

**STATE OF NEW YORK
PUBLIC SERVICE COMMISSION**

Proceedings on Motion of the Commission
to Consider Resource Adequacy Matters

Case 19-E-0530

**REPLY AFFIDAVIT OF JAMES F. WILSON
ON BEHALF OF
NATURAL RESOURCES DEFENSE COUNCIL, SUSTAINABLE FERC PROJECT,
SIERRA CLUB, NEW YORKERS FOR CLEAN POWER, ENVIRONMENTAL
ADVOCATES OF NEW YORK, AND VOTE SOLAR**

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I. Introduction

1. My name is James F. Wilson. I am an economist and independent consultant doing business as Wilson Energy Economics. My business address is 4800 Hampden Lane Suite 200, Bethesda, Maryland 20814.

2. I have over thirty-five years of consulting experience in the electric power and natural gas industries. Many of my past assignments have focused on the economic and policy issues arising from the introduction of competition into these industries, including restructuring policies, market design, market analysis and market power. Other recent engagements have included resource adequacy and capacity markets, contract litigation and damages, forecasting and market evaluation, pipeline rate cases and evaluating allegations of market manipulation. I also spent five years in Russia in the early 1990s advising on the reform, restructuring, and development of the Russian electricity and natural gas industries for the World Bank and other clients. I have submitted affidavits and presented testimony in proceedings before the Federal Energy Regulatory Commission, state regulatory agencies, and U.S. district court. I hold a B.A. in Mathematics from Oberlin College and an M.S. in Engineering-Economic Systems from Stanford University. My curriculum vitae, summarizing my experience and listing past testimony, is Attachment JFW-1 attached hereto.

3. I have been involved in electricity restructuring and wholesale market design for over twenty-five years in PJM, New England, Ontario, California, MISO, Russia, and other regions. With regard to the resource adequacy, capacity market and buyer-side mitigation issues

that are the subject of this proceeding, I have been involved in these issues in PJM, New England, California, the Midwest, and other regions for over a decade.

4. This affidavit was prepared at the request of Natural Resources Defense Council, Sustainable FERC Project, Sierra Club, New Yorkers for Clean Power, Environmental Advocates of New York and Vote Solar, who submitted comments in this proceeding on November 8, 2019.¹ On August 8, 2019, the New York Public Service Commission issued an order instituting this proceeding and soliciting comments.² My assignment was to assess the various proposals put forward in the initial round of comments in this proceeding regarding possible NYISO market design changes to better support state policy.

5. The remainder of my affidavit is organized as follows. Section II provides some preliminary observations and opinions. Section III is the main discussion of the alternatives that have been put forward. Section IV is a brief summary and conclusion.

II. Preliminary Observations

6. New York State has adopted ambitious goals for decarbonization of electricity supply in the state. Meeting these goals will require large amounts of renewable (and likely variable) resources and sufficient flexible resources to support reliable system operation with a very different resource mix than exists today. These preliminary observations and opinions are based on my experience with these issues in PJM, New England, and other regions, consideration of the New York goals, and also review of the types of proposals New York stakeholders have put

¹ *Comments of Natural Resources Defense Council, Sustainable FERC Project, Sierra Club, New Yorkers For Clean Power, Environmental Advocates of New York and Vote Solar*, November 8, 2019 (“Clean Energy Supporters’ Comments”).

² New York Public Service Commission, *Order Instituting Proceeding and Soliciting Comments*, Case 19-E-0530, August 8, 2019.

forward to attempt to harmonize wholesale market design with the state's goals. These concepts guide my comments in the following section on specific proposals stakeholders have put forward in this proceeding.

7. ***Many Directions that Contribute to Achieving the State's Policy Objectives Are Clear.*** Stakeholders' comments reflect support for a number of wholesale market design directions that I agree will be valuable for meeting the state's policy goals. Many of these directions are explained in some detail in the New York Independent System Operator ("NYISO") recent Grid in Transition report.³ These directions include:

1. Review and update energy and ancillary services ("E&AS") product definitions to better accommodate energy storage, demand side, distributed, and other emerging resource types, to reflect and value resource attributes such as location and flexibility, and to address various reliability gaps.⁴
2. Enhance energy, ancillary services and shortage pricing in the real-time and day-ahead markets to provide accurate, granular price signals that fully value the services needed by the system. These reforms should also generally increase E&AS prices and revenues, which over time should lead to lower capacity prices.
3. Develop enhanced approaches to establishing the capacity ratings of all types of resources to more accurately reflect contributions to resource adequacy.

³ *Reliability and Market Considerations for a Grid in Transition*, A Report of the New York Independent System Operator, December 20, 2019 ("Grid in Transition Report"), pp. 8-11.

⁴ Potential reliability gaps are described in the Grid in Transition Report, Appendix B.

8. While some of the details may be controversial, the potential value of such efforts is reasonably clear, and NYISO will undoubtedly make progress on these enhancements to its E&AS markets.

9. Stakeholder comments and the Grid in Transition Report also raise the possibility of imposing a price on carbon dioxide emissions in the E&AS markets. Carbon pricing could complement other market design changes, but not obviate the need for the other changes discussed herein, and it would raise many complex implementation issues.

10. ***Buyer-Side Mitigation in the Capacity Market May Be Reformed but Will Remain an Obstacle to Achieving the State’s Policy Objectives.*** NYISO intends to pursue a comprehensive review of the capacity market Buyer-Side Mitigation (“BSM”) rules in 2020.⁵ However, the BSM rules are likely to remain a barrier to achieving the state’s policy objectives.

11. Minimum offer price rules such as the BSM attempt to balance three objectives that cannot simultaneously be satisfied:⁶

1. that all resources, including public policy resources, should receive capacity supply obligations and payments that recognize their contributions to resource adequacy, so unneeded and duplicative capacity won’t be acquired to satisfy resource adequacy targets;
2. that capacity prices should not be suppressed by the presence of public policy resources, which price suppression could discourage “competitive”, in-market resources, and compensate existing resources unfairly; and
3. that the capacity construct should clear a reasonable total quantity of capacity at a reasonable total cost.

⁵ See, for instance, *Grid in Transition* p.10 (calling for a “holistic evaluation of the BSM rules”); *Initial Comments on Resource Adequacy Matters*, NYISO, November 8, 2019 (“NYISO Comments”) p. 75 (noting NYISO is committed to a comprehensive review of the BSM rules in 2020).

⁶ See, for instance, *ISO New England Inc. and New England Power Pool Participants Committee*, 135 FERC ¶ 61,029 (2011), P 95; Wilson, James F., *Affidavit in Support of the Protests of DC-MD-NJ Consumer Coalition, Joint Consumer Advocates, and Clean Energy Advocates*, FERC Docket No. ER18-1314, May 8, 2018, p. 5.

12. The never-ending struggles around minimum offer price rules in PJM, New England, New York and elsewhere reflect, to a large extent, that different stakeholders 1) disagree as to whether, and to what extent, public policy resources have an inappropriate impact on capacity prices, and 2) place different priorities on these three conflicting objectives (not surprisingly, capacity sellers and RTOs tend to emphasize objective #2 while consumer interests place more importance on objectives #1 and #3). To achieve the state's policy objectives, this conflict would have to be resolved by relaxing objective #2, but this is unlikely to happen, especially in light of a recent Federal Energy Regulatory Commission ("FERC") order on similar rules in PJM.⁷ As a result, even with modified BSM rules, the capacity construct and BSM rules will be an obstacle to achieving the state's policy objectives:

1. BSM will cause the contributions to resource adequacy of some zero carbon resources to not be recognized and/or cause consumers to acquire unneeded and duplicative capacity to satisfy resource adequacy targets (objectives #1 and #3 above will not be fully achieved);
2. BSM will continue to artificially support capacity prices, delaying retirement of some existing resources that should retire, and potentially attracting new entry of resources that are not the best choices for meeting the state's policy objectives (based on environmental, operational, and other attributes);
3. By contributing to duplicative capacity and excessive capacity prices, the capacity construct with BSM will exacerbate the excess capacity on the New York grid which, as explained next, works against meeting the state's policy objectives.

⁷ 169 FERC ¶ 61,239, *Order Establishing Just and Reasonable Rate*, Docket Nos. EL16-49 and EL18-178, issued December 19, 2019.

13. ***Excess Capacity is an Impediment to Achieving the State’s Policy Objectives; Market Design Elements that Contribute to Excess Capacity Should Also Be Addressed.***

Capacity markets, combined with slow load growth and other market conditions, have led to substantial excess capacity in New York and adjoining regions.⁸ While the immediate consequences of excess capacity are lower capacity prices and additional resource adequacy and reliability, excess capacity leads to lower E&AS prices; this weakens the incentives for the resource attributes (e.g., flexibility, storage, responsive demand) needed to support the system with increasing penetration of variable resources, and increases the out-of-market payments needed to attract and maintain such resources. Market design elements that contribute to excess capacity also delay the retirement of existing, non-zero-carbon resources that should be retired.

14. ***Centralized Auctions Are Effective for Acquiring the Real-Time and Day-Ahead Energy and Ancillary Services NYISO Needs to Operate the System Reliably and Efficiently, But May Not Be Part of an Effective Approach for Attracting New Zero-Carbon and/or Flexible Resources.***

Centralized single-clearing-price auctions, such as most RTOs’ real-time and day-ahead energy and ancillary services markets (and also most forward capacity constructs), are effective means for acquiring needed services under many circumstances where a homogenous product is being acquired. However, such mechanisms have their limitations (in particular, they require standard product definitions), as explained further in the discussion of specific proposals in the next section of this affidavit. To meet the state’s policy objectives, other mechanisms that, like centralized auctions, combine market-like and administrative features, but that accommodate

⁸ See, for instance, North American Electric Reliability Corporation, *2019 Long-Term Reliability Assessment*, p. 41 (showing anticipated reserve margins substantially larger than reference (target) levels in New York, New England, PJM, and many other regions).

consideration and valuation of a broader range of resource attributes and can accommodate longer-term contractual commitments, will likely be a better fit to the challenges ahead in New York.

15. ***It Will Not Be Practical to Modify the Capacity Market with Additional Products to Attempt to Price and Procure Zero-Carbon and/or Flexible Resources.*** New, zero-carbon resources will be needed to meet the state's policy objectives, and flexible resources will be needed to maintain reliability on the system with large amounts of variable wind and solar resources. However, as explained further later in this affidavit, it is not practical to modify the capacity market to serve as a mechanism for procuring the diverse resources and diverse attributes that are needed for the New York grid to be efficient and reliable with a high penetration of variable resources. Nor have practical means been developed to value the zero-carbon attribute through a forward capacity market or a separate forward auction mechanism. Therefore, the capacity market construct should remain focused on its traditional objective of attracting and retaining sufficient capacity to meet seasonal peak day requirements, although its role should decrease, as further explained next.

16. ***The Capacity Market's Role Should Be Clarified: Residual Procurement to Ensure One-Day-In-Ten-Years Peak Day Resource Adequacy.*** With the capacity market focused on peak day adequacy, rather than attempting to modify it to price flexibility or the zero-carbon attribute, capacity prices will tend to reflect the cost and value of the highest-cost *non-zero-carbon, non-flexible* existing or new resource needed by the system for seasonal peak day resource adequacy. As zero-carbon and flexible resources are added to the system, and if load growth remains modest, there may be little or no incremental need for such resources, and capacity prices will primarily modulate the pace of retirements. Accordingly, capacity prices should decline over time. Further development of the E&AS markets will provide additional revenues and contribute

to additional downward pressure on capacity prices. In addition, because BSM will continue to exclude zero-carbon resources from receiving capacity payments, contribute to over-pricing capacity, and exacerbate excess capacity, the capacity market rules should also be changed as needed to clarify its role as a *residual* mechanism to acquire capacity as needed to ensure resource adequacy. Load-serving entities should be permitted to satisfy some or all of their resource adequacy obligations on a bilateral basis, with any residual acquired through the capacity market.

III. Discussion of Stakeholder Proposals

17. This section of my affidavit discusses proposals put forward by stakeholders in comments submitted in this proceeding, grouped into a few categories.

A. Multiple Product Pricing in the Capacity Market

18. Joint Utilities propose an “overhaul” of the capacity market such that it would “produce locational and market-wide capacity prices differentiated base on identified characteristics of the required resources” (“Multiple Value Pricing”).⁹ The Joint Utilities Comments suggest that flexible resources, renewable resources, and offshore wind could be separately priced based on separate demand curves. New York Power Authority makes a similar proposal that it calls Multiple Characteristic Pricing.¹⁰

19. Stakeholders in PJM, New England, and elsewhere have put forward proposals in various forums to define and price additional products within a forward capacity construct,

⁹ *Initial Comments of the Joint Utilities on the Order Instituting Proceeding and Soliciting Comments*, November 8, 2019 (“JU Comments”), pp. 22-24.

¹⁰ New York Power Authority, *Initial Comments Addressing Resource Adequacy*, November 8, 2019 (“NYPA Comments”), pp. 26-27.

multiple times over many years. Such proposals were once a topic at a FERC conference, where the consensus of the participating experts was that RTOs should rely on energy and ancillary services markets for pricing operating characteristics and attracting the resources that can provide them, rather than defining additional products within capacity markets.¹¹

20. To define and price additional characteristics or services within a forward capacity construct would be complex and ultimately inefficient and unsatisfactory. The fundamental problem is that to price additional characteristics through a forward auction requires defining additional, specific “products” for each attribute, and to specify a performance period. This would necessarily require multiple rather arbitrary definitions; accordingly, the product design would be controversial and ultimately discriminatory and inefficient. The performance period to be acquired is also problematic: a shorter period (one year or less) is appropriate for existing resources, while new resources seek longer-term commitments (seven, ten or more years) to support their financing.

21. Consider, by way of example, an attempt to define a ramping product to be procured through a forward capacity construct. Many different types of resources can help with ramping needs (including gas turbines, demand response, and energy storage, to mention a few), and these resources differ in their ramp rates, notification times, and other operating characteristics. To be able to select such resources based on price through a forward auction requires a product definition that identifies the minimum characteristics required for eligibility to offer the product; how the quantity of the product a particular resource can offer is determined; the delivery period for the

¹¹ See, for instance, *Post-Technical Conference Comments on the American Public Power Association*, FERC Docket No. AD13-7, January 8, 2014, p. 17 (citing to the transcript where seven participating experts supported RTO reliance on energy and ancillary services markets to support resources with specific operating characteristics); *Comments of James F. Wilson for the Technical Conference*, September 9, 2013, p. 9 (explaining why capacity markets should not be redesigned to procure resources with specific operating attributes, for instance, as may be needed to integrate variable resources).

product; and how performance will be evaluated and non-performance penalized, among other details. These rather arbitrary definitions will necessarily over-value some attributes and under-value others, thereby arbitrarily favoring some types of resources and disfavoring others. The product definition effort will be controversial, as owners of different types of resources push to have their particular attributes more fully recognized and valued.

22. However the additional products might be defined, the resources acquired through a forward procurement would very likely fail to line up with system needs over time. The nature of the flexibility needed by the system, and the quantity of such flexibility needed, will change over time with the changing resource mix and is difficult to forecast accurately. In addition, including additional product definitions creates additional, smaller “markets” that will likely be susceptible to exercise of market power.

23. As discussed above, energy and ancillary services markets naturally price the specific operating characteristics needed by RTOs in a highly granular manner with respect to operating characteristics, location, and time. By contrast, a forward capacity construct sets prices for one or a few standard products for an extended period and with very little locational detail.¹² To meet the state’s policy goals, revenue recovery from the E&AS markets should be expanded, and the role of the forward capacity market should decline rather than being expanded, as would occur under a multiple product approach.

¹² For further discussion of the advantages of E&AS markets compared to capacity markets for providing accurate price signals see Wilson, James F., “*Missing Money*” Revisited: *Evolution of PJM’s RPM Capacity Construct*, prepared for American Public Power Association, September 2016, pp. 4-7.

B. Multiple Attribute Pricing Through Auctions Outside the Capacity Market

24. Marc D. Montalvo of Daymark Energy Advisors, on behalf of the Utility Intervention Unit (“UIU”), states that “... any workable approach likely does not involve defining a more complex multi-dimensioned version of the ICAP product,”¹³ similar to the point made in the prior subsection of this affidavit. The Montalvo/UIU Comments suggest instead a separate, simultaneous auction mechanism for procurement of multiple attributes (pp. 6-7):

“The State has called for a portfolio of supply resources consistent with its policy objectives that satisfies a set of *preferences*: cost, resource adequacy, CO2 emissions, and other environmental and health impacts.... While a complex undertaking, it is possible to structure an organized market to satisfy the State’s several preferences. Importantly, any workable approach likely does not involve defining a more complex multi-dimensioned version of the ICAP product. Rather, the better approach is to clearly define the desired attributes and to structure a procurement mechanism and set of products that, in aggregate, meets the demand for those attributes; no single resource needs to sell all products and meet all attributes. The salient components of such an approach include:

- The market administrator would establish demand curves for each desired attribute.
- Ideally the market design would not specify resource types.
- Qualified suppliers would offer portfolios of resources that provide some or all of the attributes.
- The process could be structured as a multi-round combinatorial (a.k.a. “package”) auction or as a competitive procurement.
- The administrator would select the lowest cost set of portfolios that in aggregate simultaneously meet all attribute demands.” [emphasis in original]

25. This proposal suffers from the same problems as the proposal for Multiple Product Pricing within the capacity construct discussed above: It requires defining a “product” for each attribute to be acquired, and also defining demand curves (presumably sloped and independent) for each attribute. These definitions would require multiple rather arbitrary determinations. In addition, while not specified, apparently the winning resources would be procured for the life of

¹³ Marc D. Montalvo, President, Daymark Energy Advisors, *Comments on Resource Adequacy Matters*, November 12, 2019 (“Montalvo/UIU Comments”), p. 6.

the resource (otherwise, the duration of commitment – one year, or three or seven? – becomes another very difficult and arbitrary issue to resolve). Such long-term commitments require many more details to be specified before the process can be executed, and create additional risks to consumers.

26. Even if all the definitions could be created and such a complex, multi-round combinatorial auction executed, the results would likely be inefficient when evaluated as a portfolio. The proposal raises the question – what is the advantage of this approach compared to soliciting resource proposals, and evaluating alternative combinations through an approach that considers how an entire portfolio works together, such as within an integrated resource planning (“IRP”) model? An IRP approach would take into account how different resources interact as substitutes or complements within a portfolio that meets all of the system needs at lowest cost/highest value, and likely find a more efficient portfolio than would a multi-attribute auction.

C. Variants of Two-Tiered Pricing in the Capacity Market

27. Joint Utilities also propose a modification of the capacity market (“Future Clean Capacity Requirement”, pp. 24-26) that would eliminate the BSM rules and allow all policy resources to clear, but also expand the reliability requirement (unforced capacity, or “UCAP”) to be procured, and impose a capacity price floor. This proposal bears some similarities to the two-tiered capacity procurement and pricing approaches ISO New England and PJM have proposed in the past, none of which has been approved or implemented.¹⁴

¹⁴ See, for instance, PJM Interconnection, L.L.C., *Capacity Repricing or in the Alternative MOPR-Ex Proposal: Tariff Revisions to Address Impacts of State Public Policies on the PJM Capacity Market*, Docket No. ER18-1314-000, April 16, 2018, pp. 59-96.

28. The goal is apparently to support the capacity quantities and prices for conventional resources. The capacity requirement would be increased to reflect unspecified “factors other than resource adequacy,” noting “transmission security or other local reliability requirements” as examples. The price floor would be based on the highest going-forward cost of existing resources NYISO deems necessary for reliability.

29. This concept resolves the three conflicting objectives implicated in BSM rules, discussed in an earlier section, by sacrificing the third objective, clearing a reasonable amount of capacity at reasonable cost. This proposal would result in both an artificial increase in the UCAP procured in the capacity construct (beyond the quantity needed for resource adequacy) and also an administrative price floor applied to the excessive quantity. As explained in an earlier section of my affidavit, clearing excess capacity at an excessive price in the capacity construct, in addition to imposing excessive cost on consumers, would serve as a barrier to meeting the state’s policy objectives. This proposal, or any variant of two-tiered capacity pricing, would not contribute to meeting the state’s policy goals.

D. Linking BSM Exemption to Retirements

30. New York Power Authority also proposes a variant of an approach used by New England (Competitive Auctions with Sponsored Policy Resources, or “CASPR”) that links exemption from buyer-side mitigation to retirements (“CRIS+”);¹⁵ NYISO also suggests a version of CASPR could be considered for New York.¹⁶

¹⁵ NYPA Comments pp. 27-28.

¹⁶ *Initial Comments on Resource Adequacy Matters*, New York Independent System Operator, Inc., November 8, 2019 (“NYISO Comments”), pp. 73-75.

31. CASPR is a very complex mechanism that took many stakeholder meetings to design, and that to date has achieved very little. While the CRIS+ proposal might address some of the shortcomings of CASPR, the concept of linking entry of zero-carbon resources to retirements is backward – retirements should occur when older resources are essentially pushed out by the entry of cleaner and more efficient resources with the attributes needed to meet the state’s policy objectives, rather than such entry having to wait for the decisions to retire (which would be further delayed by the artificial capacity price support resulting from such mechanisms). CASPR variants are just modifications to the BSM rules and cannot contribute substantially to meeting the state’s policy objectives.

E. Approaches Based on Bilateral Contracting

32. A number of commenters suggest consideration of an approach to meeting the state’s policy objectives that involves centralized procurement and/or bilateral contracts.¹⁷ Under these proposals, centralized and/or bilateral procurement would be used to attract the zero-carbon and flexible resources needed to meet the state’s policy objectives, while the capacity construct would acquire residual commitments as necessary to meet traditional peak day resource adequacy requirements. Traditional, “one day in ten years” resource adequacy obligations would remain, but load-serving entities would be permitted to satisfy them on a bilateral basis, with the capacity market in a residual role. This could be accomplished by changing the capacity market to a residual construct and/or by defining an opt-out alternative (such as the Fixed Resource Requirement

¹⁷ NYPA Comments pp. 28-29 (“IRP Approach”); Montalvo/UIU Comments pp. 9-10 (Bilateral approach); Clean Energy Supporters’ Comments pp. 16-17 (residual capacity market and bilateral or competitive central procurement); JU Comments p. 37 (expanded NYSERDA role).

Alternative, “FRRA”, suggested by FERC in a PJM proceeding,¹⁸ and further developed by a group of PJM stakeholders.¹⁹

33. This approach allows selecting resources with consideration of all of their attributes, and taking into account how any resource contributes to meeting all objectives (reliability, environmental, cost, etc.) within a broader portfolio. While this approach would not establish transparent prices, as would an auction approach for the particular products acquired by auction, it is a practical approach that is realistic as to what can and cannot be accomplished through forward auction-type mechanisms, either within or separate from the capacity construct.

IV. Summary and Conclusions

34. The NYISO’s E&AS markets should be further developed to provide strong and granular price signals to guide the evolution of the New York State resource mix. This will reduce reliance on the capacity construct, which should continue to serve in a residual role to ensure traditional peak day resource adequacy requirements. Load-serving entities (or NYSERDA) will need to contract for the incremental resources to meet the state’s policy objectives, including both zero-carbon resources and likely also flexible resources to support them. It is not practical to try to redesign the forward capacity construct to a broader procurement role, or to design a separate forward auction mechanism for such purposes, especially given the schedule required under state policy. Artificial price supports in the forward capacity construct, and the excess capacity that would result from it, would be an impediment to realizing the state’s policy goals.

35. This concludes my affidavit.

¹⁸ *Calpine Corporation, et al. v. PJM Interconnection, L.L.C.*, 164 FERC ¶ 61,236 (2018), P 160.

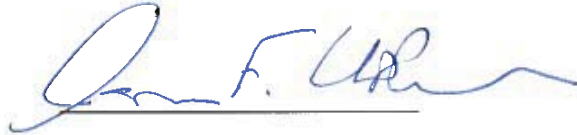
¹⁹ See, for instance, *Comments of Clean Energy and Consumer Advocates*, FERC Docket Nos. EL16-49 and EL18-178, October 2, 2018, and Attachments A, B and C.

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James F. Wilson, being first duly sworn, states he is the same James F. Wilson whose Reply Affidavit on Behalf of Natural Resources Defense Council, Sustainable FERC Project, Sierra Club, New Yorkers for Clean Power, Environmental Advocates of New York, and Vote Solar accompanies this affidavit; and that the facts set forth therein are true and correct to the best of his knowledge, information, and belief.



James F. Wilson

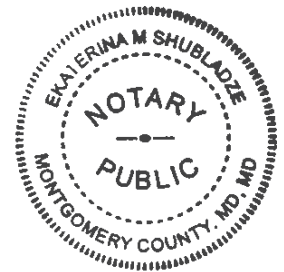
Subscribed and sworn before me, a Notary Public in and for the State of Maryland

this 31 day of January, 2020.



Notary Public

My Commission expires: 11/6/2023



James F. Wilson
Principal, Wilson Energy Economics

4800 Hampden Lane Suite 200
Bethesda, Maryland 20814 USA

Phone: (240) 482-3737
Cell: (301) 535-6571
Email: jwilson@wilsonenec.com
www.wilsonenec.com

SUMMARY

James F. Wilson is an economist with over 30 years of consulting experience, primarily in the electric power and natural gas industries. Many of his assignments have pertained to the economic and policy issues arising from the interplay of competition and regulation in these industries, including restructuring policies, market design, market analysis and market power. Other recent engagements have involved resource adequacy and capacity markets, contract litigation and damages, forecasting and market evaluation, pipeline rate cases and evaluating allegations of market manipulation. Mr. Wilson has been involved in electricity restructuring and wholesale market design for over twenty years in California, PJM, New England, Russia and other regions. He also spent five years in Russia in the early 1990s advising on the reform, restructuring and development of the Russian electricity and natural gas industries.

Mr. Wilson has submitted affidavits and testified in Federal Energy Regulatory Commission and state regulatory proceedings. His papers have appeared in the *Energy Journal*, *Electricity Journal*, *Public Utilities Fortnightly* and other publications, and he often presents at industry conferences.

Prior to founding Wilson Energy Economics, Mr. Wilson was a Principal at LECG, LLC. He has also worked for ICF Resources, Decision Focus Inc., and as an independent consultant.

EDUCATION

MS, Engineering-Economic Systems, Stanford University, 1982
BA, Mathematics, Oberlin College, 1977

RECENT ENGAGEMENTS

- Analysis of provisions to enhance resource fuel security in day-ahead and real-time wholesale electricity markets.
- Evaluated peak electric load forecasts and enhancements to load forecasting methodologies.
- Evaluated a probabilistic analysis to determine the electric generating capacity reserve margin to satisfy resource adequacy criteria.
- Evaluated the potential impact of an electricity generation operating reserve demand curve on a wholesale electricity market with a capacity construct.
- Developed wholesale capacity market enhancements to accommodate seasonal resources and resource adequacy requirements.
- Evaluation of wholesale electricity market design enhancements to accommodate state initiatives to promote state environmental and other policy objectives.
- Evaluation of proposals for natural gas distribution system expansions.
- Various consulting assignments on wholesale electric capacity market design issues in PJM, New England, the Midwest, Texas, and California.
- Cost-benefit analysis of a new natural gas pipeline.
- Evaluation of the impacts of demand response on electric generation capacity mix and emissions.

- Panelist on a FERC technical conference on capacity markets.
- Affidavit on the potential for market power over natural gas storage.
- Executive briefing on wind integration and linkages to short-term and longer-term resource adequacy approaches.
- Affidavit on the impact of a centralized capacity market on the potential benefits of participation in a Regional Transmission Organization (RTO).
- Participated in a panel teleseminar on resource adequacy policy and modeling.
- Affidavit on opt-out rules for centralized capacity markets.
- Affidavits on minimum offer price rules for RTO centralized capacity markets.
- Evaluated electric utility avoided cost in a tax dispute.
- Advised on pricing approaches for RTO backstop short-term capacity procurement.
- Affidavit evaluating the potential impact on reliability of demand response products limited in the number or duration of calls.
- Evaluated changing patterns of natural gas production and pipeline flows, developed approaches for pipeline tolls and cost recovery.
- Evaluated an electricity peak load forecasting methodology and forecast; evaluated regional transmission needs for resource adequacy.
- Participated on a panel teleseminar on natural gas price forecasting.
- Affidavit evaluating a shortage pricing mechanism and recommending changes.
- Testimony in support of proposed changes to a forward capacity market mechanism.
- Reviewed and critiqued an analysis of the economic impacts of restrictions on oil and gas development.
- Advised on the development of metrics for evaluating the performance of Regional Transmission Organizations and their markets.
- Prepared affidavit on the efficiency benefits of excess capacity sales in readjustment auctions for installed capacity.
- Prepared affidavit on the potential impacts of long lead time and multiple uncertainties on clearing prices in an auction for standard offer electric generation service.

EARLIER PROFESSIONAL EXPERIENCE

LECG, LCC, Washington, DC 1998–2009.

Principal

- Reviewed and commented on an analysis of the target installed capacity reserve margin for the Mid Atlantic region; recommended improvements to the analysis and assumptions.
- Evaluated an electric generating capacity mechanism and the price levels to support adequate capacity; recommended changes to improve efficiency.
- Analyzed and critiqued the methodology and assumptions used in preparation of a long run electricity peak load forecast.
- Evaluated results of an electric generating capacity incentive mechanism and critiqued the mechanism's design; prepared a detailed report. Evaluated the impacts of the mechanism's flaws on prices and costs and prepared testimony in support of a formal complaint.
- Analyzed impacts and potential damages of natural gas migration from a storage field.
- Evaluated allegations of manipulation of natural gas prices and assessed the potential impacts of natural gas trading strategies.
- Prepared affidavit evaluating a pipeline's application for market-based rates for interruptible transportation and the potential for market power.
- Prepared testimony on natural gas industry contracting practices and damages in a contract dispute.
- Prepared affidavits on design issues for an electric generating capacity mechanism for an eastern US regional transmission organization; participated in extensive settlement discussions.

- Prepared testimony on the appropriateness of zonal rates for a natural gas pipeline.
- Evaluated market power issues raised by a possible gas-electric merger.
- Prepared testimony on whether rates for a pipeline extension should be rolled-in or incremental under Federal Energy Regulatory Commission (“FERC”) policy.
- Prepared an expert report on damages in a natural gas contract dispute.
- Prepared testimony regarding the incentive impacts of a ratemaking method for natural gas pipelines.
- Prepared testimony evaluating natural gas procurement incentive mechanisms.
- Analyzed the need for and value of additional natural gas storage in the southwestern US.
- Evaluated market issues in the restructured Russian electric power market, including the need to introduce financial transmission rights, and policies for evaluating mergers.
- Affidavit on market conditions in western US natural gas markets and the potential for a new merchant gas storage facility to exercise market power.
- Testimony on the advantages of a system of firm, tradable natural gas transmission and storage rights, and the performance of a market structure based on such policies.
- Testimony on the potential benefits of new independent natural gas storage and policies for providing transmission access to storage users.
- Testimony on the causes of California natural gas price increases during 2000-2001 and the possible exercise of market power to raise natural gas prices at the California border.
- Advised a major US utility with regard to the Federal Energy Regulatory Commission’s proposed Standard Market Design and its potential impacts on the company.
- Reviewed and critiqued draft legislation and detailed market rules for reforming the Russian electricity industry, for a major investor in the sector.
- Analyzed the causes of high prices in California wholesale electric markets during 2000 and developed recommendations, including alternatives for price mitigation. Testimony on price mitigation measures.
- Summarized and critiqued wholesale and retail restructuring and competition policies for electric power and natural gas in select US states, for a Pacific Rim government contemplating energy reforms.
- Presented testimony regarding divestiture of hydroelectric generation assets, potential market power issues, and mitigation approaches to the California Public Utilities Commission.
- Reviewed the reasonableness of an electric utility’s wholesale power purchases and sales in a restructured power market during a period of high prices.
- Presented an expert report on failure to perform and liquidated damages in a natural gas contract dispute.
- Presented a workshop on Market Monitoring to a group of electric utilities in the process of forming an RTO.
- Authored a report on the screening approaches used by market monitors for assessing exercise of market power, material impacts of conduct, and workable competition.
- Developed recommendations for mitigating locational market power, as part of a package of congestion management reforms.
- Provided analysis in support of a transmission owner involved in a contract dispute with generators providing services related to local grid reliability.
- Authored a report on the role of regional transmission organizations in market monitoring.
- Prepared market power analyses in support of electric generators’ applications to FERC for market-based rates for energy and ancillary services.
- Analyzed western electricity markets and the potential market power of a large producer under various asset acquisition or divestiture strategies.
- Testified before a state commission regarding the potential benefits of retail electric competition and issues that must be addressed to implement it.

- Prepared a market power analysis in support of an acquisition of generating capacity in the New England market.
- Advised a California utility regarding reform strategies for the California natural gas industry, addressing market power issues and policy options for providing system balancing services.

ICF RESOURCES, INC., Fairfax, VA, 1997–1998.

Project Manager

- Reviewed, critiqued and submitted testimony on a New Jersey electric utility's restructuring proposal, as part of a management audit for the state regulatory commission.
- Assisted a group of US utilities in developing a proposal to form a regional Independent System Operator (ISO).
- Researched and reported on the emergence of Independent System Operators and their role in reliability, for the Department of Energy.
- Provided analytical support to the Secretary of Energy's Task Force on Electric System Reliability on various topics, including ISOs. Wrote white papers on the potential role of markets in ensuring reliability.
- Recommended near-term strategies for addressing the potential stranded costs of non-utility generator contracts for an eastern utility; analyzed and evaluated the potential benefits of various contract modifications, including buyout and buydown options; designed a reverse auction approach to stimulating competition in the renegotiation process.
- Designed an auction process for divestiture of a Northeastern electric utility's generation assets and entitlements (power purchase agreements).
- Participated in several projects involving analysis of regional power markets and valuation of existing or proposed generation assets.

IRIS MARKET ENVIRONMENT PROJECT, 1994–1996.

Project Director, Moscow, Russia

Established and led a policy analysis group advising the Russian Federal Energy Commission and Ministry of Economy on economic policies for the electric power, natural gas, oil pipeline, telecommunications, and rail transport industries (*the Program on Natural Monopolies*, a project of the IRIS Center of the University of Maryland Department of Economics, funded by USAID):

- Advised on industry reforms and the establishment of federal regulatory institutions.
- Advised the Russian Federal Energy Commission on electricity restructuring, development of a competitive wholesale market for electric power, tariff improvements, and other issues of electric power and natural gas industry reform.
- Developed policy conditions for the IMF's \$10 billion Extended Funding Facility.
- Performed industry diagnostic analyses with detailed policy recommendations for electric power (1994), natural gas, rail transport and telecommunications (1995), oil transport (1996).

Independent Consultant stationed in Moscow, Russia, 1991–1996

Projects for the WORLD BANK, 1992-1996:

- Bank Strategy for the Russian Electricity Sector. Developed a policy paper outlining current industry problems and necessary policies, and recommending World Bank strategy.
- Russian Electric Power Industry Restructuring. Participated in work to develop recommendations to the Russian Government on electric power industry restructuring.
- Russian Electric Power Sector Update. Led project to review developments in sector restructuring, regulation, demand, supply, tariffs, and investment.
- Russian Coal Industry Restructuring. Analyzed Russian and export coal markets and developed forecasts of future demand for Russian coal.
- World Bank/IEA Electricity Options Study for the G-7. Analyzed mid- and long-term electric power demand and efficiency prospects and developed forecasts.

- Russian Energy Pricing and Taxation. Developed recommendations for liberalizing energy markets, eliminating subsidies and restructuring tariffs for all energy resources.

Other consulting assignments in Russia, 1991–1994:

- Advised on projects pertaining to Russian energy policy and the transition to a market economy in the energy industries, for the Institute for Energy Research of the Russian Academy of Sciences.
- Presented seminars on the structure, economics, planning, and regulation of the energy and electric power industries in the US, for various Russian clients.

DECISION FOCUS INC., Mountain View, CA, 1983–1992
Senior Associate, 1985-1992.

- For the Electric Power Research Institute, led projects to develop decision-analytic methodologies and models for evaluating long term fuel and electric power contracting and procurement strategies. Applied the methodologies and models in numerous case studies, and presented several workshops and training sessions on the approaches.
- Analyzed long-term and short-term natural gas supply decisions for a large California gas distribution company following gas industry unbundling and restructuring.
- Analyzed long term coal and rail alternatives for a midwest electric utility.
- Evaluated bulk power purchase alternatives and strategies for a New Jersey electric utility.
- Performed a financial and economic analysis of a proposed hydroelectric project.
- For a natural gas pipeline company serving the Northeastern US, forecasted long-term natural gas supply and transportation volumes. Developed a forecasting system for staff use.
- Analyzed potential benefits of diversification of suppliers for a natural gas pipeline company.
- Evaluated uranium contracting strategies for an electric utility.
- Analyzed telecommunications services markets under deregulation, developed and implemented a pricing strategy model. Evaluated potential responses of residential and business customers to changes in the client's and competitors' telecommunications services and prices.
- Analyzed coal contract terms and supplier diversification strategies for an eastern electric utility.
- Analyzed oil and natural gas contracting strategies for an electric utility.

TESTIMONY AND AFFIDAVITS

In the Matter of the Application of DTE Electric Company for Reconciliation of its Power Supply Cost Recovery Plan for the 12-month Period Ending December 31, 2018, Michigan Public Service Commission Case No. U-20203, Direct Testimony on behalf of Michigan Environmental Council, January 17, 2020.

In Re: Joint Application of Longview Power II, LLC and Longview Renewable Power, LLC to Authorize the Construction and Operation of Two Wholesale Electric Generating Facilities and One High-Voltage Electric Transmission Line in Monongalia County, Public Service Commission of West Virginia Case No. 19-0890-E-CS-CN, Direct Testimony on behalf of Sierra Club, January 3, 2020; testimony at hearings January 30, 2019.

In Re: Alabama Power Company Petition for a Certificate of Convenience and Necessity, Alabama Public Service Commission Docket No. 32953, Direct Testimony on Behalf of Energy Alabama and Gasp, December 4, 2019.

In the Matter of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC Standard Offer, Avoided Cost Methodologies, and Form Contract Power Purchase Agreements, South Carolina Public Service Commission Docket Nos. 2019-185-E and 2019-186-E, Direct Testimony on behalf of the South Carolina Coastal Conservation League and Southern Alliance for Clean Energy, September 11, 2019; surrebuttal testimony, October 11, 2019; direct and surrebuttal testimony at hearings, October 22, 2019.

In the Matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery Plan in its Rate Schedules for 2019 Metered Jurisdictional Sales of Electricity,

Michigan Public Service Commission Case No. U-20221, Direct Testimony on behalf of Michigan Environmental Council, May 28, 2019.

PJM Interconnection, L.L.C., FERC Docket Nos. EL19-58 and ER19-1486 (Reserve Pricing - ORDC), Affidavit in Support of the Protest of the Clean Energy Advocates, May 15, 2019.

PJM Interconnection, L.L.C., FERC Docket Nos. EL19-58 and ER19-1486 (Reserve Pricing - Transition), Affidavit in Support of the Protests of the PJM Load/Customer Coalition and Clean Energy Advocates, May 15, 2019.

In Re: Georgia Power Company's 2019 Integrated Resource Plan, Georgia Public Service Commission Docket No. 42310, Direct Testimony on Behalf of Georgia Interfaith Power & Light and the Partnership For Southern Equity, April 25, 2019; testimony at hearings May 14, 2019.

PJM Interconnection, L.L.C., FERC Docket No. EL19-63 (RPM Market Supplier Offer Cap), Affidavit in Support of the Complaint of the Joint Consumer Advocates, April 15, 2019.

In the Matter of 2018 Biennial Integrated Resource Plans and Related 2018 REPS Compliance Plans, North Carolina Utilities Commission Docket No. E-100 Sub 157, Review and Evaluation of the Load Forecasts, and Review and Evaluation of Resource Adequacy and Solar Capacity Value Issues, with regard to the Duke Energy Carolinas and Duke Energy Progress 2018 Integrated Resource Plans, Attachments 3 and 4 to the comments of Southern Alliance for Clean Energy, Sierra Club, and the Natural Resources Defense Council, March 7, 2019; presentation at technical conference, January 8, 2020.

In the Matter of Biennial Determination of Avoided Cost Rates for Electric Utility Purchases from Qualifying Facilities – 2018, North Carolina Utilities Commission Docket No. E-100 Sub 158, Review and Evaluation of Resource Adequacy and Solar Capacity Value Issues with regard to the Duke Energy Carolinas and Duke Energy Progress 2018 Integrated Resource Plans and Avoided Cost Filing, Attachment B to the Initial Comments of the Southern Alliance for Clean Energy, February 12, 2019.

PJM Interconnection, L.L.C., FERC Docket No. ER19-105 (RPM Quadrennial Review), Affidavit in Support of the Limited Protest and Comments of the Public Interest Entities, November 19, 2018.

PJM Interconnection, L.L.C., FERC Docket No. EL18-178 (MOPR and FRR Alternative), Affidavit in Support of the Comments of the FRR-RS Supporters, October 2, 2018; Reply Affidavit on behalf of Clean Energy and Consumer Advocates, November 6, 2018.

Virginia Electric and Power Company's 2018 Integrated Resource Plan filing, Virginia State Corporation Commission Case No. PUE-2018-00065, Direct Testimony on behalf of Environmental Respondents, August 10, 2018; testimony at hearings September 25, 2018; Supplemental Testimony, April 16, 2019.

In the Matter of the Application of Duke Energy Ohio for an Increase in Electric Distribution Rates, etc., Public Utilities Commission of Ohio Case No. 17-32-EL-AIR et al, Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, June 25, 2018; deposition, July 3, 2018; testimony at hearings, July 19, 2018.

In the Matter of the Application of DTE Gas Company for Approval of a Gas Cost Recovery Plan, 5-year Forecast and Monthly GCR Factor for the 12 Months ending March 31, 2019, Michigan Public Service Commission Case No. U-18412, Direct Testimony on behalf of Michigan Environmental Council, June 7, 2018.

Constellation Mystic Power, L.L.C., FERC Docket No. ER18-1639-000 (Mystic Cost of Service Agreement), Affidavit in Support of the Comments of New England States Committee on Electricity, June 6, 2018; prepared answering testimony, August 23, 2018.

New England Power Generators Association, Complainant v. ISO New England Inc. Respondent, FERC Docket No. EL18-154-000 (re: capacity offer price of Mystic power plant), Affidavit in Support of the Protest of New England States Committee on Electricity, June 6, 2018.

PJM Interconnection, L.L.C., FERC Docket No. ER18-1314 (Capacity repricing or MOPR-Ex), Affidavit in Support of the Protests of DC-MD-NJ Consumer Coalition, Joint Consumer Advocates, and Clean Energy Advocates, May 7, 2018; reply affidavit, June 15, 2018.

In the Matter of 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, Michigan Public Service Commission Case No. U-18403, Direct Testimony on behalf of Michigan Environmental Council and Sierra Club, April 20, 2018.

Virginia Electric and Power Company's 2017 Integrated Resource Plan filing, Virginia State Corporation Commission Case No. PUE-2017-00051, Direct Testimony on behalf of Environmental Respondents, August 11, 2017; testimony at hearings September 26, 2017.

Ohio House of Representatives Public Utilities Committee hearing on House Bill 178 (Zero Emission Nuclear Resource legislation), Opponent Testimony on Behalf of Natural Resources Defense Council, May 15, 2017.

In the Matter of the Application of Atlantic Coast Pipeline, Federal Energy Regulatory Commission Docket No. CP15-554, Evaluating Market Need for the Atlantic Coast Pipeline, Attachment 2 to the comments of Shenandoah Valley Network *et al*, April 6, 2017.

In the Matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery Plan in its Rate Schedules for 2017 Metered Jurisdictional Sales of Electricity, Michigan Public Service Commission Case No. U-18143, Direct Testimony on behalf of Michigan Environmental Council and Sierra Club, March 22, 2017.

In the Matter of the Petition of Washington Gas Light Company for Approval of Revised Tariff Provisions to Facilitate Access to Natural Gas in the Company's Maryland Franchise Area That Are Currently Without Natural Gas Service, Maryland Public Service Commission Case No. 9433, Direct Testimony on Behalf of the Mid-Atlantic Propane Gas Association and the Mid-Atlantic Petroleum Distributors Association, Inc., March 1, 2017; testimony at hearings, May 1, 2017.

In the Matter of Integrated Resource Plans and Related 2016 REPS Compliance Plans, North Carolina Utilities Commission Docket No. E-100 Sub 147, Review and Evaluation of the Peak Load Forecasts and Reserve Margin Determinations for the Duke Energy Carolinas and Duke Energy Progress 2016 Integrated Resource Plans, Attachments A and B to the comments of the Natural Resources Defense Council, Southern Alliance for Clean Energy, and the Sierra Club, February 17, 2017.

In the Matter of the Tariff Revisions Designated TA285-4 filed by ENSTAR Natural Gas Company, a Division of SEMCO Energy, Inc., Regulatory Commission of Alaska Case No. U-16-066, Testimony on Behalf of Matanuska Electric Association, Inc., February 7, 2017, testimony at hearings, June 21, 2017.

PJM Interconnection, L.L.C., FERC Docket No. ER17-367 (seasonal capacity), Prepared Testimony on Behalf of Advanced Energy Management Alliance, Environmental Law & Policy Center, Natural Resources Defense Council, Rockland Electric Company and Sierra Club, December 8, 2016; Declaration in support of Protest of Response to Deficiency Letter, February 13, 2017.

Natural Resources Defense Council, Sierra Club, and Union of Concerned Scientists v. Federal Energy Regulatory Commission, U.S. District Court of Appeals for the D.C. Circuit Case No. 16-1236 (Capacity Performance), Declaration, September 23, 2016.

Mountaineer Gas Company Infrastructure Replacement and Expansion Program Filing for 2016, West Virginia Public Service Commission Case No. 15-1256-G-390P, and Mountaineer Gas Company Infrastructure Replacement and Expansion Program Filing for 2017, West Virginia Public Service Commission Case No. 16-0922-G-390P, Direct Testimony on behalf of the West Virginia Propane Gas Association, September 9, 2016.

Application of Chesapeake Utilities Corporation for a General Increase in its Natural Gas Rates and for Approval of Certain Other Changes to its Natural Gas Tariff, Delaware P.S.C. Docket No. 15-1734, Direct Testimony on behalf of the Delaware Association Of Alternative Energy Providers, Inc., August 24, 2016.

Virginia Electric and Power Company's 2016 Integrated Resource Plan filing, Virginia State Corporation Commission Case No. PUE-2016-00049, Direct Testimony on behalf of Environmental Respondents, August 17, 2016; testimony at hearings October 5, 2016.

In the Matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery Plan in its Rate Schedules for 2016 Metered Jurisdictional Sales of Electricity, Michigan Public Service Commission Case No. U-17920, Direct Testimony on behalf of Michigan Environmental Council and Sierra Club, March 14, 2016.

In the Matter of the Application Seeking Approval of Ohio Power Company's Proposal to Enter into an Affiliate Power Purchase Agreement for Inclusion in the Power Purchase Agreement Rider, Public Utilities Commission of Ohio Case No. 14-1693-EL-RDR: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, September 11, 2015; deposition, September 30, 2015; supplemental deposition, October 16, 2015; testimony at hearings, October 21, 2015; supplemental testimony December 28, 2015; second supplemental deposition, December 30, 2015; testimony at hearings January 8, 2016.

Indicated Market Participants v. PJM Interconnection, L.L.C., FERC Docket No. EL15-88 (Capacity Performance transition auctions), Affidavit on behalf of the Joint Consumer Representatives and Interested State Commissions, August 17, 2015.

ISO New England Inc. and New England Power Pool Participants Committee, FERC Docket No. ER15-2208 (Winter Reliability Program), Testimony on Behalf of the New England States Committee on Electricity, August 5, 2015.

Joint Consumer Representatives v. PJM Interconnection, L.L.C., FERC Docket No. EL15-83 (load forecast for capacity auctions), Affidavit in Support of the Motion to Intervene and Comments of the Public Power Association of New Jersey, July 20, 2015.

In the Matter of the Tariff Revisions Filed by ENSTAR Natural Gas Company, a Division of SEMCO Energy, Inc., Regulatory Commission of Alaska Case No. U-14-111, Testimony on Behalf of Matanuska Electric Association, Inc., May 13, 2015.

In the Matter of the Application of Ohio Edison Company et al for Authority to Provide for a Standard Service Offer Pursuant to R.C. 4928.143 in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 14-1297-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel and Northeast Ohio Public Energy Council, December 22, 2014; deposition, February 10, 2015; supplemental testimony May 11, 2015; second deposition May 26, 2015; testimony at hearings, October 2, 2015; second supplemental testimony December 30, 2015; third deposition January 8, 2016; testimony at hearings January 19, 2016; rehearing direct testimony June 22, 2016; fourth deposition July 5, 2016; testimony at hearings July 14, 2016.

PJM Interconnection, L.L.C., FERC Docket No. ER14-2940 (RPM Triennial Review), Affidavit in Support of the Protest of the PJM Load Group, October 16, 2014.

In the Matter of the Application of Duke Energy Ohio for Authority to Establish a Standard Service Offer in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 14-841-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, September 26, 2014; deposition, October 6, 2014; testimony at hearings, November 5, 2014.

In the Matter of the Application of Ohio Power Company for Authority to Establish a Standard Service Offer in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 13-2385-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, May 6, 2014; deposition, May 29, 2014; testimony at hearings, June 16, 2014.

PJM Interconnection, L.L.C., FERC Docket No. ER14-504 (clearing of Demand Response in RPM), Affidavit in Support of the Protest of the Joint Consumer Advocates and Public Interest Organizations, December 20, 2013.

New England Power Generators Association, Inc. v. ISO New England Inc., FERC Docket No. EL14-7 (administrative capacity pricing), Testimony in Support of the Protest of the New England States Committee on Electricity, November 27, 2013.

Midwest Independent Transmission System Operator, Inc., FERC Docket No. ER11-4081 (minimum offer price rule), Affidavit In Support of Brief of the Midwest TDUs, October 11, 2013.

ANR Storage Company, FERC Docket No. RP12-479 (storage market-based rates), Prepared Answering Testimony on behalf of the Joint Intervenor Group, April 2, 2013; Prepared Cross-answering Testimony, May 15, 2013; testimony at hearings, September 4, 2013.

In the Matter of the Application of The Dayton Power and Light Company for Approval of its Market Rate Offer, Public Utilities Commission of Ohio Case No. 12-426-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, March 5, 2013; deposition, March 11, 2013.

PJM Interconnection, L.L.C., FERC Docket No. ER13-535 (minimum offer price rule), Affidavit in Support of the Protest and Comments of the Joint Consumer Advocates, December 28, 2012.

In the Matter of the Application of Ohio Edison Company, et al for Authority to Provide for a Standard Service Offer in the Form of an Electric Security Plan, Public Utilities Commission of Ohio Case No. 12-1230-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, May 21, 2012; deposition, May 30, 2012; testimony at hearings, June 5, 2012.

PJM Interconnection, L.L.C., FERC Docket No. ER12-513 (changes to RPM), Affidavit in Support of Protest of the Joint Consumer Advocates and Demand Response Supporters, December 22, 2011.

People of the State of Illinois *ex rel.* Leon A. Greenblatt, III v Commonwealth Edison Company, Circuit Court of Cook County, Illinois, deposition, September 22, 2011; interrogatory, Feb. 22, 2011.

In the Matter of the Application of Union Electric Company for Authority to Continue the Transfer of Functional Control of Its Transmission System to the Midwest Independent Transmission System Operator, Inc., Missouri PSC Case No. EO-2011-0128, Testimony in hearings, February 9, 2012; Rebuttal Testimony and Response to Commission Questions On Behalf Of The Missouri Joint Municipal Electric Utility Commission, September 14, 2011.

PJM Interconnection, L.L.C., and PJM Power Providers Group v. PJM Interconnection, L.L.C., FERC Docket Nos. ER11-2875 and EL11-20 (minimum offer price rule), Affidavit in Support of Protest of New Jersey Division of Rate Counsel, March 4, 2011, and Affidavit in Support of Request for Rehearing and for Expedited Consideration of New Jersey Division of Rate Counsel, May 12, 2011.

PJM Interconnection, L.L.C., FERC Docket No. ER11-2288 (demand response "saturation"), Affidavit in Support of Protest and Comments of the Joint Consumer Advocates, December 23, 2010.

North American Electric Reliability Corporation, FERC Docket No. RM10-10, Comments on Proposed Reliability Standard BAL-502-RFC-02: Planning Resource Adequacy Analysis, Assessment and Documentation, December 23, 2010.

In the Matter of the Reliability Pricing Model and the 2013/2014 Delivery Year Base Residual Auction Results, Maryland Public Service Commission Administrative Docket PC 22, Comments and Responses to Questions On Behalf of Southern Maryland Electric Cooperative, October 15, 2010.

PJM Interconnection, L.L.C., FERC Docket No. ER09-1063-004 (PJM compliance filing on pricing during operating reserve shortages): Affidavit In Support of Comments and Protest of the Pennsylvania Public Utility Commission, July 30, 2010.

ISO New England, Inc. and New England Power Pool, FERC Docket No. ER10-787 (minimum offer price rules): Direct Testimony On Behalf Of The Connecticut Department of Public Utility Control, March 30, 2010; Direct Testimony in Support of First Brief of the Joint Filing Supporters, July 1, 2010; Supplemental Testimony in Support of Second Brief of the Joint Filing Supporters, September 1, 2010.

PJM Interconnection, L.L.C., FERC Docket No. ER09-412-006 (RPM incremental auctions): Affidavit In Support of Protest of Indicated Consumer Interests, January 19, 2010.

In the Matter of the Application of Ohio Edison Company, et al for Approval of a Market Rate Offer to Conduct a Competitive Bidding Process for Standard Service Offer Electric Generation Supply, Public Utilities Commission of Ohio Case No. 09-906-EL-SSO: Direct Testimony on Behalf of the Office of the Ohio Consumers' Counsel, December 7, 2009; deposition, December 10, 2009, testimony at hearings, December 22, 2009.

Application of PATH Allegheny Virginia Transmission Corporation for Certificates of Public Convenience and Necessity to Construct Facilities: 765 kV Transmission Line through Loudon, Frederick and Clarke Counties, Virginia State Corporation Commission Case No. PUE-2009-00043: Direct Testimony on Behalf of Commission Staff, December 8, 2009.

PJM Interconnection, L.L.C., FERC Docket No. ER09-412-000: Affidavit on Proposed Changes to the Reliability Pricing Model on behalf of RPM Load Group, January 9, 2009; Reply Affidavit, January 26, 2009.

PJM Interconnection, L.L.C., FERC Docket No. ER09-412-000: Affidavit In Support of the Protest Regarding Load Forecast To Be Used in May 2009 RPM Auction, January 9, 2009.

Maryland Public Service Commission et al v. PJM Interconnection, L.L.C., FERC Docket No. EL08-67-000: Affidavit in Support Complaint of the RPM Buyers, May 30, 2008; Supplemental Affidavit, July 28, 2008.

PJM Interconnection, L.L.C., FERC Docket No. ER08-516: Affidavit On PJM's Proposed Change to RPM Parameters on Behalf of RPM Buyers, March 6, 2008.

PJM Interconnection, L.L.C., Reliability Pricing Model Compliance Filing, FERC Docket Nos. ER05-1410 and EL05-148: Affidavit Addressing RPM Compliance Filing Issues on Behalf of the Public Power Association of New Jersey, October 15, 2007.

TXU Energy Retail Company LP v. Leprino Foods Company, Inc., US District Court for the Northern District of California, Case No. C01-20289: Testimony at trial, November 15-29, 2006; Deposition, April 7, 2006; Expert Report on Behalf of Leprino Foods Company, March 10, 2006.

Gas Transmission Northwest Corporation, Federal Energy Regulation Commission Docket No. RP06-407: Reply Affidavit, October 26, 2006; Affidavit on Behalf of the Canadian Association of Petroleum Producers, October 18, 2006.

PJM Interconnection, L.L.C., Reliability Pricing Model, FERC Docket Nos. ER05-1410 and EL05-148: Supplemental Affidavit on Technical Conference Issues, June 22, 2006; Supplemental Affidavit Addressing Paper Hearing Topics, June 2, 2006; Affidavit on Behalf of the Public Power Association of New Jersey, October 19, 2005.

Maritimes & Northeast Pipeline, L.L.C., FERC Docket No. RP04-360-000: Prepared Cross Answering Testimony, March 11, 2005; Prepared Direct and Answering Testimony on Behalf of Firm Shipper Group, February 11, 2005.

Dynergy Marketing and Trade v. Multiut Corporation, US District Court of the Northern District of Illinois, Case. No. 02 C 7446: Deposition, September 1, 2005; Expert Report in response to Defendant's counterclaims, March 21, 2005; Expert Report on damages, October 15, 2004.

Application of Pacific Gas and Electric Company, California Public Utilities Commission proceeding A.04-03-021: Prepared Testimony, Policy for Throughput-Based Backbone Rates, on behalf of Pacific Gas and Electric Company, May 21, 2004.

Gas Market Activities, California Public Utilities Commission Order Instituting Investigation I.02-11-040: Testimony at hearings, July, 2004; Prepared Testimony, Comparison of Incentives Under Gas Procurement Incentive Mechanisms, on behalf of Pacific Gas and Electric Company, December 10, 2003.

Application of Red Lake Gas Storage, L.P., FERC Docket No. CP02-420, Affidavit in support of application for market-based rates for a proposed merchant gas storage facility, March 3, 2003.

Application of Pacific Gas and Electric Company, California Public Utilities Commission proceeding A.01-10-011: Testimony at hearings, April 1-2, 2003; Rebuttal Testimony, March 24, 2003; Prepared Testimony, Performance of the Gas Accord Market Structure, on behalf of Pacific Gas and Electric Company, January 13, 2003.

Application of Wild Goose Storage, Inc., California Public Utilities Commission proceeding A.01-06-029: Testimony at hearings, November, 2001; Prepared testimony regarding policies for backbone expansion and tolls, and potential ratepayer benefits of new storage, on behalf of Pacific Gas and Electric Company, October 24, 2001.

Public Utilities Commission of the State of California v. El Paso Natural Gas Co., FERC Docket No. RP00-241: Testimony at hearings, May-June, 2001; Prepared Testimony on behalf of Pacific Gas and Electric Company, May 8, 2001.

Application of Pacific Gas and Electric Company, California Public Utilities Commission proceeding A.99-09-053: Prepared testimony regarding market power consequences of divestiture of hydroelectric assets, December 5, 2000.

San Diego Gas & Electric Company, *et al*, FERC Docket No. EL00-95: Prepared testimony regarding proposed price mitigation measures on behalf of Pacific Gas and Electric Co., November 22, 2000.

Application of Harbor Cogeneration Company, FERC Docket No. ER99-1248: Affidavit in support of application for market-based rates for energy, capacity and ancillary services, December 1998.

Application of and Complaint of Residential Electric, Incorporated vs. Public Service Company of New Mexico, New Mexico Public Utility Commission Case Nos. 2867 and 2868: Testimony at hearings, November, 1998; Direct Testimony on behalf of Public Service Company of New Mexico on retail access issues, November, 1998.

Management audit of Public Service Electric and Gas' restructuring proposal for the New Jersey Board of Public Utilities: Prepared testimony on reliability and basic generation service, March 1998.

PUBLISHED ARTICLES

Forward Capacity Market CONEfusion, Electricity Journal Vol. 23 Issue 9, November 2010.

Reconsidering Resource Adequacy (Part 2): Capacity Planning for the Smart Grid, Public Utilities Fortnightly, May 2010.

Reconsidering Resource Adequacy (Part 1): Has the One-Day-in-Ten-Years Criterion Outlived Its Usefulness? Public Utilities Fortnightly, April 2010.

A Hard Look at Incentive Mechanisms for Natural Gas Procurement, with K. Costello, National Regulatory Research Institute Report No. 06-15, November 2006.

Natural Gas Procurement: A Hard Look at Incentive Mechanisms, with K. Costello, Public Utilities Fortnightly, February 2006, p. 42.

After the Gas Bubble: An Economic Evaluation of the Recent National Petroleum Council Study, with K. Costello and H. Huntington, Energy Journal Vol. 26 No. 2 (2005).

High Natural Gas Prices in California 2000-2001: Causes and Lessons, Journal of Industry, Competition and Trade, vol. 2:1/2, November 2002.

Restructuring the Electric Power Industry: Past Problems, Future Directions, Natural Resources and Environment, ABA Section of Environment, Energy and Resources, Volume 16 No. 4, Spring, 2002.

Scarcity, Market Power, Price Spikes, and Price Caps, Electricity Journal, November, 2000.

The New York ISO's Market Power Screens, Thresholds, and Mitigation: Why It Is Not A Model For Other Market Monitors, Electricity Journal, August/September 2000.

ISOs: A Grid-by-Grid Comparison, Public Utilities Fortnightly, January 1, 1998.

Economic Policy in the Natural Monopoly Industries in Russia: History and Prospects (with V. Capelik), Voprosi Ekonomiki, November 1995.

Meeting Russia's Electric Power Needs: Uncertainty, Risk and Economic Reform, Financial and Business News, April 1993.

Russian Energy Policy through the Eyes of an American Economist, Energeticheskoye Stroitelstvo, December 1992, p 2.

Fuel Contracting Under Uncertainty, with R. B. Fancher and H. A. Mueller, IEEE Transactions on Power Systems, February, 1986, p. 26-33.

OTHER ARTICLES, REPORTS AND PRESENTATIONS

Panel: Reserve Pricing, Organization of PJM States Spring Strategy Meeting, April 8, 2019.

Panel: Capacity Markets, AWEA Future Power Markets Summit 2018, September 5, 2018.

With Rob Gramlich, *Maintaining Resource Adequacy in PJM While Accommodating State Policies: A Proposal for the Resource-Specific FRR Alternative*, July 27, 2018, prepared for Sierra Club, Natural Resources Defense Council, District of Columbia Office of the People's Counsel, American Council on Renewable Energy.

Seasonal Capacity Technical Conference, Federal Energy Regulatory Commission Docket Nos. EL17-32 and EL17-36, *Pre-Conference Comments* April 11, 2018; panelist, April 24, 2018, post-conference comments July 13, 2018.

Panel: Demand Response, Organization of PJM States Spring Strategy Meeting, April 9, 2018.

Panel: Energy Price Formation, Organization of PJM States Spring Strategy Meeting, April 9, 2018.

Panel: Regional Reliability Standards: Requirements or Replaceable Relics? Harvard Electricity Policy Group Ninetieth Plenary Session, March 22, 2018.

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PROFESSIONAL ASSOCIATIONS

United States Association for Energy Economics

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