of the energy from renewables would amount to about 10,000 GWH. Again, this is proof that States and utilities in the PJM footprint are serious about energy efficiency and renewable energy and are taking actions to achieve more of it. Energy efficiency and renewable energy will be profoundly affecting the loads and load shapes PJM will attempt to serve.

**Q.** How much would you expect energy efficiency and renewable energy initiatives in the District of Columbia to reduce PEPCo's forecasted loads?

A. I have assumed that 15% of the economic potential for energy efficiency as quantified by District of Columbia's Department of the Environment would be captured. With 58% of the load in the District of Columbia, I would expect about 58% of the captured load to be PEPCo's load. PEPCo's load would be reduced by 479 GWH annually as a result of energy efficiency. I assumed that 5% of the renewable energy technical potential as quantified by District of Columbia's Department of the Environment would be captured, yielding 72 GWH of renewable energy. Assuming PEPCo's energy efficiency programs would deliver results similar to Dominion's, energy efficiency would reduce PEPCo's peak demand by 181 MW. Using a conservative assumption that on average wind and

solar generation has a capacity factor of 20%, the renewable energy sources would add about 41 MWs of capacity

**Q. Is information available regarding the potential for Energy Efficiency and Renewable resources in Maryland?**

A. Yes. The Maryland Legislature passed a law in April 2017 that mandated a 2% per year reduction in electric energy use. With Maryland's electric energy use in 2016 at over 93,000 GWH, the 2% mandate would be 1,868 GWH.

**Q. Why is this activity in Maryland relevant to the IEC Project?**

A. It is relevant for several reasons.

- Maryland is in the target zone for locating alternative non-transmission resources that would unload the congested transmission lines and thus will tend to mitigate congestion levels on the AP South Reactive Interface. Efforts to reduce the load in the Maryland would mitigate the congestion, which would reduce the projected market inefficiency. It would reduce the purported benefits of the IEC Project.

- The third largest beneficiary of the IEC Project, as modeled by PJM, is BGE, which is also the largest electric distributor in Maryland. In 2016, BGE sold or distributed 32% of the electricity consumed in MD. Being a large beneficiary of the IEC Project means that BGE is adversely affected by the congestion. Actions reducing loads at BGE will relieve the congestion on the AP South Reactive Interface.

- The statutory efficiency mandate is proof that States and utilities in the PJM footprint are serious about energy efficiency and renewable energy and are taking actions to achieve more of it. Energy efficiency and renewable energy will be profoundly affecting the loads and load shapes PJM will attempt to serve.

- It is unclear whether and how this Maryland energy efficiency mandate was incorporated into PJM's planning. Clearly it was not included in the forecasts when the IEC Project was selected, as the selection process predated the legislation. However, the impacts of this legislation may not have yet fully made their way into the end use energy intensity trendlines utilized in PJM's recent forecasting models.

Q. How much would you expect energy efficiency and renewable energy initiatives in Maryland to reduce BGE's forecasted loads?

A. With 32% of the load in the Maryland, I would expect about 32% of the captured load to be BGE's load. BGE's load would be reduced by about 600 GWH annually as a result of energy efficiency. Assuming BGE's energy efficiency programs would deliver results similar to Dominion's, energy efficiency would reduce BGE's peak demand by about 227 MW.

**Q. Are you proposing specific energy efficiency, demand response, or renewable portfolios for Maryland, the District of Columbia or Virginia?**

A. I am not recommending that any particular state specific programs be implemented in a certain manner as alternatives to the IEC Project. How these programs are enacted, rolled out, implemented, maintained & improved is up to the local jurisdiction, Public Utility Commission, or Legislature in those areas.

I am identifying viable non-wires alternatives that do exist beyond merely building new transmission infrastructure.

## DISTRIBUTED GENERATION RESOURCE PROGRAMS

**Q. How much CHP resource is available in the target area comprised of Maryland, Virginia and the District of Columbia?**

A. According to the United States Department of Energy 2016 Technical potential study there is 7,861 MW's of CHP technical potential in the District of Columbia, Maryland and Virginia. Technical potential is defined as the estimation of market size constrained only by technological limits without regard to economic or market factors.

**Q. How much of this technical potential CHP resource is likely to be developed?**

A. That is difficult to forecast, since each CHP unit is in essence customized to the specific heat and electrical needs of the company installing it. However, to provide some context, I've assumed that 5% of the technical potential is developed, or about 400 MW in the District of Columbia, Maryland and Virginia.

**Q. Did you estimate how much of the CHP resource would be developed in Dominion, PEPCo and BGE?**

A. Yes. CHP would be developed primarily in the commercial and industrial sectors. For purposes of this assessment, I assumed that 400 MW would be allocated by the amount of commercial/industrial sales in Dominion, PEPCo and BGE in proportion to the combined commercial/industrial sales in the District of Columbia, Maryland and Virginia. On that basis, about 131 MW of CHP would be developed in Dominion, 47 MW in BG&E and 24 MW in PEPCo and would reduce demand.

CHP units will have high utilization rates (a high percentage of capacity that a device is expected to be used productively). I've assumed capacity factors(ratio of actual output compared to a period of time a unit is a providing full nameplate output) averaging 70%. On that basis, about 802 GWH of CHP would be developed in Dominion, 286 GWH in BGE and 144 GWH in PEPCo.

## DEMAND RESPONSE PROGRAMS

**Q. Is Demand Response considered to be a good fit when considering a transmission related economic efficiency project?**

A. No. DR is a short term, "peaky" response strategy that is valuable when dealing with an acute short-term load imbalance and system reliability issues. The value of DR applied to an economic efficiency project is very limited because demand response resources are designed to respond to short-term load imbalance conditions. Energy efficiency measures and resources produce benefits over long periods of time and are more valuable and responsive to a transmission congestion/constraint condition.

## NON-TRANSMISSION ALTERNATIVES SUMMARY

**Q. Would inclusion of the non-wire alternatives mentioned earlier in this testimony impact the benefit cost ratio for The IEC Project?**

A. Yes. MD, VA and DC have a significant magnitude of energy efficiency, renewable energy and distributed generation potential. Even with the conservative assumptions I have built into my assessment, the amount of energy efficiency, renewable energy and CHP that will be developed over the next 15 years in the target zone will be the equivalent of a moderately sized utility. As shown in Table 2, the load reduction on the target utilities due to these resources could be on the order of 36% of the size of PEPCo and 47% of the size of West Penn Power. These are substantial impacts. Some are already underway through formal initiatives, while others are likely to develop due to economics and resource use.

Table 2 Revised

| NON-TRANSMISSION ALTERNATIVE RESOURCES | | | | |
|---|---|---|---|---|
| **ENERGY GWH** | | | | |
| | Energy Efficiency | Renewable Energy | CHP | Total |
| Dominion | 545 | 6,523 | 802 | 7,870 |
| PEPCo | 479 | 72 | 144 | 695 |
| BGE | 600 | 0 | 286 | 886 |
| TOTAL | 1,624 | 6,595 | 1,232 | 9,451 |
| | | | PEPCO 2016 Sales | 26,114 |
| | | | TOTAL as % of PEPCO | 36% |
| | | | West Penn Power 2016 Sales | 19,966 |
| | | | TOTAL as % of West Penn | 47% |
| **CAPACITY MW** | | | | |
| | Energy Efficiency | Renewable Energy | CHP | Total |
| Dominion | 206 | 3,723 | 131 | 4,060 |
| PEPCo | 181 | 41 | 24 | 246 |
| BGE | 227 | 0 | 47 | 273 |
| TOTAL | 614 | 3,764 | 201 | 4,579 |
| | | | PEPCO 2016 Peak | 5,786 |
| | | | TOTAL as % of PEPCO | 79% |
| | | | West Penn Power 2016 Peak | 3,947 |
| | | | TOTAL as % of West Penn | 116% |

PJM did not give due consideration to these alternatives in their benefit/cost analysis. The impact of including the alternatives mentioned above would impact the economic viability of The IEC Project.

**Q. Please summarize your recommendations in this case.**

A. The Commission should adopt the following recommendations, in this case:

(1) Non-transmission alternatives exist and are available, which reduce the need for the IEC Project and should be recognized and included in the assessment gauging the need for the IEC Project.

(2); Energy efficiency, renewable energy resources, distributed resources can offset transmission congestion during any hour, day, month, season and at any point during the year and this was not reflected in PJM's analysis.

(3); The proposed IEC Project should not be authorized;

**Q. Does this complete your testimony?**

A. Yes.

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

| | | |
|---|---|---|
| Application of Transource Pennsylvania, LLC for approval of the Siting and Construction of the 230 kV Transmission Line Associated with the Independence Energy Connection - East and West Projects in portions of York and Franklin Counties, Pennsylvania. | : | A-2017-2640195<br>A-2017-2640200 |
| Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Rice Substation in Franklin County, Pennsylvania is reasonably necessary for the convenience or welfare of the public. | : | P-2018-3001878 |
| Petition of Transource Pennsylvania, LLC for a finding that a building to shelter control equipment at the Furnace Run Substation in York County, Pennsylvania is reasonably necessary for the convenience or welfare of the public. | : | P-2018-3001883 |
| Application of Transource Pennsylvania, LLC for approval to acquire a certain portion of the lands of various landowners in York and Franklin Counties, Pennsylvania for the siting and construction of the 230 kV Transmission Line associated with the Independence Energy Connection – East and West Projects as necessary or proper for the service, accommodation, convenience or safety of the public. | : | A-2018-3001881, *et al.* |

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VERIFICATION

I, Geoffrey Crandall, hereby state that the facts above set forth in my Direct Testimony OCA Statement No. 3 are true and correct and that I expect to be able to prove the same at a hearing held in this matter. I understand that the statements herein are made subject to the penalties of 18 Pa.C.S. § 4904 (relating to unsworn falsification to authorities).

Signature: _____

Geoffrey Crandall
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crandall@msbnrg.com

DATED: September 25, 2018
*259206

# OCA Witness Crandall
# EXHIBIT OCA 3-1

Résumé of

Geoffrey C. Crandall

Vice President and Principal

EDUCATION

B.S. in Business and Pre-Law, Western Michigan University, 1974.

Mr. Crandall has also completed courses at Michigan State University Graduate School, the University of Wisconsin-Madison and Wayne State University, in areas of federal taxation, accounting, management and the economics of utility regulation. Mr. Crandall also completed the examination for the National Conference of States on Building Codes and Standards Energy Auditor.

EXPERIENCE

Mr. Crandall joined MSB in January 1990. Mr. Crandall has addressed issues related to fuel and purchase power, natural gas, re-regulation, planning, regulatory issues, residential and low-income issues, energy efficiency and impacts of utility restructuring on customers in California, New York, Colorado, Iowa, and Michigan. He has analyzed and/or designed energy efficiency programs for residential customers in Michigan, Georgia, Wisconsin, Arizona, and New Orleans, and has conducted workshops on system planning, energy efficiency, low-income restructuring and energy efficiency issues in over 20 states, including Washington, Hawaii, Nevada, Kansas, Michigan, Rhode Island, California, Virginia, and New Orleans. Mr. Crandall has analyzed integrated resource plan and or energy efficiency programs in the states of Arizona, Georgia, Hawaii, Illinois, Maine, Michigan, Minnesota, North Carolina, Ohio, Pennsylvania, Utah, Washington State, California, Iowa, Montana, Colorado, Missouri, Virginia, Wisconsin, and Washington D.C.

Prior to joining MSB, Mr. Crandall was employed by the Michigan Public Service Commission from 1974 through 1989, where he served in several capacities including analyst in the rates and tariff section, Technical Assistant to the Chief of Staff, and as the Director of the Demand-Side Management Division. He had responsibilities that included rate and tariff review, rate cases, utilities uncollectible and bad debts, integrated resource planning, the development, implementation and monitoring of government- and utility-sponsored demand-side management, energy-efficiency and load response policies and programs. These activities involved customers in the residential, commercial, industrial and institutional sectors.

Mr. Crandall has dealt with a wide variety of regulatory issues beyond energy efficiency, including utility diversification, incentive regulation, utility billing practices, utility power plant maintenance and management of plant outages.

Mr. Crandall served as Chair of the NARUC Energy Conservation Staff Subcommittee from 1986-1989. He has lectured and made presentations to many groups on demand-side programs and least-cost planning, including two NARUC-sponsored least-cost planning conferences; the 1990 NARUC Regional Workshops on Least-Cost Utility Planning in Newport, Rhode Island and Little Rock, Arkansas; the Wisconsin Public Service Commission's Integrated Resource Planning Workshop; the 1988, 1989, and 1990 Michigan State University Graduate School of Public Utilities and the U.S. Department of Energy.

Mr. Crandall has testified before the: United States Congress, Michigan Legislature, Michigan Public Service Commission, North Carolina Utilities Commission, Public Service Commission of the District of Columbia, Illinois Commerce Commission, Maine Public Utilities Commission, Massachusetts Department of Public Utilities, Public Service Commission of Hawaii, Minnesota Public Service Commission, Iowa Public Service Commission, Georgia Public Service Commission, Public Utility Commission of Ohio, Virginia Public Service Commission, Wisconsin Public Service Commission, and the City Council of the City of New Orleans, Louisiana.

Mr. Crandall has written several articles published in the Public Utilities Fortnightly and Electricity Journal, Natural Gas Magazine, and a number of proceedings for the Biennial Regulatory Information Conference and the American Council for an Energy-Efficient Economy.

TESTIMONY

Case No. U-5531, (8/77), Consumers' Power Company electric rate increase application. Mr. Crandall served as the Staff Witness and recommended that the Applicant initiate the Residential Electric Customers' Information program.

Case No. U-6743, (3/81), Michigan Consolidated Gas Company. Mr. Crandall served as the Staff policy witness and recommended that the Commission approve a surcharge to cover all reasonable and prudent costs associated with Applicant's implementation of the Michigan Residential Conservation Services Program.

Case No. U-6819, (6/81), Michigan Power Company-Gas. Mr. Crandall served as the Staff policy witness and described the basis for the program and the expected level of activity, recommending that the Commission approve a surcharge to cover all reasonable and prudent costs associated with Applicant's implementation of the Michigan Residential Conservation Service Program.

Case No. U-6787, (6/81), Michigan Gas Utilities Company. Served as the Staff policy witness and described the basis for the program and the expected level of activity, recommending that the Commission approve a surcharge to cover all reasonable and prudent costs associated with the implementation of the Michigan Residential Conservation Service Program.

Case No. U-6820, (6/81), Michigan Power Company-Electric. Served as the Staff policy witness and reviewed the Applicant's request to operate the Michigan Residential Conservation Service Program. Although not mandated by federal law, Applicant chose to operate the program in conjunction with its other services offered to residential gas customers. Recommended the establishment of a surcharge to cover all reasonable and prudent costs associated with the operation of that program.

Case No. U-5451-R, (10/82), Michigan Consolidated Gas Company. Served as the Staff policy witness and described the Staff's position regarding Applicant's proposed adjustment of surcharge level. Recommended that the eligibility criteria for customers be adjusted to more accurately reflect proper fuel consumption and to include customers who would be likely to realize a seven-year return on their investment by installing flue-modification devices in conjunction with Applicant's financing program.

Case No. U-6743-R, (10/82), Michigan Consolidated Gas Company. Served as the Staff policy witness regarding the Applicant's proposed expenses and revenues, as well as the reasonableness of activity and expense levels in the company's projected period.

Case No. U-7341, (12/84), Detroit Edison Company, Request for Authority for Certain Non-Utility Business Activities. Represented the Staff's position during settlement discussions and sponsored the settlement agreement.

Case No. U-6787-R, (3/84), Michigan Gas Utilities Company. Served as the Staff witness regarding the Applicant's proposed expenses and revenues. This also included a review of the company's future expenses associated with the Energy Assurance Program, the Specialized Unemployed Energy Analyses, and the Michigan Business Energy Efficiency Program expenses.

Case No. U-8528, (3/87), Commission's Own Motion on the Costs, Benefits, Goals and Objectives of Michigan's Utility Conservation Programs. Represented the Staff on the costs and savings of conservation programs and the other benefits of existing programs, and described alternative actions available to the Commission relative to future energy-conservation programs and services and other conservation policy matters.

Case No. U-8871, et al., (4/88), Midland Cogeneration Venture Limited Partnership. For approval of capacity charges contained in a power-purchase agreement with Consumers' Power Company. Served as the Staff witness on Michigan conservation potential and reasonably achievable programs that could be operated by Consumers' Power Company, and testified to the potential impact of these conservation programs on the Company's request for use of its converted nuclear plant cogeneration project. Also recommended levels of demand-side management potential for the commercial, industrial and institutional sectors in Consumers' Power service territory.

Case No. U-9172, (1/89), Consumers' Power Company, Power-Supply Cost-Recovery Plan and Authorization of Monthly Power-Supply Cost-Recovery Factors for 1989. Served as Staff witness on the conservation potential and reasonably achievable programs that could be operated by Consumers' Power Company. Testified to the potential impact of these conservation programs

on the Company's fuel and purchase practices, its five-year forecast and the fuel factor. Recommended levels of demand-side management potential for the commercial, industrial and institutional sectors in Consumers' Power service territory as an offset to its more-expensive outside and internally generated power. Suggested that CPCO vigorously pursue conservation, demand-side management research, and planning and program implementation.

Case No. U-9263, (4/89), Consumers' Power Company Request to Amend its Gas Rate Schedule to Modify its Rule on Central Metering. Served as a Staff witness on the conservation effect of converting from individual metered apartments to a master meter. Suggested that the Commission continue its moratorium on the master meters, due to the adverse energy-conservation and efficiency impact.

Case No. E-100, (1/90), North Carolina Public Service Commission proceeding on review of the Duke Power Company's least-cost utility plan. Testified on behalf of the North Carolina Consumers' Council regarding utility energy-efficiency and demand-side management programs and the concept of profitability and implementation of demand-side management programs.

Case No. 889, (1/90), Public Service Commission of the District of Columbia. Testified on behalf of the Government of the District of Columbia in the Potomac Electric Power Company's application for an increase in its retail rates (general rate case). Sponsored testimony regarding the design and implementation and overall appropriateness of PEPCO's existing and proposed energy-efficiency and conservation programs.

Case No. 889, (4/90), Public Service Commission of the District of Columbia. Provided supplemental direct testimony and testified on behalf of the Government of the District of Columbia in the Potomac Electric Power Company's application for an increase in its retail rates (general rate case). Offered supplemental testimony regarding a more detailed review of PEPCO's existing pilot and full-scale energy-efficiency and conservation programs. Offered suggestions and recommendations for a future direction for PEPCO to pursue in order to implement more cost-effective and higher-impact energy-efficiency and conservation programs.

Case No. ICC Docket 90-004 and 90-0041, (6/90), Illinois Commerce Commission proceeding to adopt an electric-energy plan for Central Illinois Light Company (CILCO). Testified on behalf of the State of Illinois, Office of Public Counsel and the Small-Business Utility Advocate. Reviewed the CILCO electric least-cost plan filing and the conservation and load-management programs proposed in its filing. Sponsored testimony regarding my analysis of the proposed programs, and offered alternative programs for the Company's and the Commission's consideration.

Case No. D.P.U. 90-55, (6/90), Commonwealth of Massachusetts Department of Public Utilities. Testified on behalf of the Commonwealth of Massachusetts, Division of Energy Resources. Reviewed and analyzed Boston Gas' proposed energy-conservation programs that were submitted for pre-approval in its main rate case. In addition, suggested that it might consider implementation of other natural-gas energy- efficiency programs, and not award an economic incentive for energy-efficiency and conservation programs until minimum program-implementation standards are satisfied.

Case No. U-9346, (6/90), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency Association. Reviewed and analyzed the Consumers' Power Company rate-case filing related to energy-efficiency and demand-side management programs. Proposed alternative energy-efficiency programs and recommended program budgets and a cost-recovery mechanism.

Case No. 89-193; 89-194; 89-195; and 90-001, (6/90), Maine Public Utilities Commission. Testified on behalf of the Maine Public Advocate's Office. Reviewed the appropriateness of Bangor Hydro-Electric Company's existing energy-efficiency and demand-side management programs in the context of BHE's main rate case and request for approval to construct the Basin Mills Hydro-Electric dam. Reviewed the overall resource plan and suggested alternative programs to strengthen the energy-efficiency and demand-side management resource efforts.

Case No. 6617, (4/91), Hawaii Public Utility Commission. Testified on behalf of the Hawaii Division of Consumer Advocacy. Described what demand-side management resources are, why they should be included in the integrated resource planning process, and proposed the implementation of several pilot projects in Hawaii along with guidelines for the pilot programs.

Case No. E002/GR-91-001, (5/91), Minnesota Public Utilities Commission. Testified on behalf of Minnesotans for an Energy Efficient Economy. Assessed the DSM programs being operated or proposed by Northern States Power Company and made recommendations as to ways in which NSP could improve its DSM efforts.

Case No. 905, (6/91), Public Service Commission of the District of Columbia. Testified on behalf of the District of Columbia Energy Office. Responded to the energy-efficiency and load management aspects of Potomac Electric Company's filing and made several recommendations for DC-PSC action.

Case No. 6690-UR-106, (9/91), Public Service Commission of Wisconsin. Testified on behalf of The Citizens' Utility Board of Wisconsin. Assessed the DSM programs being operated or proposed by the Wisconsin Public Service Corporation, made recommendations as to the WPSCO energy efficiency programs, and suggested ways the company could improve its DSM efforts.

Case No. E002/CN-91-19, (12/91), Minnesota Public Utilities Commission. Testified on behalf of Minnesota Department of Public Service. Assessed the DSM potential and programs being operated or proposed by Northern States Power Company and made recommendations as to the potential for energy efficiency in the NSP service territory and ways in which NSP could improve its DSM efforts.

Case No. 912, (4/92), Public Service Commission of the District of Columbia. Testified on behalf of the Government of the District of Columbia in the Potomac Electric Power Company's application for an increase in its retail rates for the sale of electric energy. Testified regarding the reasonableness of DSM and EUM policy changes, the cost allocation of the DSM and EUM expenses, an examination of the prudence of management regarding the energy-efficiency

programs, and an examination of the appropriateness of the costs associated with energy-efficiency programs.

Case No. PUE 910050, (5/92), Virginia State Corporation Commission. Testified on behalf of the Citizens for the Preservation of Craig County regarding the need for the Wyoming-Cloverdale 765 kV transmission line. Specifically, addressed the adequacy of the DSM planning of Appalachian Power Company and Virginia Power/North Carolina Power. Made recommendations as to APCO and VEPCO's energy efficiency programs, and suggested ways the company could improve its DSM efforts.

Case No. EEP-91-8, (5/92), Iowa Utilities Board. Testified on behalf of the Izaak Walton League concerning the adequacy of Iowa Public Service Company's Energy Efficiency Plan. Reviewed the plan and suggested modifications to it.

Case No. 4131-U and 4134-U, (5/92), Georgia Public Service Commission. Testified on behalf of the Georgia Public Service Commission staff regarding the demand-side management portions of Georgia Power Company's and Savannah Electric and Power Company's Integrated Resource Plans. Testimony demonstrated that it is reasonable for the Commission to expect that the utilities can successfully secure substantial amounts of demand-side management resources by working effectively with customers.

Case No. 917, (8/92), Public Service Commission of the District of Columbia. Testified on behalf of the District of Columbia Energy Office in hearings on Potomac Electric Power Company's Integrated Resource Planning process. Addressed a number of program-specific issues related to PEPCO's demand-side management efforts.

Case No. 4132-U, 4133-U, 4135-U, 4136-U, (10/92), Georgia Public Service Commission. Testified on behalf of the Staff Adversary IRP Team of the Georgia PSC. Provided a critique of Georgia Power Company's and Savannah Electric and Power Company's proposed residential and small commercial DSM programs.

Case No. 4135-U, (3/93), Georgia Public Service Commission. Testified on behalf of the Staff Adversary IRP Team of the Georgia PSC. Provided a critique of Savannah Electric and Power Company's proposed Commercial and Industrial DSM programs.

Case No. R-0000-93-052, (12/93), Arizona Corporation Commission. Testified on behalf of the Arizona Community Action Association. Critiqued and made recommendations regarding the integrated resource plans and demand-side management programs of Arizona Public Service Company and Tucson Electric Power Company.

Case No. 934, (4/94), Public Service Commission of the District of Columbia. Filed testimony on behalf of the District of Columbia Energy Office in hearings concerning the Washington Gas Light Company (WGL) general rate case application to increase existing rates and charges for gas service. Testimony involved critiquing and reviewing WGL's least cost planning efforts and integration of DSM, marketing and gas supply efforts.

Case No. U-10640, (10/94), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency Association concerning the need to integrate DSM and load promotion analysis into MichCon's GCR planning process.

Case No. 05-EP-7, (3/95), Wisconsin Public Service Commission. Testified on behalf of the Citizens' Utility Board on level of utility DSM and program designs and strategies.

Case No. 05-EP-7, (3/95), Wisconsin Public Service Commission. Testified on behalf of the Wisconsin Community Action Program Association on low-income customers and utility DSM programs.

Case No. TVA 2020-IRP, (9/95), Tennessee Valley Authority. Testified on behalf of the Tennessee Valley Energy Reform Coalition. Assessed, critiqued and made recommendations regarding the integrated resource plans and demand-side management programs proposed by the Tennessee Valley Authority.

Case No. R-96-1, (10/95), Alaska Public Utilities Commission. Testified on behalf of the Alaska Weatherization Directors Association regarding the proposed standards and guidelines for integrated resource planning and energy efficiency initiatives under consideration in Alaska.

Case No. D95.9.128, (2/96), Montana Public Service Commission. Testified on behalf of the District XI Human Resources Council concerning the low-income energy efficiency programs offered by the Montana Power Company.

Case No. DPSC Docket No. 95-172, (5/96), Delaware Public Service Commission. Prepared draft testimony on behalf of the Low-Income Energy Consumer Interest Group regarding Delmarva Power & Light Company's application to revise its demand-side programs. The case was settled, with LIECIG obtaining funding for low-income energy efficiency programs, prior to testimony.

Case No. U-11076, (8/96), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Michigan Jobs Commission's recommendations regarding electric and gas reform. Discussed the implications of utility restructuring and the needs of residential and low-income households, and proposed regulatory and industry solutions.

Case No. 96-E-0897, (3/97), New York Public Service Commission. Prepared draft testimony for New York's Association for Energy Affordability regarding the impact of proposed utility restructuring plans on low-income customers. The case was settled in Spring 1997.

Case No. R-00973954, (7/97), Pennsylvania Public Utilities Commission. Testified on behalf of the Commission on Economic Opportunity regarding the economics of demand-side measures and programs proposed for implementation by Pennsylvania Power & Light Company.

Case No. 98-07-037, (7/98), California Public Utilities Commission. Testified on the California Alternative Rates for Energy and the Low Income Energy Efficiency programs regarding the

implementation and adoption of revisions to these programs necessitated by the AB 1890 and the Low Income Governing Board.

Case No. U-12613, (3/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Wisconsin Public Service Corporation application to implement PA 141 the electricity deregulation law. I reviewed the portions of the filing related to their provision of electric energy efficiency and load management.

Case No. U-12649, (3/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Wisconsin Electric Power Company and the Edison Sault Electric Company application to implement PA 141 Michigan's electricity deregulation law. I reviewed the portions of the filing related to their provision of electric energy efficiency and load management.

Case No. U-12651, (3/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Northern States Power Company – Wisconsin application to implement PA 141 the electricity deregulation law. I reviewed the portions of the filing related to their provision of electric energy efficiency and load management.

Case No. U-12652. (3/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Indiana Michigan Power Company d/b/a American Electric Power application to implement PA 141 the electricity deregulation law. I reviewed the portions of the filing related to their provision of electric energy efficiency and load management.

Case No. U-12725, (4/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Wisconsin Electric Power Company and the Edison Sault Electric Company application to increase its residential rates. I reviewed the portions of the filing related to their provision of electric energy efficiency and load management and recommended a significant increase in these activities.

Case No. U-13060, (12/01), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Michigan Consolidated Gas Company application for Approval of their Gas Cost Recovery Plan and Five-Year gas Forecast. I reviewed the filing and recommended the Commission reject the proposed GCR factor and suggested continuation of the existing GCR factor or adopt an adjusted MCAAA sponsored GCR factor. I also suggested a set-aside allocation be designated for low-income customers to ensure access to alternative gas providers under the applicant's customer choice program.

Case No. 6690-UR-114, (9/02), Wisconsin Public Service Commission. Testified on behalf of the Citizens Utility Board regarding the Wisconsin Public Service Corporation application to increase its electric and natural gas rates. I reviewed the portions of the filing related to their low-income assistance/weatherization and the proposed executive compensation incentive plan.

Case No. U-14401, (04/05), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Michigan Consolidated Gas Company application for Approval of their Gas Cost Recovery Plan and Five-Year gas Forecast. I reviewed the filing and recommended the Commission reject the proposed plan and suggested initiation of strategies that would lower the need to acquire expensive and unnecessary gas supplies.

Case No. U-14401-R, (10/05), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Michigan Consolidated Gas Company application re-opener Approval of their Gas Cost Recovery Plan and Five-Year gas Forecast. I reviewed the filing and recommended the Commission reject the proposed plan and suggested initiation of strategies that would lower the need to acquire expensive and unnecessary gas supplies.

Case No. U-14701, (02/06), Michigan Public Service Commission. Testified on behalf of the Michigan Environmental Council and The Public Interest Group In Michigan regarding the Consumers Energy Company application for Approval of a Power Supply Cost Recovery Plan and for Authorization of Monthly Power Supply Cost Recovery Factors for calendar year 2006. I reviewed the filing including the application, testimony, exhibits, discovery responses and submitted testimony recommending that the Commission not approve the five-year PSCR plan as filed due to the impacts related to the Palisades sale and the absence of alternative resources in the projected five-year resource portfolio.

Case No. U-14702, (02/06), Michigan Public Service Commission. Testified on behalf of the Michigan Environmental Council and The Public Interest Group In Michigan regarding The Detroit Edison Company application for authority to implement a Power Supply Cost Recovery Plan in its rate schedules for 2006-metered jurisdictional sales of electricity. I reviewed the application; testimony, exhibits and submitted testimony that recommended that the Commission not approve the proposed five-year PSCR plan as filed due because it was deficient in its selection of alternative resources in the projected five-year resource portfolio.

Case No. U-14992, (12/06), Michigan Public Service Commission. Testified on behalf of the Michigan Environmental Council and The Public Interest Group In Michigan regarding The Consumers Energy Company application for approval of the proposed Power Purchase Agreement in connection with the sale of the Palisades Nuclear Power Plant and other assets. The purpose of my testimony was to address the overall soundness of this application and proposal. I reviewed the application, testimony, exhibits and submitted testimony that recommended that the Commission not approve the proposed purchase power agreement and transfer the ownership of the nuclear plant and other assets.

Case No. 06-0800, (3/07), Illinois Commerce Commission. Provided testimony on behalf of the Illinois Citizens Utility Board regarding the Illinois electricity resource auction process. I assessed the existing resource/power supply auction based bidding process and recommended modifications and improvements to the Illinois resource acquisition mechanism.

Case No. 24505-U, (5/07), Georgia Public Service Commission. Testified on behalf of the Georgia Public Service Commission Advocacy staff regarding the demand-side management portions of Georgia Power Company's Integrated Resource Plans. Testimony demonstrated that it is reasonable for the Commission to approve the five proposed DSM programs and expect that Georgia Power can successfully secure considerably more demand-side management resources by working effectively with its customers.

Case No. U-14992, (11/07), Michigan Public Service Commission. Testified on behalf of the Michigan Environmental Council and The Public Interest Group In Michigan regarding The Consumers Energy Company rate application for approval of a rate increase and the recovery of energy efficiency programs and certain costs in connection with the sale of the Palisades Nuclear Power Plant and other assets. I reviewed the application, testimony, exhibits and submitted testimony that recommended that the Commission not approve the recovery of transaction costs involving the transfer the ownership of the nuclear plant and other assets and on various aspects of its proposed energy efficiency programs and proposed incentives.

Case No. 07-0540, (12/07), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Commonwealth Edison Company application for approval of its proposed Energy Efficiency and Demand Response Plan. I assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. 07-0539, (12/07), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Central Illinois Light Company d/b/a and Ameren CIPS CENTRAL ILLINOIS PUBLIC SERVICE COMPANY and Ameren CIPS ILLINOIS POWER COMPANY d/b/a Ameren IP application for approval of its proposed Energy Efficiency and Demand Response Plan. I assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. U-15415, (2/08), Michigan Public Service Commission. Testified on behalf of the American Association of Retired People regarding The Consumers Power Company application for approval for authority to implement a Purchase Power recovery plan, 5-year forecast, and monthly PSCR factors for the 12-month period calendar year 2008. I reviewed the application, testimony, exhibits and submitted testimony that recommended that the Commission adopt a more effective and less expensive resource acquisition procedure to help keep the cost of energy down in Michigan.

Case No. U-15417, (4/08), Michigan Public Service Commission. Provided testimony on behalf of the American Association of Retired People regarding The Detroit Edison Company for Authority to Implement a Power Supply Cost Recovery Plan in its Rate Schedule for 2008 Metered Jurisdictional Sales of Electricity. I reviewed the application, testimony, exhibits and submitted testimony that recommended that the Commission adopt a more effective and less expensive resource acquisition procedure to help keep the cost of energy down in Michigan.

Case No. U-15244, (7/08), Michigan Public Service Commission. Provided testimony on behalf of the Michigan Environmental Council and The Public Interest Group In Michigan regarding The Detroit Edison Company request for Authority to increase rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority. I reviewed the application, testimony, and exhibits and submitted testimony that recommended that the Commission direct DECO to make modifications to its Integrate Resource Planning analysis.

Case No. EEP-08-2, (7-08), Iowa Public Utilities Board. Provided testimony on behalf of the environmental interveners regarding the request of the Mid American Energy Company for approval of an Energy Efficiency Plan. I made an assessment of the proposed energy efficiency and demand response plan and recommended modifications and improvements to the implementation strategy and proposed programs.

Case No. EEP-08-1, (8-08), Iowa Public Utilities Board. Provided testimony on behalf of the environmental interveners regarding the Interstate Power and Light Company request for approval of an Energy Efficiency Plan. I made an assessment of the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed programs and implementation strategy.

Case No. 137-CE-147, (2-09), Public Service Commission of Wisconsin. Provided testimony on behalf of PRESERVE OUR RURAL LANDS regarding the Application of American Transmission Company, as an Electric Public Utility, to Construct a new 345 kV Line from the Rockdale Substation to the West Middleton Substation, Dane County, Wisconsin. I suggested modifications of the proposal and rejection of the approval of the line.

Case No. M2009-2093218, (8-09), Pennsylvania Public Utility Commission. Provided testimony on behalf of The Office Of Consumer Advocate regarding the West Penn Power Company d/b/a Allegheny Power Energy Efficiency and Conservation Plan request for plan approval. I analyzed the proposed plan and made an assessment of the proposed energy efficiency and demand response and cost recovery plan. I suggested modifications and improvements to the proposed programs as well as the proposed implementation strategy.

Case No. 09-1947-EL-POR, 09-1948-EL-POR, 09-1949-EL-POR, 09-1942-EL-EEC, 09-1943-EL-EEC, 09-1944-EL-EEC, POR, 09-580-EL-EEC, 09-580-EL-EEC, 09-580-EL-EEC, Public Utilities Commission of Ohio. Provided testimony on behalf of The Office Of The Environmental Law and Policy Center regarding the Ohio Edison Company, The Cleveland Electric Illuminating Company and the Toledo Edison Company for approval of their energy efficiency and peak demand reduction program portfolio and associated cost recovery mechanism and approval of their initial benchmark reports and in the matter of the energy efficiency and peak demand reduction programs. I reviewed, analyzed and assessed the appropriateness of the proposed plans, benchmark reports and proposed peak reduction program portfolio. I suggested modifications and improvements to the proposed programs. I also made recommendations regarding the proposed implementation strategy as well as accounting and program cost tracking.

Case No. U-16412, (10/10), Michigan Public Service Commission. Provided testimony on behalf of the Natural Resources Defense Council, Michigan Environmental Council and The Environmental Law and Policy Center regarding the Consumers Energy Company request to Amend its natural gas & energy efficiency Energy Optimization Plan. I reviewed the application, testimony, exhibits, discovery responses and submitted testimony that recommended modifications to the proposed Energy Optimization Plan.

Case No. 10-0570, (11/10), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Commonwealth Edison Company application for approval of its proposed Energy Efficiency and Demand Response Plan. Assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. 10-0568, (11/10), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Central Illinois Light Company d/b/a and Ameren CIPS CENTRAL ILLINOIS PUBLIC SERVICE COMPANY and Ameren CIPS ILLINOIS POWER COMPANY d/b/a Ameren IP application for approval of its proposed Energy Efficiency and Demand Response Plan. Assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. 10-0564, (11/10), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the People's Gas Light and Coke Company and North Shore Gas Company request for approval of its proposed Energy Efficiency Plan. Assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. 10-0567, (11/10), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Northern Illinois Gas Company application for approval of its proposed Energy Efficiency Plan and approval of Rider 30, Energy Efficiency Plan Cost recovery and related changes to Nicor tariffs. Assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. M-2010-2210316, (3/11), Pennsylvania Public Utility Commission. I provided testimony on behalf of The Office Of Consumer Advocate regarding the UGI Utilities, Inc. Electric Division (UGI-Electric) request for Efficiency and Conservation Plan approval. I analyzed the proposed plan and made an assessment of the proposed energy efficiency and demand response and cost recovery plan. I suggested modifications and improvements to the proposed programs and implementation strategy.

Case No. 11-07026 and 11-07027, (11/11), Public Utilities Commission of Nevada. I provided testimony on behalf of the Bureau of Consumer Protection regarding both the Sierra Pacific Power Company and Nevada Power Company 2011 Annual Demand Side Management Update reports. I reviewed the filings and made recommendations regarding various aspects of demand response resources and demand side management portfolios.

Case No., U-16671 (01/12), Michigan Public Service Commission. I provided testimony on behalf of the Environmental Law and Policy Center regarding the reasonableness of the Detroit Edison Company's filing and assertions made by a witness regarding a net-to-gross factor relative to the 2010 and 2011 energy efficiency programs implemented in response to Public Act 295 of 2008.

Case Nos. P-2012-2320468, P-2012-2320480, P-2012-2320484, P-2012-2320450, (10/12), Pennsylvania Public Utility Commission. I provided testimony on behalf of The Office Of the Consumer Advocate regarding the application of Metropolitan Edison Company, Pennsylvania Electric Company, West Penn Power, Pennsylvania Power Company on the Energy Efficiency regarding the benchmarks established for the period June 1, 2013 through May 31, 2016. I analyzed the proposed adjustments of Phase II Energy Efficiency and Conservation target levels and energy efficiency acquisition costs.

Case No. Case Nos. 12-2190-EL-POR, 12-2191-EL-POR, 12-2192-EL-POR, (10/12) Application of Ohio Edison Company, The Cleveland Electric Illuminating Company and the Toledo Edison Company for Approval of their energy efficiency and peak demand reduction program portfolio plan for 2013-2015. I provided testimony on behalf of Ohio Environmental Council and The Environmental Law and Policy Center regarding the Ohio Edison Company, The Cleveland Electric Illuminating Company and the Toledo Edison Company for approval of their 2013-2015 energy efficiency and peak demand reduction program portfolio. I reviewed, analyzed and assessed the appropriateness of the proposed plans, benchmark reports and proposed peak reduction program portfolio. I suggested modifications and improvements to the proposed programs and made recommendations and proposed new approaches to the proposed implementation strategy.

Case No., 12-06052 and 12-06053 (10/12), Public Utilities Commission of Nevada, I provided testimony on behalf of the Attorney General of the State of Nevada, Bureau of Consumer Protection regarding both the Sierra Pacific Power Company and Nevada Power Company 2013-2015 Triennial Integrated Resource Plan covering the period 2013-2032 and Approval of its Energy Supply Plan for the period 2013-2015. I reviewed, analyzed and assessed the appropriateness of the proposed plans and proposed peak reduction portfolio. I suggested modifications and improvements to the proposed programs and made recommendations and proposed new approaches to the implementation strategy.

Case No. U-16434-R, (10/12), Michigan Public Service Commission. Provided testimony on behalf of the Michigan Community Action Agency Association regarding The Detroit Edison Company for Reconciliation of its Power Supply Cost Recovery Plan for 12-month Period Ending December 31, 2011. I reviewed the application, testimony, exhibits and submitted testimony that recommended that the Commission adopt a remedy in regards to several aspects of the Reduced Emission Fuels projects that Detroit Edison was involved in.

Case No. Docket No. M-2012-2334388 (12/12), Pennsylvania Public Utility Commission. I provided testimony on behalf of The Office of the Consumer Advocate regarding the Petition of PPL Electric Utilities Corporation for Approval of an Energy Efficiency and Conservation Plan. I analyzed the proposed plan and made an assessment of the proposed energy efficiency and demand response and cost recovery plan. I suggested modifications to the proposed programs and implementation strategy to enhance its effectiveness.

Case No. U-17097, (03/13) Michigan Public Service Commission. Provided testimony on behalf of the Michigan Community Action Agency Association regarding The Detroit Edison Company filing for Reconciliation of its Power Supply Cost Recovery Plan for 12-month Period Ending December 31, 2013. I reviewed the application, testimony, exhibits and submitted testimony recommending that the Commission adopt a remedy regarding the Reduced Emission Fuels projects that Detroit Edison was participating in.

Case No. U-17095, (04/13) Michigan Public Service Commission. Provided testimony on behalf of the Michigan Community Action Agency Association regarding The Consumers Electric Company Application for Approval of A Power Supply Cost Recovery Plan and for Authorization of Monthly Power Supply Cost Recovery Factors for 2013. I reviewed the application, testimony, and exhibits and submitted testimony recommending that the Commission reject the proposed five-year resource plan. I also recommend that the Commission prohibit CECO from collecting capital related investments for a pipeline in Zeeland, Michigan. I also recommended that CECO demonstrate to the Commission that the Palisades and MCV generation plants purchase power agreements are cost-effective, being complied with and are in the public interest.

Case No. EEP-2012-0001, (4-13), Iowa Public Utilities Board. Provided testimony on behalf of the environmental interveners regarding the Interstate Power and Light Company 2014-2018 Energy Efficiency Plan. I made an assessment of IPL's proposed resource planning as well their energy efficiency, renewable energy and demand response resources. I recommended modifications and improvements to the proposed programs, implementation and resource measurement strategy.

Case No. U-17131, (04/13), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Michigan Consolidated Gas Company application for Approval of their Gas Cost Recovery Plan and Five-Year gas Forecast and approval to implement a reservation charge. I reviewed the filing and recommended the Commission require MichCon to initiate procurement strategies that would reduce the heavy reliance that is being placed on the 75% VCA gas procurement strategy.

Case No. U-17133, (04/13), Michigan Public Service Commission. Testified on behalf of the Michigan Community Action Agency regarding the Consumers Energy Company application for approval of its gas cost recovery plan and authorization of a gas cost recovery factor from April

2013- March 2014. I reviewed the filing and made recommendations regarding the Quartile Fixed Price Purchases Gas purchasing strategy used by CECO.

Case No. EEP-2012-0002, (6/13), Iowa Public Utilities Board. Provided testimony on behalf of the environmental interveners regarding the Mid American Energy Company 2014-2018 Energy Efficiency Plan. I made an assessment of MidAm's proposed resource planning as well their energy efficiency, renewable energy and demand response resources. I recommended modifications and improvements to the proposed programs, implementation and resource measurement strategy.

Case No. 13-0431-EL-POR (08/13), Public Utility Commission of Ohio. Provided testimony regarding the Application of Duke Energy Ohio, Inc. for Approval of its Energy Efficiency and Peak Demand Reduction Portfolio of Programs.
The testimony was provided on behalf of Ohio Environmental Council and The Environmental Law and Policy Center. Duke Energy Ohio, Inc. was seeking approval of their revised energy efficiency and peak demand reduction program portfolio. I analyzed and reviewed the appropriateness of the revised plan and proposed peak reduction program portfolio. I suggested significant additions and modifications to the proposed programs. I offered specific program recommendations and new elements be added to their programs and implementation strategy.

Case No. 13-0498, (10/13), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the request by Ameren Illinois for approval of its proposed Energy Efficiency and Demand Response Plan 3. Assessed the proposed energy efficiency and demand response plan and recommended modifications and improvements to the proposed plan filing.

Case No. 13-0499 (10/13), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the request by The Illinois Department of Commerce and Economic Opportunity for approval of its proposed Energy Efficiency Plan 3. Assessed the proposed energy efficiency plan and recommended modifications and improvements to the proposed plan filing.

Case No. 13-0495 (11/13), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the request by Commonwealth Edison application for approval of its proposed third Energy Efficiency Plan. I assessed the proposed energy efficiency plan and recommended modifications and enhancements to the proposed plan.

Case No. 13-0550 (12/13), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the request by North Shore Gas Company and The Peoples Gas Light and Coke Company for approval of its proposed second Energy Efficiency Plan. I assessed the proposed energy efficiency plan and recommended modifications and enhancements to the proposed plan.

Case No. 13-0549, (01/14), Illinois Commerce Commission. Provided testimony on behalf of the Environmental Law and Policy Center regarding the Northern Illinois Gas Company

D/b/a/ Nicor for approval of its proposed second Energy Efficiency Plan, Cost recovery and related changes to Nicor tariffs. I assessed the proposed energy efficiency plan and recommended modifications and improvements to the proposed plan filing.
Case No. U-17319, (06/14), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the DTE Electric Company application for approval of its PSCR Plan 2014 - 2018. I reviewed the filing and made recommendations regarding the PSCR five-year forecast and plan.

Case No. U-17317, (08/14), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the Consumers Energy Company application for approval of its PSCR Plan 2014 - March 2018. I reviewed the filing and made recommendations regarding the PSCR five-year forecast and plan.

Case No. U-17680, (03/15), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the DTE Electric Company application for approval of its PSCR Plan 2015 - 2019. I reviewed the filing and made recommendations regarding the PSCR five-year forecast and plan.

Case No. U-17678, (04/15), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the Consumers Energy Company application for approval of its 2015 – 2019 PSCR Plan. I reviewed the application, filing and related documents and offered suggestions to improve the proposed five-year PSCR forecast and plan.

Case No. U-17735, (04/15), Michigan Public Service Commission. Provided testimony on behalf of the Michelle Rison and the Residential Consumer Group regarding aspects of the Consumers Energy Company general rate case application for authority to increase its rates for the generation and distribution of electricity and other relief. I reviewed the general rate case application, filing and related documents regarding CECO's reliance on and implementation of an Advanced Metering Infrastructure to deliver services to its customers. I offered specific recommendations regarding tariffs and policies related to Advanced metering infrastructure.

Case No. U-17767, (05/15), Michigan Public Service Commission. Provided testimony on behalf of a number of residential customers of DTE Electric under the nomenclature of Dominic and Lillian Cusumano and the Residential Customer Group. I provided testimony regarding DTE Electric's general rate case application for authority to increase its rates for the generation and distribution of electricity and other relief. I reviewed the general rate case filing and issues related to DTE Electric's reliance on and implementation of an Advanced Metering Infrastructure. I offered specific suggestions to improve DTE Electric's tariffs, policies and procedures related to implementation of an advanced metering infrastructure.

Case No. Docket No. P-2014-2459362 (06/15), Pennsylvania Public Utility Commission. I provided testimony on behalf of The Office of the Consumer Advocate regarding the Petition of Philadelphia Gas Works for Approval of Demand-Side Management Plan for FY 2016-2020; and Philadelphia Gas Works Universal Service and Energy Conservation Plan for 2014-2016 52 Pa Code Section 62.4- Request for Waivers. I analyzed the proposed five-year DSM plan and made

an assessment of the proposed plan emphasizing the proposed conservation adjustment mechanism and the proposed performance incentives mechanisms. I suggested extensive modifications to the proposed Plan.

Case No. U-17792 (08/15), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association. I provided testimony and exhibits regarding Consumers Energy Company proposed 2015 Biennial Renewable Energy Plan. I reviewed the Biennial Renewable Energy Plan, testimony, exhibits and supporting information related to Consumers Energy Company renewable resource strategy resulting from the enabling statute (Public Act 295 of 2008). I offered my opinion and assessment of the reasonableness of the proposed plan as well as specific recommendations to improve the 2015 Biennial Renewable Energy Plan as well as Consumers Energy Company's electric resource planning procedures.

Case No. U-17793 (08/15), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association. I provided testimony and exhibits regarding the proposed DTE Electric Company 2015 Biennial Renewable Energy Plan. I reviewed the proposed Biennial Renewable Energy Plan, testimony, exhibits and supporting information related to the DTE Electric Company renewable resource strategy resulting from Public Act 295 of 2008. I offered my opinion and assessment of the reasonableness of the proposed plan and made specific recommendations for improvement of the 2015 Biennial Renewable Energy Plan as well as DTE Electric Company's annual PSCR plan development and electric resource planning procedures.

Case No. M-2015-2514767 (01/16). I provided testimony on behalf of The Office of the Consumer Advocate regarding the joint Petition of the First Energy Companies serving customers in Pennsylvania. I reviewed the proposed five-year Energy Efficiency and Conservation Plan and offered suggestions to modify and improve various programs proposed for the 2016-2020 Plans.

Case No. M-2015-2515691 (01/16). I provided testimony on behalf of The Office of the Consumer Advocate regarding the joint Petition of the PECO Energy Company serving customers in Pennsylvania. I reviewed the proposed five-year Energy Efficiency and Conservation Plan and offered suggestions to modify and improve various programs proposed for the Act 129 related Energy Efficiency and Conservation Plan for 2016 – 2020.

Case No. U-17920, (03/16), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the DTE Electric Company application for approval of its PSCR Plan 2016 – 2020. I reviewed the filing and made recommendations regarding the PSCR five-year forecast and plan.

Case No. U-17918, (03/16), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the Consumers Energy Company application for approval of its PSCR Plan 2016 – 2020. I reviewed the application,

filing and supporting materials and made recommendations regarding the PSCR five-year forecast and plan.

Case No. U-18014, (07/16), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the DTE Electric Company general rate case application for approval to raise rates. I reviewed the filing and made recommendations regarding inclusion of a corporate tax deferred debit, policies and tariffs related to smart meters and DTE's transition to an automated meter infrastructure.

Case No. U-17087 (Remand), (08/16), Michigan Public Service Commission. Provided testimony on behalf of the Residential Consumer Group regarding the Consumers Energy Company application to increase its rates for the generation and distribution of electricity. I reviewed the filing regarding the support and substantiation for the opt-out tariff that is included and approved for Consumers Energy Company. I made a series of specific recommendations regarding the lack of substantiation for the up-front and monthly charges (both existing and proposed) contained within the non-transmitting meter tariff (among other tariffs) and policies related to smart meters and DTE's transition to an automated meter infrastructure.

Case No. U-18111, (08/16), Michigan Public Service Commission. The purpose of my testimony was to address the reasonableness of Detroit Edison Company's (DTE) requested changes to its Biennial Renewable Energy Plan which had been previously approved in Case No. U-17793. I also recommended procedural changes in an effort to enhance the review, assessment and ultimately the integration of additional renewable resources into DTE's provision of electricity to its customers in the future.

Case No. U-18090, (10/16), Michigan Public Service Commission. Provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the Consumers Energy response to the Commission's own Motion to establish a method and avoided cost for comply with the Public Utilities Regulatory Policy Act of 1978, 16 USC 2601 et seq. I reviewed the filing including Consumers Energy proposal for their preferred avoid cost methodology and made recommendations as to an appropriate approach and methodology for deriving avoided costs to be relied upon by Qualifying Facilities in Michigan.

Case No. U-18402 (04/18), I provided testimony on behalf of the Great Lakes Renewable Energy Association regarding Consumers Energy Company PSCR application, 2018-2022 five-year plan and filing materials. Based on my review I offered suggestions and recommendations regarding the PSCR level, impacts of residential, commercial and industrial customer owned renewable resources in its 2018-2022 PSCR resource mix.

Case No. M-2017-2640306 (04/18), The Pennsylvania Office of Consumer Advocate regarding a Peoples Natural Gas Company proposed the Energy Efficiency and Conservation Plan. I reviewed the proposed five-year Combined Heat and Power, Energy Efficiency and Conservation Plan proposed by Peoples Natural Gas Company. I sponsored direct, rebuttal and surrebuttal testimony, which addressed the design of the programs due to the deficiencies that were embodied in the proposed Plan.

Case No. U-18403 (04/18), I provided testimony on behalf of the Great Lakes Renewable Energy Association regarding the Application of DTE Electric Company for authority to Implement a Power Supply Cost Recovery Plan in its Rate Schedules For 2018 Metered Jurisdictional Sales of Electricity. Based on my review I offered recommendations regarding the reasonableness of its PSCR factor level and resource mix proposed for its 2018-2022 PSCR resource mix.

Case No. U-18231 (04/18), I provided testimony on behalf of the Great Lakes Renewable Energy Association regarding Consumers Energy Company Renewable Energy Plan application. I reviewed the proposed renewable energy plan and related filing materials. Based on my review I offered suggestions and recommendations regarding to improve the REP Plan development process. I recommended that the REP Plan development process be coordinated with Act 304 as well as Integrated Resource Planning processes and general rate proceedings to result in a more beneficial resource mix to better serve CECO ratepayers.

Case No. U-18232 (07/18), I provided testimony on behalf of the Great Lakes Renewable Energy Association regarding The Detroit Edison Company Biennial Renewable Energy Plan application. I reviewed the proposed renewable energy plan and related filing materials. Based on my review I offered suggestions and recommendations regarding to improve the REP Plan development process. I recommended that the REP Plan development process be coordinated with Act 304 as well as Integrated Resource Planning processes and general rate proceedings to result in a more beneficial resource mix which would benefit Detroit Edison Company ratepayers.

Case No. M-2017-2640306 (09/18), The Pennsylvania Office of Consumer Advocate regarding a Peoples Natural Gas Company proposed the Energy Efficiency and Conservation Plan. I reviewed the proposed five-year Combined Heat and Power, Energy Efficiency and Conservation Plan proposed by Peoples Natural Gas Company. I offered Supplemental Surrebuttal testimony with suggestions for energy efficiency program and plan improvements.

In addition, I have served the following public sector clients since 1990.

| Client | **Nature of Service** |
|---|---|
| Alaska Housing Finance Corporation | Analysis of energy efficiency, system planning and applicability of Energy Policy Act standards to Alaska resource selection process. |
| California Low Income | In conjunction with AB 1890 the state's restructuring statute |

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|---|---|
| Governing Board | provided analyses of options to deliver energy efficiency and assistance programs to low-income households in a restructured utility environment. Assisted the CPUC and Low Income Governing Board in developing low-income energy assistance and energy efficiency programs, implementation methods and procedures under interim utility administration. |
| Conservation Law Foundation of New England | Provided technical support to the collaborative working groups with Boston Edison, United Illuminating, Eastern Utilities Association, and Nantucket Electric regarding system planning approaches, energy efficiency programs and resource screening. |
| District of Columbia Public Service Commission | Testimony regarding demand-side management, least cost planning principles. |
| Germantown Settlement, Philadelphia | Analysis and technical support regarding business structure and market to aggregate load and/or provide energy efficiency and energy assistance services to low-income households. |
| City of New Orleans | Developed least cost planning rules, guided a public working group to develop demand-side programs, and developed a low income, senior citizens energy efficiency program. |
| Oak Ridge National Laboratory | Prepared an economic analysis of the customer impact from various electricity restructuring configurations for the State of Ohio |
| Ohio Office of Consumer Council | Analyzed two utilities' long-range plans and energy efficiency resource options. Analyzed the Dominion East Gas Company application to be relieved of the merchant function. |
| Ontario Energy Board | Developed demand-side management programs and evaluated need for natural gas integrated resource planning rules. |
| U.S. Environmental Protection Agency | Developed handbook, "Energy Efficiency and Renewable Energy: Opportunities from Title IV of the Clean Air Act", which focuses on how energy efficiency and renewables relate to acid rain compliance strategies. |
| U.S. Environmental Protection Agency and U.S. Department of Energy | Analyzed and compared utility supply- and demand-side resource selection for Clean Air Act compliance on the Pennsylvania-New Jersey-Maryland (PJM) interconnection. |
| Washington State | Natural Gas energy conservation program design involving |

| | |
|---|---|
| Weatherization Directors | Cascade Natural Gas Company |

# OCA Witness Crandall
# EXHIBIT OCA 3-2

**Application of Transource Pennsylvania LLC**
**Independence Energy Connection-East & West Projects**
**Docket Nos. A-2017-2640195 and A-2017-2640200**

**Interrogatories of the Office of Consumer Advocate**
**Set XIII**
**(Responses dated 5/14/2018)**

**Data Request OCA-XIII-09:**

According to Monitoring Analytics' PJM State of the Market Reports (http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2017.shtml), under the Section titled "Congestion and Marginal Losses," the cost associated with the AP South constraint dropped dramatically between 2014 and 2015. The average congestion cost at AP South was 8 times higher in 2012-2014 than it was in 2015-2017. The same dramatic drop also occurred in the number of hours of congestion from the day ahead and real time perspectives between 2014 and 2015. Please describe in detail the change in circumstances that led to these dramatic changes.

**Response:**

PJM has not conducted analysis to identify the unique causes of AP South Reactive Interface congestion each year, 2012 through 2017. Power flow on the transmission lines comprising the AP South Reactive Interface can vary by hour, month, season, and year based on a number of parameters as described in Mr. McGlynn's testimony at page 24, lines 1 through 15. For information purposes, congestion on the system can be affected by fuel prices, including gas and system topology. The Company further notes, consistent with PJM's FERC-approved planning process and PJM's Manual 14B, that the model used by PJM to conduct its market efficiency analysis reflects projected changes to these inputs, as well as system topology changes approved by the PJM Board, among many other factors.

PJM analysis that determined that Project 9A is needed as a market efficiency project in PJM's RTEP was based on forward-looking annual production cost across 8,760 hours for four discrete years, not based on the historical congestion experienced by PJM from 2012 through 2017.

**Witness:** Paul F. McGlynn

# OCA Witness Crandall
# EXHIBIT OCA 3-3

**Application of Transource Pennsylvania LLC**
**Independence Energy Connection-West Project**
**Docket No A-2017-2640200**

**Interrogatories of the Office of Consumer Advocate**
**Set IV**
**(Responses dated 3/8/2018)**

**Data Request OCA-IV-24:**

Have PJM and electric utilities promoted efforts and policies to encourage increased reliance on energy efficiency, demand response, wind energy, solar PV energy, and distributed resources as a means to mitigate congestion in Maryland? If so, what actions have been taken by PJM and what is the expected impact? If not, why not?

**Response:**

The Company lacks information to form a belief about the conduct of other electric utilities. The Company further states that levels of energy efficiency, demand response, wind resources, solar resources, and other distributed energy resources are assumptions incorporated into PJM's RTEP at the start of the RTEP process cycle pursuant to PJM's Operating Agreement, Schedule 6, 1.5.3. More information can be found regarding PJM's support for variable resources through the following link: https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/support-variable-resources.ashx?la=en

**Witness:** Paul F. McGlynn

**Application of Transource Pennsylvania LLC**
**Independence Energy Connection-West Project**
**Docket No A-2017-2640200**

***Interrogatories of the Office of Consumer Advocate***
**Set IV**
**(Responses dated 3/8/2018)**

**Data Request OCA-IV-29:**

Have PJM and electric utilities promoted efforts and policies to encourage increased reliance on energy efficiency, demand response, wind energy, solar PV energy, and distributed resources as a means to mitigate congestion in Virginia? If so, what actions have been taken by PJM and what is the expected impact? If not, why not?

**Response:**

Please see the Company's response to OCA-IV-24.

**Witness:** Paul F. McGlynn

**Application of Transource Pennsylvania LLC**
**Independence Energy Connection-West Project**
**Docket No A-2017-2640200**

**Interrogatories of the Office of Consumer Advocate**
**Set IV**
**(Responses dated 3/8/2018)**

**Data Request OCA-IV-39:**

Have PJM and electric utilities promoted efforts and policies to encourage increased reliance on energy efficiency, demand response, wind energy, solar PV energy, and distributed resources as a means to mitigate transmission congestion and loads on the transmission grid in the District of Columbia? If so, please provide, If not, why not?

**Response:**

Please see the Company's response to OCA-IV-24.

**Witness:** Paul F. McGlynn

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# OCA Witness Crandall
# EXHIBIT OCA 3-4

**Application of Transource Pennsylvania LLC**
**Independence Energy Connection-East & West Projects**
**Docket Nos. A-2017-2640195 and A-2017-2640200**

**Interrogatories of the Office of Consumer Advocate**
**Set XIII**
**(Responses dated 5/14/2018)**

**Data Request OCA-XIII-14:**

Please describe how PJM considers the impact of state-approved energy efficiency programs in its planning. For example, if the Pennsylvania PUC approves a Pennsylvania utility's energy efficiency program, i) how does PJM consider the impact of that program on PJM's planning and Plans? ii) Are the energy efficiency resources subject to PJM's Auction and clearing process completely independent of and in addition to the resources included in the state-approved energy efficiency programs? iii) Please explain.

**Response:**

Please refer to the Company's responses to OCA IV-06, OCA IV-24, OCA IV-45, OCA IV-46, and OCA IV-47. Please also refer to additional information regarding PJM's support for variable resources through the following link: [https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/support-variable-resources.ashx?la=en]

i. Please refer to the Company's response to OCA XIII-11. PJM has not conducted studies to identify the impact of existing or imminent state-approved utility programs for energy efficiency, demand response, CHP or renewable resources as it relates to the need for Project 9A.

   Notwithstanding, the Company further states that whether or not a resource is driven by a state program does not affect how capacity resources are reflected in PJM's applicable forecasts. From a PJM planning perspective, capacity resources are incorporated into the RTEP consistent with established processes and business rules as described in Manual 14B, "PJM Region Transmission Planning Process": [http://pjm.com/-/media/documents/manuals/m14b.ashx].

ii. Please refer to the Company's response to subpart i.

iii. Please refer to the Company's response to subpart i. Please also refer to the Company's response to OCA XIII-11.

**Witness:** Paul F. McGlynn