OCC EXHIBIT NO. _____

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

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	)	Case No. 14-1693-EL-RDR
In the Matter of the Application of Ohio Power Company for Approval of Certain Accounting Authority	)	Case No. 14-1694-EL-AAM

DIRECT TESTIMONY
OF
RAMTEEN SIOSHANSI

On Behalf of the
The Office of the Ohio Consumers' Counsel
10 West Broad Street, Suite 1800
Columbus, Ohio 43215-3485

SEPTEMBER 11, 2015

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I. INTRODUCTION

Q1. PLEASE STATE YOUR NAME, POSITION, AND BUSINESS ADDRESS.

A1. My name is Ramteen Sioshansi. I am an operations researcher who focuses on issues related to electricity industry economics, market design, regulation, operations, planning, and policy. My business address is 60 East Spring Street, Columbus, OH 43215.

Q2. PLEASE DESCRIBE YOUR EXPERIENCE AND QUALIFICATIONS.

A2. I have 17 years of academic and consulting experience within the electric power industry. Much of my academic research, which I carry out as an associate professor of industrial and systems engineering at The Ohio State University, is focused on the design and analysis of restructured wholesale and retail electricity markets and market power issues in the United States and abroad. My research also examines issues related to energy economics, energy policy, and electric power system regulation. Other areas of research include techno-economic analyses of the integration of renewable energy sources, electric vehicles, and energy storage technologies into electric power systems.

Through this and other work, I am very familiar with how short-term operations and long-term planning of power systems are optimized. My consulting work has included analyses of wholesale electricity market designs for a market participant, including the development of generation offer strategies. I have also advised a

renewable technology developer on structuring power purchase agreements ("PPAs") with U.S. electric utilities. I have worked as a research intern for the chief economist to the Federal Energy Regulatory Commission ("FERC") and am currently serving a two-year term as a member of the U.S. Department of Energy's Electricity Advisory Committee. I hold a B.A. in economics and applied mathematics and an M.S. and Ph.D. in industrial engineering and operations research from the University of California, Berkeley. I also hold an M.Sc. in econometrics and mathematical economics from the London School of Economics and Political Science. My curriculum vita, summarizing my experience, is Attachment RMS-1, attached hereto.

Q3. ON WHOSE BEHALF ARE YOU TESTIFYING?

A3. I am providing testimony on behalf of the Office of the Ohio Consumers' Counsel ("OCC").

Q4. HAVE YOU TESTIFIED BEFORE A REGULATORY AGENCY?

A4. Yes. I have submitted testimony to the Public Utilities Commission of Ohio ("PUCO") on behalf of OCC and the Northeast Ohio Public Energy Council in Case No. 14-1297-EL-SSO.

Q5. WHAT IS THE PURPOSE AND SCOPE OF YOUR TESTIMONY?

A5. In this proceeding Ohio Power Company (the "Utility" or "AEP Ohio") seeks approval of a PPA with AEP Generation Resources ("AEPGR") for the output

and costs (including a guaranteed return) of several specific generating units ("PPA Units"). AEP Ohio will, in turn, offer the output of the PPA Units into the energy, ancillary service, and capacity markets operated by PJM Interconnection, L.L.C. ("PJM"). The revenues earned by offering these services in the PJM-operated markets will be netted against the PPA costs and the difference will be charged or credited to customers via a non-bypassable surcharge ("PPA Rider"). The term of the PPA is for the "entire commercial operational life of all PPA units, including any post-retirement period necessary to fulfill all asset retirement obligations."[1]

My assignment was to review the Utility's amended application, supporting testimony, work papers, and discovery in this proceeding. I was asked to evaluate the effect of the proposed PPA and PPA Rider on the efficiency of the PJM-operated markets. I also was asked to evaluate what effect the PPA and PPA Rider would have on AEP Ohio's and AEPGR's operating the PPA Units in an economically prudent manner, including decisions surrounding plant retirements. In addition, I was asked to assess whether the factors established by the PUCO to evaluate if the PPA and PPA Rider benefit customers and are in the public interest are appropriate and exhaustive and whether AEP Ohio's amended filing fully addresses the factors established by the PUCO. I was finally asked to make recommendations on how the negative impacts of the PPA and PPA Rider

[1] Direct testimony to the Amended Application of AEP Witness Kelly D. Pearce, Exhibit KDP-1, page 1.

could be mitigated through alternative arrangements to deliver the purported benefits of the PPA and PPA Rider.

Q6. WHAT ARE THE FACTORS ESTABLISHED BY THE PUCO TO EVALUATE IF THE PPA AND PPA RIDER BENEFIT CUSTOMERS AND ARE IN THE PUBLIC INTEREST?

A6. The PUCO issued an order on February 25, 2015, regarding AEP Ohio's application for an electric security plan ("ESP") in Case No. 13-2385-EL-SSO. In its order, the PUCO approved the PPA proposed by AEP Ohio as a placeholder rider, at an initial rate of zero, for the term of the ESP. The PUCO determined that AEP Ohio must show that the PPA is reasonable, in the public interest, and benefits customers. The PUCO instructed AEP Ohio to make a future filing to justify any amount above zero and offered advice on what that future filing should address.

Specifically, the PUCO listed four additional factors (the "AEP Ohio PPA Factors") to include in a future filing, which are:

1) financial need of the generating plant;
2) necessity of the generating facility, in light of future reliability concerns and, including supply diversity;
3) description of how the generation plant is compliant with all pertinent environmental regulations and its plan for

compliance; and

4) the impact that a closure of the generating plant would have on electric prices and the results' effect on economic development.

The PUCO also required any future filing by AEP Ohio to:

1) provide for rigorous Commission oversight of the rider, including a proposed process for a periodic substantive review and audit;
2) commit to full information sharing with the Commission and its Staff; and
3) include an alternative plan to allocate the rider's financial risk between both the Company and its ratepayers.

Finally, the PUCO required that AEP Ohio include a severability provision that recognizes that all other provisions of its ESP will continue in the event that the PPA rider is invalidated, in whole or in part at any point, by a court of competent jurisdiction.

Q7. WHAT ARE YOUR SPECIFIC RECOMMENDATIONS AND FINDINGS?

A7. I recommend that the Utility's proposal should be denied for the following five reasons:

1) The PPA and PPA Rider directly subsidize the operating and capital costs of the PPA Units. Such a subsidy has no place in a competitive wholesale market, such as those operated by PJM, because the market is intended to provide revenues for economically efficient assets to recover their costs. A properly functioning competitive wholesale market can provide benefits to customers because it is designed to ensure that the electric power system efficiently and reliably serves customer demands in the short- and long-run.

2) Furthermore, allowing subsidized generators to participate in a wholesale market against unsubsidized assets can potentially destroy the short- and long-run efficiency benefits of the price signals provided by the market. The PPA and PPA Rider could also result in anticompetitive behavior by AEP Ohio or AEPGR. These types of effects would eliminate the customer benefits of a properly functioning competitive wholesale market outlined above.

3) By fully subsidizing the operating and capital costs of the PPA Units, the PPA and PPA Rider eliminates any incentives that the PJM-operated markets are designed to create to reduce the operating and capital costs of the PPA Units. The subsidy further eliminates incentives to make

prudent retirement decisions regarding the PPA Units. This means that the cost of supplying customers' energy and capacity needs using the PPA Units may be higher than they would otherwise be without the subsidy in place.

4) AEP Ohio and its proposal have not met a number of the AEP Ohio PPA Factors established by the PUCO.

5) Notwithstanding the above, the AEP Ohio PPA Factors are not sufficient for the PUCO to determine if the PPA and PPA Rider benefit customers and are in the public interest. This is because the AEP Ohio PPA Factors focus solely on the benefits of the PPA and PPA Rider, and do not consider their costs. As such, the AEP Ohio PPA Factors do not provide the PUCO with sufficient information to determine the *net* benefits of the PPA and PPA Rider to AEP Ohio's captive customers.

For these reasons, I recommend that AEP Ohio's proposal be denied.

II. MARKET EFFICIENCY AND PRUDENT DECISION MAKING EFFECTS

Q8. PLEASE EXPLAIN THE DISTINCTION BETWEEN THE SHORT AND LONG RUN IN THE CONTEXT OF ELECTRIC POWER SYSTEM OPERATIONS AND CAPACITY PLANNING.

A8. In the context of an electric power system, the short run typically refers to the period of time when the installed generation, transmission, and distribution assets are static, meaning that one is only concerned with how the installed assets are operated.[2] Conversely, the long run refers to the period of time when assets can be built and added to or removed from the system, for economic, reliability, public-policy-related, or other reasons.[3]

Q9. PLEASE EXPLAIN WHAT IS MEANT BY SHORT- AND LONG-RUN EFFICIENCY IN AN ELECTRIC POWER SYSTEM.

A9. In the short run, the installed assets should be operated in a manner that ensures customer demands are met reliably and at minimum cost. In the long run, assets should be added to or removed from the system to serve customer demand reliably and at minimum cost. This long-run planning is typically forward-looking, and accounts for expected demand growth, changes in fuel and capital costs, and policy and regulatory changes. Long-run planning also requires an

[2] S. Stoft, "Power System Economics: Designing Markets for Electricity," Wiley-IEEE, 2002.

[3] S. Stoft, "Power System Economics: Designing Markets for Electricity," Wiley-IEEE, 2002.

understanding of how the power system will be operated in the short run, because capacity additions or removals should account for both capital and operating costs.

Q10. PLEASE EXPLAIN HOW THE PJM-OPERATED WHOLESALE MARKETS ARE INTENDED TO ENSURE SHORT-RUN EFFICIENCY OF THE ELECTRIC POWER SYSTEM FOR THE BENEFIT OF CUSTOMERS.

A10. The underlying premise of restructured wholesale electricity markets, such as those operated by PJM, is that assets compete against one another to reliably supply customers at least cost. The market operator achieves this by soliciting generation offers from market participants. These generation offers are matched against demand bids in a series of unit commitment- and economic dispatch-based markets to determine which generators supply energy and ancillary services. Because generators must compete with one another through their generation offers, generators that are most efficient (either due to having the lowest cost or the requisite amount of flexibility needed by the system) operate to serve customers at least cost. Moreover, the day-ahead and real-time markets operated by PJM co-optimize the supply of energy and ancillary services and include security constraints. These security constraints ensure that sufficient capacity is available to reliably serve customers in the event of unanticipated generator or transmission failures or unforecasted load spikes.

Q11. PLEASE EXPLAIN HOW THE PJM-OPERATED WHOLESALE MARKETS ARE INTENDED TO ENSURE LONG-RUN EFFICIENCY OF THE ELECTRIC POWER SYSTEM FOR THE BENEFITS OF CUSTOMERS.

A11. Restructured wholesale electricity markets, such as those operated by PJM, are also intended to ensure long-run efficiency of the electric power system. Long-run efficiency of the generation mix is achieved by allowing generation assets to freely enter and exit the market. Generation technologies that are inefficient in the long run, in the sense that lower-cost alternatives (on the basis of capital and operating costs) exist, are driven out of the market. This is because such assets cannot recover their costs through market revenues. Conversely, long-run efficient technologies are able to recover their capital and operating costs through market revenues. Incumbent firms and new entrants, thus, have strong incentives to invest in adding efficient generation technologies, because these technologies represent profit opportunities. The market also provides competitive pressure for generation owners to reduce capital and operating costs. By doing so, asset owners can increase the profitability of generators in the market. In some instances, such cost reductions can make an otherwise long-run inefficient generator efficient. These competitive pressures benefit customers by having their demands met reliably and at minimum cost in the long run.

PJM supplements the energy and ancillary service revenues earned by generators in the day-ahead and real-time markets through its Reliability Pricing Model ("RPM") market. The RPM is a capacity market that is meant to ensure that there

are sufficient capacity resource products available to maintain system reliability. This is done by providing payments to sources of capacity (including generators) that meet reliability criteria established by PJM. These capacity payments provided by the RPM market further strengthen the economic incentives for efficient capacity to be built in the system. This is because generators must compete with each other in the RPM auction on the basis of cost. Generators that can provide capacity and reliability to the system at lower cost will clear in the RPM auction and receive capacity payments. Conversely, inefficient sources of capacity may not clear the auction or may clear the auction but, nevertheless, not be able to recover their entire costs through market revenues.

Q12. PLEASE PROVIDE YOUR ASSESSMENT OF HOW AEP OHIO'S PROPOSED PPA AND PPA RIDER WOULD IMPACT THE ABILITY OF THE PJM-OPERATED WHOLESALE MARKETS TO ENSURE THE SHORT-RUN EFFICIENCY OF THE ELECTRIC POWER SYSTEM FOR THE BENEFIT OF CUSTOMERS.

A12. The proposed PPA and PPA Rider threaten to undermine the short-run efficiency benefits of the PJM-operated wholesale markets. This is because the capital and operating costs of the PPA Units plus a guaranteed return on investment to AEPGR would be fully subsidized by AEP Ohio's customers. Thus, neither AEP Ohio nor AEPGR would have to compete against other generators in the PJM-operated markets to recover the costs of the PPA Units. As such, AEP Ohio could follow any strategy in offering the energy, ancillary services, and capacity of the

PPA Units in the PJM-operated markets and have the PPA Units' costs fully collected through the PPA and the PPA Rider.

As an example of this, AEP Ohio could choose to offer the PPA Units into the PJM-operated markets below their true costs. This could result in the PPA Units being dispatched by PJM at a net operating cost. Although the PPA Units would not recover their costs through the market in such an instance, AEPGR and AEP Ohio would recover the cost deficit from AEP Ohio's customers through the PPA Rider. Moreover, the PJM system would not be operated efficiently in the short run, because there are other more efficient generators that could serve customer demands at lower cost than the PPA Units. This would translate into higher costs for AEP Ohio customers.

A converse example could also be given, in which AEP Ohio could choose to offer the PPA Units into the PJM-operated markets above their costs. This could result in the PPA Units not being dispatched, and PJM having to operate higher-cost assets in their place. This practice is often referred to as economic withholding. Although the PPA Units would not earn revenues in the market if they are economically withheld, AEPGR and AEP Ohio would collect this revenue shortfall from AEP Ohio's customers through the PPA Rider. Moreover, the PJM system would not be operated efficiently in the short-run, because other higher-cost generators would be operated in place of the PPA Units. This would also translate into higher AEP Ohio customer costs. It should be noted that any

discussion of the PPA Units being economically withheld is premised on a case in which the PPA Units would be part of an economically efficient generation mix, meaning that the PPA and PPA Rider generate a credit for AEP Ohio's customers. AEP Ohio's testimony includes analyses that purport the PPA Units generating such a credit in the future. However, the analysis of the PPA Units presented by OCC witness Wilson calls into question whether the PPA Units will ever produce a credit to customers, as his analysis shows the PPA Units producing a cost to AEP Ohio's customers in each year of the proposed PPA.

It is my understanding that, to date, AEP Ohio has not made a firm commitment as to how the PPA Units will be offered into the PJM-operated markets, except to state that "the regulated commercial operations group of [American Electric Power Service Corporation], acting as agent for AEP Ohio, will provide guidance to AEPGR in order to make the daily offers of the units into PJM."[4] Thus, it is not clear what type of short-run operating and efficiency impacts the PPA and PPA Rider would have. Moreover, any claims to offer the PPA Units into the PJM-operated markets at cost would be difficult to evaluate. This is because the inherent subsidy in the PPA and PPA Rider imply that the PPA Units have zero marginal capital and operating costs to AEPGR and AEP Ohio.

It should be noted that I am not advocating that AEP Ohio or AEPGR publicly disclose their offer strategies. Doing so could also harm the wholesale markets

[4] Direct testimony of Kelly D. Pearce on Behalf of AEP Ohio, p. 8.

and may be deemed a form of collusion among market participants. Instead, I am stating that it is difficult, with the way that the PPA and PPA Rider are structured, to guarantee that they would not have anti-competitive effects on the PJM-operated wholesale markets or cause those markets to operate inefficiently, to the detriment of customers. Given the state of Ohio's commitment to allowing competitive wholesale markets to deliver more efficient and reliable electricity service to customers, the PUCO should heavily factor the potentially detrimental effects of the PPA and PPA Rider on the wholesale markets and customers in making any decision to approve the Utility's proposal.

Q13. PLEASE PROVIDE YOUR ASSESSMENT OF HOW AEP OHIO'S PROPOSED PPA AND PPA RIDER COULD IMPACT THE ABILITY OF THE PJM-OPERATED WHOLESALE MARKETS TO ENSURE THE LONG-RUN EFFICIENCY OF THE ELECTRIC POWER SYSTEM FOR THE BENEFITS OF CUSTOMERS.

A13. The proposed PPA and PPA Rider threaten to undermine the long-run efficiency benefits of the PJM-operated wholesale markets in two ways. If they do, this means that it would be more costly to supply customer demands reliably in the long run.

First, the operating and capital costs of the PPA Units (plus a return on investment to AEPGR) would be subsidized by AEP Ohio's customers through the PPA. Moreover, there would be no net cost to AEP Ohio, due to the PPA Rider. This

could result in the PPA Units remaining in the PJM system regardless of whether lower-cost alternatives exist or enter the market. This is because the PPA term sheet states that "decisions regarding retirement of pre-retirement divestiture of any of the PPA Units shall be by mutual agreement of [AEP Ohio] and [AEPGR]."[5] Given that the PPA guarantees full cost recovery for AEPGR, there is a disincentive for AEPGR to retire a PPA Unit. Moreover, the PPA Rider transfers all PPA costs and operating risks to AEP Ohio's captive customers, thus there is no incentive for AEP Ohio to retire any of the PPA Units. Indeed, if AEPGR's return on investment is high enough, the PPA terms may create strong financial incentives for AEPGR and AEP Ohio to overinvest in the PPA Units.

Given this design of the PPA and PPA Rider, even though it may be efficient in the long run for the PPA Units to exit the system and be replaced by lower-cost and more efficient alternatives, they may remain in the system due to the guaranteed cost recovery paid for by AEP Ohio's customers. This would translate into higher customer costs than would occur without the PPA and PPA Rider.

The PPA and PPA Rider could also undermine the long-run efficiency benefits of the PJM-operated wholesale markets through the effects of the Companies' offering strategies on wholesale market prices. As outlined in my response to Q12, the subsidy inherent in AEP Ohio's proposal could result in the PPA Units being offered into the PJM-operated markets above or below their costs.

[5] Direct testimony of Kelly D. Pearce on Behalf of AEP Ohio, Exhibit KDP-1, p. 5.

Such offer behavior could suppress or increase market prices compared to the PPA Units being offered into the market without a customer-funded subsidy.

For instance, offering the PPA units into the market below their true costs could result in them being dispatched by PJM in place of lower-cost generators and suppressing market prices. Conversely, economically withholding the PPA Units will tend to increase prices. As noted in my response to Q11, the PJM-operated markets ensure long-run efficiency of the electric power system by allowing generators to enter and exit the market based on profits and revenues earned. If the prices generated by the market are arbitrary, insomuch as they are driven by the PPA Units not being offered into the market on the basis of true cost, this distorts the signals provided for long-term investment. For instance, if the strategies employed to offer the PPA Units into the PJM-operated markets act to suppress market prices, this could result in lower cost generation, which would be efficient absent the price effects, not entering the market. These investment effects that the strategies used to offer the PPA Units into the PJM-operated markets can translate into customers seeing higher energy prices in the long-run because long-term investments are not being driven by true market fundamentals.

Q14. PLEASE EXPLAIN HOW THE PARTICIPATION OF AEP OHIO'S AFFILIATES IN THE PJM-OPERATED MARKETS FURTHER COMPLICATES THE OFFERING STRATEGIES FOR THE PPA UNITS TO THE DETRIMENT OF AEP OHIO'S CUSTOMERS.

A14. AEP Ohio has a number of affiliates that own generation assets participating in the PJM-operated markets that are not covered by the proposed PPA. The issue of how AEP Ohio and AEPGR may offer the PPA Units into the PJM-operated markets is further complicated by the participation of these affiliated assets in the markets. As outlined in my response to Q13, the strategies employed for offering the PPA Units into the PJM-operated markets can suppress or increase wholesale prices. Because these prices determine revenues earned by the affiliates' non-PPA generation assets, AEP Ohio and AEPGR may have an incentive to economically withhold the PPA Units from the PJM-operated markets. As noted in my response to Q12, it is my understanding that, to date, AEP Ohio has not made a firm commitment as to how the PPA Units will be offered into the PJM-operated markets. Thus, it is not clear how AEP Ohio's offering strategies may be influenced by the participation of affiliate generation assets participating in the PJM-operated markets.

In a worse-case scenario for customers, AEP Ohio may adopt an offer strategy in which the PPA Units are offered into the market above cost and do not clear any of PJM's energy, ancillary service, or capacity markets. Although the PPA Units would not generate any revenues in the market, AEPGR would nevertheless earn

a guaranteed profit through the PPA. Furthermore, AEP Ohio's profits would not be affected since 100 percent of the PPA costs would be passed through the PPA Rider to AEP Ohio's customers. Moreover, the resulting increase in wholesale PJM-market prices would improve the revenues earned by affiliate-owned generators participating in the PJM-operated markets. This would translate into improved shareholder value.[6] In this worst-case scenario, customer costs rise due to higher wholesale market prices and customers must pay to subsidize generation assets that are not used to their full potential to serve customer demands (due to their being economically withheld from the market).

Q15. PLEASE EXPLAIN HOW THE AMBIGUITY AROUND THE TREATMENT OF BILATERAL TRANSACTIONS INVOLVING THE PPA UNITS FURTHER COMPLICATES THE OFFERING STRATEGIES EMPLOYED BY AEP OHIO.

A15. My understanding of AEP Ohio's proposal is that the PPA Rider will be calculated by netting revenues earned by the PPA Units in the PJM-operated markets against the cost of the PPA. AEP Ohio's proposal does not discuss if and how revenues earned from bilateral energy, ancillary service, or capacity sales would factor into computing the PPA Rider. If such revenues are not netted against cost, this could provide AEP Ohio with an added incentive to economically withhold the PPA Units from the PJM-operated markets. By doing

[6] Conversely, offering the PPA Units below cost will not affect the profits earned on those assets (due to the guaranteed profit through the PPA Rider). However, this could erode wholesale market prices, reducing the profitability of affiliate-owned generation.

so, the PPA Units would not be dispatched (or would be dispatched less) in the market. The energy, ancillary services, and capacity of the PPA Units could then be sold to affiliated or unaffiliated third parties bilaterally inside or outside of the PJM footprint. As a result, AEPGR and AEP Ohio would recover the PPA Units' costs from AEP Ohio's captive customers through the PPA and PPA Rider. Moreover, AEP Ohio could also earn any profits associated with their bilateral transactions (in addition to full cost recovery through the PPA Rider) because these revenues will not be netted in computing the PPA Rider. This is harmful to customers because they would be subsidizing generation assets that provide no direct benefit to them, and instead only increase AEP Ohio's shareholder value.

Q16. PLEASE EXPLAIN WHAT EFFECTS THE PPA AND PPA RIDER COULD HAVE ON COST CONTROLS FOR THE PPA UNITS.

A16. As outlined in my response to Q12, AEP Ohio's proposal fully subsidizes the operating and capital costs (including a guaranteed return on investment) of the PPA Units. By subsidizing these costs and guaranteeing profits to AEPGR, and at the same time fully transferring these costs from AEP Ohio to its customers through the PPA Rider, the proposal eliminates any incentives to reduce the operating or capital costs of the PPA Units. As outlined in my response to Q11, the PJM-operated markets provide generation owners with strong incentives to reduce costs. This is because generation owners must recover costs through revenues earned in the market. Any cost reduction achieved by a generation owner translates into a profit increase. These incentives are completely

eliminated by the subsidy inherent in the proposal. This incentive effect means that energy, ancillary services, and capacity supplied by the PPA Units may be more costly than what would be supplied absent the subsidy, to the detriment of customers.

As outlined in my response to Q11, competitive wholesale markets, such as those operated by PJM, only support economically prudent capital investments. For example, a flue-gas desulfurization ("FGD") system may be added to a coal-fired plant in an effort to reduce pollutants. However, this would only be done if the FGD system is the most efficient means of achieving these emissions reductions. If so, the costs of the FGD system would be borne by the market and the coal-fired plant would collect its costs. Otherwise, if a more efficient source of emissions reduction (e.g., displacing the coal-fired plant with a natural gas-fired plant) exists, that asset would enter the market and drive the coal-fired plant out.

The Utility's proposal eliminates any incentives for AEP Ohio and AEPGR to only make economically prudent investments, because those costs and a return on investment are ensured. Moreover, any PPA Unit retirement decisions must be made by mutual agreement between AEP Ohio and AEPGR. Given that the PPA guarantees full recovery of all PPA Unit costs and a return on investment, the PPA provides AEPGR disincentive to ever retire any of the PPA Units, to the detriment of customers.

Q17. COULD THE EARLY TERMINATION CLAUSE OF THE PPA TERM SHEET ALLEVIATE THE CONCERNS REGARDING THE MARKET-EFFICIENCY AND PRUDENT DECISION MAKING EFFECTS OF THE PPA AND PPA RIDER RAISED IN YOUR RESPONSES Q12 THROUGH Q16?

A17. Not necessarily. The Early Termination clause in the PPA term sheet allows AEP Ohio to "terminate the [PPA] upon notice to [AEPGR] if retail rate recovery for [AEP Ohio's PPA] costs is discontinued or substantially diminished, including through a one-time significant disallowance for retail rate recovery of costs, provided [AEP Ohio] must pay [AEPGR] an amount equal to the sum of the net book value and retirement-related costs associated with the PPA Units at that time."[7]

A potential outcome of this clause is that it would allow the PUCO to effectuate a termination of the PPA by disallowing collection of PPA costs through the PPA Rider. The threat of such cost disallowance could provide an incentive to moderate strategic offer behavior or uneconomic decisions to overinvest in or not retire the PPA Units. However, such cost disallowance may prove an extremely costly action to AEP Ohio's customers and the state of Ohio's taxpayers, because of the requirement that AEP Ohio pay AEPGR the net book value and retirement-related costs of PPA Units if the Early Termination clause is exercised. If the Early Termination clause is invoked, the PUCO may find itself in the position of

[7] Direct Testimony of Kelly D. Pearce on Behalf of AEP Ohio, Exhibit KDP-1, p. 5.

having to allow for recovery of Early Termination clause-related costs from ratepayers or having AEP Ohio bear these costs. This latter option may prove untenable, because it could harm AEP Ohio's financial solvency and reduce AEP Ohio's ability to reliably serve customer demands.

As an example of this, the poor design of the Competition Transition Charge that was included in California's market restructuring led to financial difficulty for the two largest investor-owned utilities ("IOUs") in the state and the eventual bankruptcy of Pacific Gas and Electric Company. These financial difficulties made it increasingly difficult for the IOUs to procure energy on the wholesale markets for customers.[8] Given such realities, the Early Termination clause of the PPA term sheet may prove an incredible threat to moderate the types of strategic or uneconomic concerns with the PPA and PPA Rider raised in my responses to Q12 through Q16.

Q18. PLEASE EXPLAIN WHAT EFFECTS THE PPA AND PPA RIDER WILL HAVE ON THE SHARING OF COST RISK BETWEEN AEP OHIO AND ITS CUSTOMERS.

A18. The PPA and PPA rider completely transfer all risks associated with the continued operation of the PPA Units to AEP Ohio's customers. AEP Ohio justifies the proposal, in part, by projecting that the PPA Rider will result in a $574 million

[8] These difficulties were not fully alleviated until the California Department of Water Resources purchased energy on the wholesale market on behalf of the IOUs.

total credit to customers.[9] This purported credit is based on an analysis using a set of PJM market price and load assumptions that may not necessarily materialize in the future. If not, the PPA Units may be more costly than alternative sources of energy, ancillary services, and capacity.

If market fundamentals do not change as projected by the Utility, its customers must nevertheless fully guarantee cost recovery and profits of what may be highly uneconomic and long-term inefficient PPA Units. Thus, AEP Ohio's customers fully bear all of the cost and economic risk of the PPA Units.

Such transfer of risk to captive monopoly customers is improper in a restructured market for generation services. Moreover, as I outline in my response to Q13, the PPA terms only allow for PPA Units to retired by mutual agreement between AEP Ohio and AEPGR. Given that the PPA guarantees full cost recovery and a return on investment, AEPGR has a disincentive to agree to retiring any of the PPA Units.

AEP Ohio's claim that the PPA could produce a $574 million credit to ratepayers over its term is difficult to accept *prima facie*. The Utility admits that the PPA Units may not be able to recover their costs from PJM market revenues today. If AEP Ohio believes its own analysis, that the PPA Units are likely to become profitable within a few years (to the tune of nearly $574 million over their

[9] Direct Testimony of Kelly D. Pearce on Behalf of AEP Ohio, p. 13.

planned lifetimes), one would expect that AEPGR would invest capital to keep the PPA Units operating until that time. Because AEPGR (and presumably shareholders and investors) is unwilling to bear that risk, there is no rationale for why AEP Ohio's customers should be obliged to do so. The only assumption that is guaranteed to come to fruition throughout the course of the PPA is the ongoing (and possibly uneconomic) profits for the PPA Units. Under this proposal, these profits would be guaranteed by AEP Ohio's captive retail customers. This is not a fundamentally sound nor reasonable public policy. The goal of the regulator should be to provide strong incentives for the regulated entity to serve customer loads reliably in the most economically prudent manner possible, not to guarantee company profits and shareholder value for an unregulated affiliate of an electric distribution utility.

Q19. DOES AEP OHIO CLAIM THERE IS A RISK SHARING MECHANISM IN THE PPA AGREEMENT?

A19. Yes, witness Vegas claims that AEP Ohio's proposal does include a risk-sharing mechanism, because the PUCO could opt to disallow the recovery of PPA costs through the PPA Rider.[10] As noted in my response to Q17, however, this may provide a risk-sharing mechanism that is extremely costly to AEP Ohio's ratepayers or even the taxpayers of the state of Ohio. It also does not appear as though the PUCO or any other regulatory body will have the ability to fully examine the offer strategy employed by the Companies. Thus, it would be very

[10] Direct Testimony of Pablo A. Vegas on Behalf of AEP Ohio, p. 29.

difficult to recognize the types of inefficient or anti-competitive offer behavior that I describe in my response to Q12. Finally, the disallowance of imprudent cost is not a risk-sharing mechanism; it is the charge of the PUCO. It seems improper to offer one of the basic roles of the PUCO in protecting the captive customers of the Utility from covering imprudent costs as a risk-sharing mechanism. For these reasons, I believe that the Utility's proposal places an undue risk burden on AEP Ohio's ratepayers.

III. ADDRESSING AEP OHIO PPA FACTORS

Q20. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL FULLY ADDRESSES THE FIRST AEP OHIO PPA FACTOR, WHICH REQUIRES AEP OHIO TO DEMONSTRATE THE FINANCIAL NEED OF THE GENERATING PLANT?

A20. AEP Ohio's proposal only partially addresses the first AEP Ohio PPA Factor. The testimony of witnesses Vegas, Pearce, and Thomas present analyses suggesting that the PPA Units may be on a financial bubble in the short run. Although none of these analyses explicitly make such a statement, the testimony suggests that these circumstances may lead to the PPA Units being retired.

These analyses only paint a limited picture, however. As I outline in my response to Q11, the PJM-operated markets are designed to foster long-run system efficiency by allowing free entry and exit of generating assets. Generating assets

that are not able to and do not expect to be able to recover their costs from market revenues are inefficient or uneconomic and should exit the market. Thus, the financial analyses presented by the Utility may be a consequence of the PPA Units being long-run inefficient and the market signaling their need to be retired. The analyses provided by AEP Ohio do not make a compelling case that this is not the case with the PPA Units.

As such, it is difficult for the PUCO to determine that the PPA Units have a financial need that is not a natural and expected consequence of their being uneconomic and long-term inefficient assets that should be retired. It should also be stressed that approving a PPA of this sort given the limited evidence provided by AEP Ohio would set a dangerous precedent. This is because a generating plant in the state of Ohio that is uneconomic and inefficient could request this type of a customer-funded subsidy. This would make the retirement of uneconomic and inefficient generating assets much more difficult in the state of Ohio.

Q21. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL FULLY ADDRESSES THE SECOND AEP OHIO PPA FACTOR, WHICH REQUIRES AEP OHIO TO DEMONSTRATE THE NECESSITY OF THE GENERATING PLANT?

A21. No, I do not. The Utility argues that the PPA is needed by claiming that the PPA Units provide needed reliability to the system. However, they provide no clear evidence of any reliability benefit provided by the PPA Units.

Reliability benefits of generating units are typically measured by conducting a loss of load expectation ("LOLE") or similar reliability study of a power system. LOLE is a probabilistic assessment of the likelihood that the system will experience a generating capacity shortfall over some future planning horizon. The benefit that a particular generator or a portfolio of generators (in the case of the PPA Units) provides is measured by determining the effect of adding (or removing) that generator to (or from) the system would have on the system LOLE. Absent a complete LOLE analysis, one could also conduct a back-of-the-envelope system assessment based on the planning reserve margin.

AEP Ohio's testimony does not, to my knowledge, include any such assessments to measure the reliability benefits of the PPA Units on either the PJM system or Ohio customers. Instead, the Utility presents figures on the amount of generating capacity in the state of Ohio that has been retired recently and on the fraction of generating capacity that has recently applied to enter the PJM Generation Queue that has been placed in service. Neither of these analyses address the fundamental question of how much the PPA Units contribute to system reliability.

Furthermore, AEP Ohio does not provide a compelling argument that the PPA Units contribute to supply diversity. Indeed, one could argue that the PPA Units make the generation mix in Ohio more homogeneous, because they are coal-fired units in a state which has a coal-dominated generation mix.[11] To illustrate this,

[11] http://www.eia.gov/electricity/state/ohio/

the state of Ohio had about 32.4 GW generating capacity installed in 2013, of which about 18.8 GW and 9.5 GW was coal- and natural gas-fired, respectively.[12] This means that 58 percent and 29 percent of the generation mix in 2013 was coal- and natural gas-fired, respectively. If the 2.7 GW of coal-fired capacity that AEPGR owns among the PPA Units were to have been retired and replaced with natural gas-fired generation, the generation mix would have changed to 50 percent and 38 percent coal and natural gas-fired generation, respectively, which would have been a more diverse generation mix.

Moreover, AEP Ohio is not responsible for providing reliability for the entire PJM system. PJM is responsible for procuring enough energy and capacity for its entire 13-state region. In its most recent capacity auction, held during the week of August 10, 2015, PJM procured a reserve margin of 19.8 percent—4.1 percent greater than the target reserve margin of 15.7 percent.[13] This suggests that there is excess generation capacity in the PJM system and that reliability is not a concern.

Finally, if the PPA Units do provide any reliability benefits (which AEP Ohio has not demonstrated in its filing) these benefits could accrue to the entire PJM footprint. It would be unjust and unreasonable to have AEP Ohio's captive retail customers bear the full cost and risk of the PPA Units, which could be providing reliability benefits to other customers. This points to yet another reason that

[12] http://www.eia.gov/electricity/state/ohio/xls/sept04oh.xls

[13] http://www.pjm.com/markets-and-operations/rpm.aspx

reliability assessment, procurement, and cost allocation is best handled on a regional level by an entity such as PJM.

Q22. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL FULLY ADDRESSES THE THIRD AEP OHIO PPA FACTOR, WHICH REQUIRES AEP OHIO TO DEMONSTRATE HOW THE GENERATING PLANT IS COMPLIANT WITH ALL PERTINENT ENVIRONMENTAL REGULATIONS AND ITS PLAN FOR COMPLIANCE?

A22. Environmental compliance issues are addressed by OCC witness Jackson.

Q23. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL FULLY ADDRESSES THE FOURTH AEP OHIO PPA FACTOR SHOWING THE IMPACT THAT A CLOSURE OF THE GENERATING PLANT WOULD HAVE ON ELECTRIC PRICES AND EFFECTS ON ECONOMIC DEVELOPMENT?

A23. No, I do not. AEP Ohio witness Allen's testimony purportedly includes analyses of employment and tax impacts of the PPA Units. It is my understanding that the testimony of OCC witness Dormady addresses the veracity of these analyses. Notwithstanding the issues raised therein, the analyses presented by the Utility paint a very limited picture of the economic development effects of the PPA Units, whereas the PUCO should consider economic development in a more expansive manner.

The PUCO's consideration of an economic analysis should take into account any

of the costs of keeping potentially inefficient plants running. In addition, such an analysis should take into account the economic development associated with the potential entry of new generating or transmission assets if the PPA Units are retired. That is to say, if the PPA Units are retired they may be replaced with more efficient generating assets that will create employment, spur economic development, and provide a strong tax base for the local region and the state that does not potentially require costly customer-funded subsidies. Thus, in sum, the PPA may have detrimental effects on economic development, job retention, and the local and statewide tax base that are not captured at all in the limited analysis provided by AEP Ohio and witness Allen's analysis.

As one potential example of this, the PPA and PPA Rider may result in higher retail rates for AEP Ohio' customers. OCC witness Wilson's analysis of the PPA costs under alternative price scenarios shows that it could result in net charges to AEP Ohio's captive customers. These charges ultimately mean that AEP Ohio's customers have less disposable income available for consumption, investment, and other economic activity. If the PPA Rider does result in a net charge to AEP Ohio's captive customers, the associated loss of economic activity may result in greater economic harm, ancillary job losses, and lost tax revenues than any economic benefits that may be provided by maintaining and operating inefficient plants. Similarly, potentially higher retail rates could also reduce the competitiveness of Ohio businesses in regional, national, and international markets.

AEP Ohio witness Allen's analyses completely neglect these types of impacts. Thus, the Utility has not fully addressed this AEP Ohio PPA Factor.

Q24. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL PROVIDES FOR RIGOROUS COMMISSION OVERSIGHT OF THE RIDER?

A24. No, I do not. AEP Ohio's proposal does allow for the Commission to review revenue and cost data used in determining the PPA Rider. However, the only option that appears to be at the PUCO's disposal if it deems that AEP Ohio or AEPGR is making decisions that are not in the public or ratepayer interest is to disallow collection of PPA costs through the PPA Rider. As outlined in my response to Q17, the PUCO could use such cost disallowance to effectuate the termination of the PPA. However, as outlined in my responses to Q17 and Q19, taking such an action could be costly for AEP Ohio's ratepayers and the taxpayers of the state of Ohio. Thus, this may be seen as an incredible threat to moderate inefficient or uneconomic behavior on the part of AEP Ohio or AEPGR.

Q25. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL PROVIDES FOR FULL INFORMATION SHARING WITH THE COMMISSION AND ITS STAFF?

A25. No, I do not. While the PUCO and its staff have jurisdiction over AEP Ohio, it does not have the ability to fully review all purchasing and expenditure decisions made by AEPGR, an unregulated affiliate of AEP. It will, thus, be difficult, if not impossible, for the PUCO to fully examine the activities of the non-regulated generation assets in the PPA.

Q26. DO YOU BELIEVE THAT AEP OHIO'S PROPOSAL INCLUDES A REASONABLE PLAN TO ALLOCATE THE RIDER'S FINANCIAL RISK BETWEEN BOTH THE UTILITY AND ITS CUSTOMERS?

A26. No, I do not. As outlined in my response to Q19, AEP Ohio witness Vegas claims that AEP Ohio's proposal does include a risk-sharing mechanism, because the PUCO could opt to disallow the recovery of PPA costs through the PPA Rider. As noted in my responses to Q17, Q19, and Q24, this may provide a risk-sharing mechanism that is extremely costly to AEP Ohio's ratepayers and the taxpayers of the state of Ohio.

IV. ADDITIONAL PPA FACTORS FOR PUCO CONSIDERATION

Q27. ARE THE AEP OHIO PPA FACTORS APPROPRIATE AND EXHAUSTIVE WHEN EVALUATING THE AEP OHIO'S PPA AND PPA RIDER?

A27. No. The PPA is unjust and unreasonable for all of the reasons presented in the preceding sections of my testimony and in the direct testimony of OCC witnesses Rose, Wilson, Dormady, Duann, Hixon and Jackson. Therefore, the factors should not be looked upon by the PUCO as a means for justifying PPA approval.

If the Commission, however, authorizes some form of a PPA, the AEP Ohio PPA Factors are not appropriate; nor are they exhaustive because they fail to consider whether the PPA benefits customers and is in the public interest. Specifically, the factors that have been established are biased toward building a case that would

support approval of the PPA by focusing solely on their benefits to AEP Ohio and AEPGR and do not enable the PUCO to evaluate the *net* benefits of the PPA and PPA Rider.

To determine whether the PPA and PPA Rider benefit AEP Ohio's customers and are in the public interest, the PUCO must evaluate additional factors beyond the four identified. This would allow a more complete assessment of the proposal to be carried out in an evaluation of its *net* benefits to customers. The AEP Ohio PPA Factors are not sufficient because they do not enable the PUCO to make such a determination.

There are two important considerations that should be included to provide a more comprehensive assessment of the net benefits of the PPA and PPA Rider to customers. The first consideration is potential costs or detriments to customers. These costs and detriments should be accounted for to assess whether the program is reasonable and benefits customers.

The second is the cost of achieving the same benefits that the PPA and PPA Rider provide compared to alternatives. These factors are important to consider even if the PPA and PPA Rider provide net benefits to consumers. This is because alternatives may exist that could provide greater benefits to customers at the same or lower costs. If so, those alternatives should be considered when examining whether the proposal benefits customers and is in the public interest.

Q28. CAN YOU PROVIDE A LIST OF ADDITIONAL FACTORS THAT THE PUCO SHOULD INCLUDE IN ASSESSING WHETHER AEP OHIO'S PROPOSAL IS REASONABLE AND BENEFITS CUSTOMERS?

A28. The following is a list of eight additional factors that, if added to the AEP Ohio PPA Factors, would allow for a more comprehensive evaluation of whether AEP Ohio's proposal is reasonable, benefits customers, and is in the public interest.

1) The total cost of the potential subsidy and guaranteed profit that AEP Ohio's captive customers would fund during the ESP period and the full PPA period under a variety of independently produced future price scenarios.
2) The effect of the potential subsidies on the PJM-operated markets and the related effects those offer strategies would have on customers' rates *vis a vis* market efficiency and competitiveness.
3) Incentives for AEP Ohio and AEPGR to control the operating and capital costs of the PPA Units, which customers will be required to fund under the program.
4) Incentives for AEP Ohio and AEPGR to make rational retirement decisions pertaining to the PPA Units to provide reasonable limits to customers' exposure to risk and cost under the Utility's proposal.
5) Economic impacts of imposing higher retail rates on AEP

Ohio's captive customers.

6) The cost of using a least-cost combination of new and existing generation and transmission assets to deliver the purported benefits of the PPA and PPA Rider to AEP Ohio's customers.

7) The cost of achieving the same price stability for AEP Ohio's customers through a combination of physical and financial contracts entered into with affiliated and/or unaffiliated entities through a competitive solicitation, such as the competitive auctions used to meet the supply needs of Standard Service Offer ("SSO") customers.

8) The cost of meeting current and expected future environmental regulations with the PPA Units compared to the cost of meeting these with other generation assets and/or transmission alternatives.

Q29. WHY DO YOU SUGGEST THAT AEP OHIO PROVIDE ASSESSMENTS OF THE PPA AND PPA RIDER UNDER A VARIETY OF FUTURE PRICE SCENARIOS?

A29. In its filing and supporting testimony, AEP Ohio has provided an assessment of the cost of the potential subsidy and guaranteed profit that AEPGR would earn through the PPA. Specifically, they provided estimates of how much of a charge or credit the PPA Rider would impose on AEP Ohio's captive customers.

However, this analysis was conducted using a set of PJM market-price and load assumptions provided by AEP Ohio witness Bletzacker. Using these assumptions, the PPA and PPA Rider were shown to result in a net credit of $574 million[14] to AEP Ohio's customers over the term of the PPA.

OCC witness Wilson conducted an additional independent analysis of the PPA and PPA Rider using, among other factors, electricity prices that were adjusted to be consistent with recent AD Hub peak and off-peak prices. Using these electricity price forecasts, which are consistent with recent market data, OCC witness Wilson demonstrates that the PPA and PPA Rider could yield a net charge to AEP Ohio's captive customers over the term of the PPA.

The dichotomy of the results using price forecasts generated by AEP Ohio's witnesses and those produced by market-derived prices demonstrates that the net impact of the PPA and PPA Rider on customers is highly sensitive to input parameters. For the PUCO to be able to more fully assess the impacts of the PPA and PPA Rider on customers, an analysis of its impacts using a variety of independently produced price forecasts is necessary. That is, the PUCO cannot simply consider one set of assumptions to assess the impacts of the proposal.

Moreover, an analysis of AEP Ohio's proposal must consider its impact on captive retail customers' rates and bills, especially due to the potential for anti-

[14] AEP Witness Pearce Exhibit KDP-2 "Average of High and Low Forecast."

competitive subsidies. Furthermore, even if the PUCO chooses to consider the financial need of the PPA Units (which it should not consider in a vacuum), any alleged need must be weighed against the impacts on customers' rates to determine if any potential price increases are just and reasonable.

Q30. WHY DO YOU SUGGEST THAT THE EFFECT OF THE PPA AND PPA RIDER ON HOW THE PPA UNITS WILL BE OFFERED INTO THE PJM-OPERATED MARKETS BE INCLUDED AS A PPA FACTOR?

A30. If the competitive market does not function properly, customers may lose the benefits that they are entitled to under the law, including the benefits of reasonably priced retail electric service.[15] Active, economically reasonable, and competitive PJM market participation by the PPA Units is crucial if the PPA is to provide any benefits to consumers. The state of Ohio has demonstrated a commitment to allowing competitive wholesale markets, such as those operated by PJM, to provide lower-cost, more reliable, and more efficient electricity service to the benefit of customers throughout the state. The state of Ohio's commitment has been demonstrated through the adoption of S.B. 33 and subsequently through S.B. 221.

The potential subsidy and guaranteed profit inherent to the PPA could result in AEP Ohio and AEPGR adopting offer strategies into the PJM-operated markets that could undermine the markets' ability to ensure the short- and/or long-run

[15] *See* Ohio Revised Code 4928.02(A), Competitive Retail Electric Service.

efficiency of the electric power system. Moreover, the participation of affiliated generation assets in the PJM-operated markets and the lack of clarity surrounding the treatment of bilateral transactions in the calculation of PPA Rider charges further complicates the choice of offer strategy employed. The offer strategies employed may undermine the short- and/or long-run efficiency of the PJM-operated markets, could be anti-competitive, and could be harmful to customers. For instance, AEP Ohio and AEPGR could choose to adopt an offer strategy that results in the PPA Units being economically withheld from the PJM-operated markets.

Q31. WHY DO YOU RECOMMEND THAT INCENTIVES FOR AEP OHIO AND AEPGR TO CONTROL THE COST OF THE PPA UNITS BE CONSIDERED BY THE PUCO AS AN ADDITIONAL FACTOR?

A31. The PPA Rider permits 100 percent pass through of the PPA Units' actual fixed and variable costs (net of revenues) to AEP Ohio's captive customers. Thus, there is no incentive to control these costs. In addition, AEPGR is guaranteed to earn a return on investment through the PPA terms. These passed through costs of maintaining and operating the PPA Units and AEPGR's guaranteed return on investment are fully paid by AEP Ohio's captive customers under the PPA and PPA Rider. The design of the PPA and PPA Rider significantly reduces any incentives for AEPGR to control or reduce the capital or operating costs of the PPA Units, because costs are guaranteed to be collected through charges to AEP Ohio's captive customers.

Q32. WHY DO YOU RECOMMEND THAT INCENTIVES FOR AEP OHIO AND AEPGR TO MAKE RATIONAL RETIREMENT DECISIONS PERTAINING TO THE PPA UNITS BE INCLUDED AS AN ADDITIONAL FACTOR FOR PUCO CONSIDERATION?

A32. When a plant no longer appears likely to recover its going forward costs over any future time frame (in the short- or long-term), the owner should retire or repower it. However, the guaranteed cost recovery in the PPA provides a disincentive for AEPGR to retire the PPA Units. Thus, even if the PPA Units are economically unviable, in the sense that they cannot collect their costs, there is no incentive mechanism within the proposed PPA for these assets to be retired, regardless of how costly or uneconomic they may be. Indeed, the PPA terms state that retirement decisions regarding the PPA Units must be made by mutual agreement between AEP Ohio and AEPGR. Given that AEPGR's costs plus a return on investment are fully covered by the PPA, AEPGR has a disincentive to agree to a PPA Unit retirement. The PPA incents AEPGR and AEP Ohio to keep the PPA Units operational because AEPGR continue to receive a guaranteed return on investment while they are operational. If, on the other hand, the PPA units are retired, the guaranteed return on investment would disappear.

This could result in higher costs to customers, because lower-cost alternatives may not be able to enter the market due to the subsidized PPA Units not being retired. Therefore, any proposed PPA should be evaluated based on whether it provides incentives for owners to make sensible retirement decisions. As stated

above, 100 percent pass-through of costs and a guaranteed return on investment provides no incentive (or even disincentives) for rational decisions.

Q33. WHY DO YOU SUGGEST THAT THE ECONOMIC IMPACTS OF THE HIGHER RETAIL RATES THAT MAY BE IMPOSED ON AEP OHIO'S CAPTIVE CUSTOMERS BE INCLUDED AS A FACTOR?

A33. This factor is recommended to supplement the fourth AEP Ohio PPA Factor regarding prices and economic effects if the plants are to close. AEP Ohio's interpretation of this factor only considers the impacts of a generation plant closure in a limited manner. As noted in my response to Q23, the PUCO should consider economic development in a more expansive manner than the analyses presented by AEP Ohio.

The PUCO's consideration of an economic analysis should take into account any of the costs of keeping potentially inefficient plants running. In addition, such an analysis should take into account the economic development associated with the potential entry of new generating or transmission assets if the PPA Units are retired. Thus, in sum, the PPA may have detrimental effects on economic development, job retention, and the local and statewide tax base that are not captured at all in the limited analysis provided by AEP Ohio.

Q34. WHY DO YOU SUGGEST THAT AN ANALYSIS OF A LEAST-COST COMBINATION OF NEW AND EXISTING GENERATION AND/OR TRANSMISSION ASSETS BE INCLUDED AS A FACTOR?

A34. The first five factors that I have recommended to be considered by the PUCO are intended to address the question of what the *net* benefits of the PPA and PPA Rider are. That is to say, whether the benefits associated with the PPA and PPA Rider outweigh their costs and customer detriments. This will assist the PUCO in determining whether the proposal will benefit customers and is in the public interest.

An equally important question, however, is whether there are alternatives available that could deliver greater benefits at the same or lower costs than the PPA. If so, these alternatives should be pursued. This is especially true if alternatives that do not rely on potentially anti-competitive and inefficient customer-funded subsidies with guaranteed profits exist.

This factor that I propose addresses this question, in part, by determining what combination of existing and new transmission and generation assets could be added to the system to deliver the benefits claimed by AEP Ohio of the PPA and PPA Rider. Moreover, as outlined in my response to Q11, the PJM-operated markets are designed in a way that tends to incent generation and transmission assets to be built to address cost stability, reliability, and other issues without the

need for potentially anti-competitive and inefficient customer-funded subsidies with guaranteed profits to AEPGR.

Q35. WHY DO YOU PROPOSE THAT THE COST OF ACHIEVING PRICE STABILITY USING PHYSICAL AND FINANCIAL CONTRACTS ENTERED INTO WITH AFFILIATED AND/OR UNAFFILIATED ENTITIES THROUGH A COMPETITIVE SOLICITATION BE INCLUDED AS A FACTOR?

A35. I recommend this as a factor for the same reason as my fifth factor. It is important to assess whether there is a lower-cost, more efficient, or less anti-competitive alternative than the proposed PPA and PPA Rider. If such an alternative exists, it will be a factor for the PUCO to consider when determining whether the proposal benefits customers and is in the public interest.

SSO customers already have access to a price-stabilizing mechanism. This is achieved by having the supply needs of SSO customers met through one- to three-year full-requirements contracts that result from competitive auctions. By doing so, the rates that SSO customers pay are established through the blending of multiple auctions held months to years in advance of delivery. The rate resulting from each auction tends to reflect the then-prevalent forward price plus a markup. Because the forward prices for delivery months to years ahead tend to be relatively stable over time, these auctions tend to stabilize prices paid by SSO customers.

It, therefore, is reasonable that any price stability benefit that the PPA and PPA Rider may provide could instead be provided through the type of contracts that are used to supply SSO customers. The cost of doing so should be compared to that of the PPA to determine if it provides price stability more efficiently than other contracting options available. Moreover, if price stability could be delivered through such competitive auctions without the need for potential anti-competitive subsidies with return on investment to AEPGR, such mechanisms should be pursued.

In addition, most AEP Ohio customers have the ability to obtain their supply through a Competitive Retail Electric Supplier ("CRES"). A CRES is able to offer a variety of long- and short-term products, through which a customer is able to decide the level of risk it is willing to take. A customer may want their retail price to fluctuate with the market, in which case it would choose a variable-price contract. Conversely, if a customer wants rate stability, the customer could choose a long-term, fixed-price contract. Interestingly, if the PPA and PPA Rider do have any price-stabilizing effect, this effect would be most pronounced for customers who have opted for a variable-price contract. Thus, any rate-stabilizing effect that the PPA and PPA Rider have would, perversely, be more pronounced for customers that have explicitly stated a preference for less price stability through their free-market contract decisions.

Q36. WHY DO YOU PROPOSE THAT THE COST OF MEETING CURRENT AND EXPECTED FUTURE ENVIRONMENTAL REGULATIONS WITH GENERATION AND/OR TRANSMISSION ALTERNATIVES TO THE PPA AND PPA RIDER BE INCLUDED AS A FACTOR?

A36. I suggest this as a factor for the same reason as my fifth and sixth factors. The AEP Ohio PPA Factors include a description of how the PPA Units are compliant with all pertinent environmental regulations and AEP Ohio's and AEPGR's plans for compliance. Even if AEP Ohio and AEPGR have a plan in place to meet current and expected future environmental regulations, that does not mean that there are not generation and transmission alternatives that could provide the purported benefits of the PPA and PPA Rider while also meeting current and expected future environmental regulations at lower costs.

If there exist transmission and generation alternatives to the PPA and PPA Rider that could deliver their purported benefits and meet current and expected future environmental regulations at lower cost, these alternatives should be considered. Again, this should be a factor for the PUCO to consider in determining whether the PPA benefits customers and is in the public interest. This factor that I propose addresses this issue, in part, by determining what combination of transmission and generation assets could be added to the system to deliver the benefits claimed by AEP Ohio of the PPA and PPA Rider and the cost of meeting current and expected future environmental regulations with those alternatives. Proposed EPA

111(d) regulations and their impacts on the proposed PPA are addressed in more detail by OCC witness Jackson.

V. ALTERNATIVES TO CUSTOMER-FUNDED SUBSIDY

Q37. IF THE PPA UNITS ARE DEEMED TO HAVE A TRUE FINANCIAL NEED, COULD THIS BE ADDRESSED THROUGH AN ALTERNATIVE TO THE PROPOSED PPA?

A37. Yes. If the PPA Units are deemed to have a true financial need, this could be addressed through alternatives to the proposed PPA. These alternatives would be advantageous relative to the proposed PPA and PPA Rider because they do not entail a potential customer-funded subsidy of cost and a guaranteed return on investment to AEPGR. These potential alternatives, further, do not have the potential to create inefficient market distortions or reduce the incentives for rational retirement and investment decisions by AEP Ohio and AEPGR.

Two possible alternatives are for AEPGR to directly contract with customers that would like to benefit from the purported rate-stability benefits of the proposed PPA and PPA Rider or for AEPGR to continue operation of the PPA Units through privately secured financing.

Q38. HOW WOULD AEPGR DIRECTLY CONTRACT WITH CUSTOMERS THAT WOULD LIKE TO BENEFITS FROM THE PURPORTED RATE-STABILITY BENEFITS OF THE PROPOSED PPA AND PPA RIDER?

A38. AEP Ohio witness Allen states that as opposed to liquidating all of the energy, ancillary services, and capacity of the PPA Units into the PJM, the Utility could sell these services directly to specific customers that could benefit from a more stable price.[16] Witness Allen suggests that this could be done as part of AEP Ohio's proposal and the revenues from such contracting could be netted against PPA costs in computing PPA Rider charges.

Under my proposed alternative to the PPA and PPA Rider, this type of contracting could be executed directly between AEPGR and specific customers that could benefit from a more stable price. AEP Ohio witness Vegas states that the purported price hedge, protection from the impacts of market volatility, and retail price certainty offered by the PPA and PPA Rider is desired by Ohio business, which is demonstrated by the endorsement of AEP Ohio's PPA proposal by the Ohio Energy Group ("OEG").[17]

Given this endorsement, it is reasonable that AEPGR could directly contract with OEG members to provide them the full price-stability and hedging benefits of the PPA and PPA Rider, as opposed to imposing it on all of AEP Ohio's captive

[16] Direct Testimony of William A. Allen on Behalf of AEP Ohio, p. 12.

[17] Direct Testimony of Pablo A. Vegas on Behalf of AEP Ohio, p. 3-4.

customers, including residential customers who may not necessarily want the PPA. Indeed, as noted in my response to Q35, any price-stabilizing effect that the PPA and PPA Rider may have would be imposed to a greater extent on the subset of shopping customers that have explicitly opted not to have price stability through their contracting decisions. That is to say, if the PPA and PPA Rider have any price-stabilizing benefit, this benefit would run counter to the revealed preferences of shopping customers. Thus, direct contracting between AEPGR and customers wanting price stability would alleviate this perverse effect of PPA and PPA Rider.

Q39. HOW WOULD AEPGR CONTINUE OPERATION OF THE PPA UNITS THROUGH PRIVATELY SECURED FINANCING?

A39. AEP Ohio's analyses of the PPA and PPA Rider suggest that any financial difficulties that the PPA Units face are shorter-term. Their analyses suggest that in the long-run, PJM market prices should rise to levels that would sustain the operation of the PPA Units.[18] Indeed, on the basis of these future price increases, AEP Ohio projects that the PPA Rider will result in a $574 million total credit to customers over the term of the PPA. Moreover, AEP Ohio's supporting testimony suggests that some of these future price increases will be a result of current design flaws in the PJM-operated markets being addressed.[19]

[18] Direct Testimony of Pablo A. Vegas on Behalf of AEP Ohio, p. 16-17.

[19] Direct Testimony of Pablo A. Vegas on Behalf of AEP Ohio, p. 20-24.

If AEPGR believes AEP Ohio's analysis that the PPA Unit could earn a net profit of $574 million over their remaining lifetimes, AEPGR could continue operation of the PPA Units through privately secured finance. This would be considerably preferred to their operation relying on a customer-funded complete subsidy of the capital and operating costs of the PPA Units.

Privately secured finance does not introduce the market inefficiency and uneconomic retirement and investment issues raised by the PPA and PPA Rider. Moreover, a privately secured financing arrangement transfers the risk of uneconomic or inefficient decisions to AEPGR, shareholders, lenders, and investors, as opposed to transferring all of those risks to captive retail customers and potentially to taxpayers.

Q40. DOES THIS CONCLUDE YOUR TESTIMONY?

A40. Yes. However, I reserve the right to supplement my testimony later in the event that any party submits new or corrected information which materially affects the findings and recommendations presented in my testimony.

CERTIFICATE OF SERVICE

It is hereby certified that a true copy of the foregoing *Direct Testimony of Ramteen Sioshansi on Behalf of the Office of the Ohio Consumers' Counsel* was served via electronic transmission this 11th day of September 2015.

/s/ William Michael
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Professional Experience

The Ohio State University
Associate Professor; Integrated Systems Engineering Department; 2014-Present
Assistant Professor; Integrated Systems Engineering Department; 2008-2014
Associate Fellow; Center for Automotive Research; 2012-Present

National Renewable Energy Laboratory
Postdoctoral Researcher; Strategic Energy Analysis and Applications Center; 2007-2008

University of California, Berkeley
Postdoctoral Researcher; Engineering Research Center; 2007-2008
Graduate Student Researcher; Electronics Research Laboratory; 2001-2007

Federal Energy Regulatory Commission
Economist; Office of Energy Markets and Reliability; Summer 2006

Education

University of California, Berkeley
Ph.D., Industrial Engineering and Operations Research, Spring 2007
Minors: Economics, Game Theory, and Probability Theory
Dissertation Title: Design and Analysis of Electricity Markets
Committee: Shmuel Oren (chair), Ilan Adler, Richard Gilbert

University of California, Berkeley
M.S., Industrial Engineering and Operations Research, Spring 2004

University of London, The London School of Economics and Political Science
M.Sc., Econometrics and Mathematical Economics, July 2002

University of California, Berkeley
B.A., Economics and Applied Mathematics, Spring 2001

Research Interests

Optimization · renewable energy analysis · power systems economics · energy policy · market and mechanism design · game theory · decision science

Publications

Appeared/Accepted

1. X. Xi and R. Sioshansi, "A Dynamic Programming Model of Energy Storage and Transformer Deployments to Relieve Distribution Constraints," *Computational Management Science*, 2015, forthcoming.
2. R. Sioshansi, "Optimized Offers for Cascaded Hydroelectric Generators in a Market with Centralized Dispatch," *IEEE Transactions on Power Systems*, vol. 30, pp. 773–783, March 2015.
3. C. Weiller and R. Sioshansi, "The Role of Plug-In Electric Vehicles with Renewable Resources in Electricity Systems," *Revue d'économie industrielle*, vol. 148, pp. 291–316, 2014.

4. R. Sioshansi, "Pricing in Centrally Committed Markets," *Utilities Policy*, vol. 31, pp. 143–145, December 2014.
5. X. Xi, R. Sioshansi, and V. Marano, "A Stochastic Dynamic Programming Model for Co-optimization of Distributed Energy Storage," *Energy Systems*, vol. 5, pp. 475–505, September 2014.
6. X. Xi and R. Sioshansi, "Using Price-Based Signals to Control Plug-in Electric Vehicle Fleet Charging," *IEEE Transactions on Smart Grid*, vol. 5, pp. 1451–1464, May 2014.
7. H. B. Smith, A. Pielow, A. Jayakumar, M. Muratori, B. J. Yurkovich, R. Sioshansi, A. Krishnamurthy, G. Rizzoni, and M. C. Roberts, "A User-Steered Energy Generation and Consumption Multi-Model Simulation for Pricing and Policy Development," *Computing in Science and Engineering*, vol. 16, pp. 22–33, March/April 2014.
8. R. Sioshansi, S. H. Madaeni, and P. Denholm, "A Dynamic Programming Approach to Estimate the Capacity Value of Energy Storage," *IEEE Transactions on Power Systems*, vol. 29, pp. 395–403, January 2014.
9. R. Sioshansi, "When Energy Storage Reduces Social Welfare," *Energy Economics*, vol. 41, pp. 106–116, January 2014.
10. G. D. Filippo, V. Marano, and R. Sioshansi, "Simulation of an Electric Transportation System at The Ohio State University," *Applied Energy*, vol. 113, pp. 1686–1691, January 2014.
11. S. H. Madaeni and R. Sioshansi, "Measuring the Benefits of Delayed Price-Responsive Demand in Reducing Wind-Uncertainty Costs," *IEEE Transactions on Power Systems*, vol. 28, pp. 4118–4126, November 2013.
12. R. Sioshansi and P. Denholm, "Benefits of Colocating Concentrating Solar Power and Wind," *IEEE Transactions on Sustainable Energy*, vol. 4, pp. 877–885, October 2013.
13. S. H. Madaeni and R. Sioshansi, "The Impacts of Stochastic Programming and Demand Response on Wind Integration," *Energy Systems*, vol. 4, pp. 109–124, June 2013.
14. X. Xi, R. Sioshansi, and V. Marano, "Simulation-optimization model for location of a public electric vehicle charging infrastructure," *Transportation Research Part D: Transport and Environment*, vol. 22, pp. 60–69, July 2013.
15. M. Muratori, M. C. Roberts, R. Sioshansi, V. Marano, and G. Rizzoni, "A highly resolved modeling technique to simulate residential power demand," *Applied Energy*, vol. 107, pp. 465–473, July 2013.
16. S. H. Madaeni and R. Sioshansi, "Using Demand Response to Improve the Emission Benefits of Wind," *IEEE Transactions on Power Systems*, vol. 28, pp. 1385–1394, May 2013.
17. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants with Thermal Energy Storage: A Case Study of the Southwestern United States," *IEEE Transactions on Power Systems*, vol. 28, pp. 1205–1215, May 2013.
18. R. Sioshansi, "'Handbook of Renewable Energy Technology,' edited by Ahmed F. Zobaa and Ramesh C. Bansal (book review)," *The Energy Journal*, vol. 34, pp. 246–249, 2013.
19. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Comparing Capacity Value Estimation Techniques for Photovoltaic Solar Power," *IEEE Journal of Photovoltaics*, vol. 3, pp. 407–415, January 2013.
20. R. Sioshansi and A. Tignor, "Do Centrally Committed Electricity Markets Provide Useful Price Signals?" *The Energy Journal*, vol. 33, pp. 97–118, 2012.
21. A. Pielow, R. Sioshansi, and M. C. Roberts, "Modeling Short-run Electricity Demand with Long-term Growth Rates and Consumer Price Elasticity in Commercial and Industrial Sectors," *Energy*, vol. 46, pp. 533–540, October 2012.
22. R. Sioshansi, "Modeling the Impacts of Electricity Tariffs on Plug-in Hybrid Electric Vehicle Charging, Costs, and Emissions," *Operations Research*, vol. 60, pp. 506–516, May-June 2012.
23. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants: A Case Study of the Southwestern United States," *IEEE Transactions on Power Systems*, vol. 27, pp. 1116–1124, May 2012.
24. R. Sioshansi, P. Denholm, and T. Jenkin, "Market and Policy Barriers to Deployment of Energy Storage," *Economics of Energy & Environmental Policy*, vol. 1, pp. 47–63, 2012.

25. S. H. Madaeni, R. Sioshansi, and P. Denholm, "How Thermal Energy Storage Enhances the Economic Viability of Concentrating Solar Power," *Proceedings of the IEEE*, vol. 100, pp. 335–347, February 2012.
26. R. Sioshansi, "Emissions Impacts of Wind and Energy Storage in a Market Environment," *Environmental Science and Technology*, vol. 45, pp. 10 728–10 735, December 2011.
27. R. Sioshansi and J. Miller, "Plug-in hybrid electric vehicles can be clean and economical in dirty power systems," *Energy Policy*, vol. 39, pp. 6151–6161, October 2011.
28. E. Drury, P. Denholm, and R. Sioshansi, "The Value of Compressed Air Energy Storage in Energy and Reserve Markets," *Energy*, vol. 36, pp. 4959–4973, August 2011.
29. R. Sioshansi and E. Nicholson, "Towards Equilibrium Offers in Unit Commitment Auctions with Nonconvex Costs," *Journal of Regulatory Economics*, vol. 40, pp. 41–61, August 2011.
30. R. Sioshansi, P. Denholm, and T. Jenkin, "A Comparative Analysis of the Value of Pure and Hybrid Electricity Storage," *Energy Economics*, vol. 33, pp. 56–66, January 2011.
31. R. Sioshansi, "Increasing the Value of Wind with Energy Storage," *The Energy Journal*, vol. 32, pp. 1–30, 2011.
32. R. Sioshansi, S. Oren, and R. O'Neill, "Three-Part Auctions versus Self-Commitment in Day-ahead Electricity Markets," *Utilities Policy*, vol. 18, pp. 165–173, December 2010.
33. R. Sioshansi, R. Fagiani, and V. Marano, "Cost and emissions impacts of plug-in hybrid vehicles on the Ohio power system," *Energy Policy*, vol. 38, November 2010.
34. R. Sioshansi and P. Denholm, "The Value of Concentrating Solar Power and Thermal Energy Storage," *IEEE Transactions on Sustainable Energy*, vol. 1, pp. 173–183, October 2010.
35. R. Sioshansi and D. Hurlbut, "Market Protocols in ERCOT and Their Effect on Wind Generation," *Energy Policy*, vol. 38, pp. 3192–3197, July 2010.
36. R. Sioshansi, "Evaluating the Impacts of Real-Time Pricing on the Cost and Value of Wind Generation," *IEEE Transactions on Power Systems*, vol. 25, pp. 741–748, April 2010.
37. R. Sioshansi and P. Denholm, "The value of plug-in hybrid electric vehicles as grid resources," *The Energy Journal*, vol. 31, pp. 1–23, 2010.
38. R. Sioshansi, "Welfare Impacts of Electricity Storage and the Implications of Ownership Structure," *The Energy Journal*, vol. 31, pp. 173–198, 2010.
39. P. Denholm and R. Sioshansi, "The value of compressed air energy storage with wind in transmission-constrained electric power systems," *Energy Policy*, vol. 37, pp. 3149–3158, August 2009.
40. R. Sioshansi and W. Short, "Evaluating the Impacts of Real-Time Pricing on the Usage of Wind Generation," *IEEE Transactions on Power Systems*, vol. 24, pp. 516–524, May 2009.
41. R. Sioshansi, P. Denholm, T. Jenkin, and J. Weiss, "Estimating the Value of Electricity Storage in PJM: Arbitrage and Some Welfare Effects," *Energy Economics*, vol. 31, pp. 269–277, March 2009.
42. R. Sioshansi and P. Denholm, "Emissions Impacts and Benefits of Plug-in Hybrid Electric Vehicles and Vehicle to Grid Services," *Environmental Science and Technology*, vol. 43, pp. 1199–1204, February 2009.
43. R. Sioshansi, R. P. O'Neill, and S. S. Oren, "Economic Consequences of Alternative Solution Methods for Centralized Unit Commitment in Day-Ahead Electricity Markets," *IEEE Transactions on Power Systems*, vol. 23, pp. 344–352, May 2008.
44. R. Sioshansi and S. Oren, "How good are supply function equilibrium models: an empirical analysis of the ERCOT balancing market," *Journal of Regulatory Economics*, vol. 31, pp. 1–35, February 2007.
45. S. S. Oren and R. Sioshansi, "Joint Energy and Reserve Auction with Opportunity Cost Payments for Reserves," *International Energy Journal*, vol. 6, pp. 35–44, June 2005.

Book Chapters

1. R. Sioshansi, S. S. Oren, and R. P. O'Neill, "The Cost of Anarchy in Self-Commitment Based Electricity Markets," in *Competitive Electricity Markets: Design, Implementation & Performance*, F. P. Sioshansi, Ed. Elsevier, 2008.

Books

1. L. F. Cabeza, R. Sioshansi, and J. Yan, Eds., *Handbook of Clean Energy Systems*. John Wiley & Sons, Limited, 2014, vol. 5, Energy Storage.

Under Review

1. Y. Liu, M. C. Roberts, and R. Sioshansi, "A Vector Autoregression Weather Model for Electricity Supply and Demand Modeling," submitted to *Energy*.
2. R. Sioshansi, "Retail Electricity Tariff and Mechanism Design to Incentivize Distributed Renewable Generation," submitted to *Energy Policy*.
3. X. Xi and R. Sioshansi, "Quantifying the Energy-Storage Benefits of Controlled Plug-in Electric Vehicle Charging," submitted to *Journal of Modern Power Systems and Clean Energy*.

PRESENTATIONS

1. R. Sioshansi and F. Wu, "Vehicle-Grid System Integration Policies: Electric Vehicle Charging Station Placement and Management," *2015 US-China Clean Energy Research Center Annual Meeting*. August 17-18, 2015, Beijing, People's Republic of China.
2. R. Sioshansi, "Inclusion of solar generation in adequacy studies: a survey by the PES 'Capacity Value of Solar Power' Task Force," *2015 IEEE Power and Energy Society General Meeting*. July 26-30, 2015, Denver, CO.
3. R. Sioshansi, "Needs for Improved Modeling of Storage and Greater Consistency in Methods and Metrics," *2015 IEEE Power and Energy Society General Meeting*. July 26-30, 2015, Denver, CO.
4. R. Sioshansi, "Non-Technical Barriers to Energy Storage Entering the Market," *2015 IEEE Power and Energy Society General Meeting*. July 26-30, 2015, Denver, CO.
5. R. Sioshansi, "Stochastic Dynamic Programming Models for Co-Optimizing Storage Operations," *22nd International Symposium on Mathematical Programming*. July 12-17, 2015, Pittsburgh, PA.
6. R. Sioshansi, 'A Dynamic Programming Approach to Estimating the Capacity Value of Energy Storage," invited seminar at Durham University Durham Energy Institute. June 16, 2015, Durham, United Kingdom.
7. R. Sioshansi, "Retail Electricity Tariff and Mechanism Design to Incentivize Distributed Generation," *The 2nd Meeting of the ERIA Research Working Group 2014–2015 for Studies on "Financing Renewable Energy Development in EAS Countries: A Primer of Effective Policy Instruments"*. May 16-17, 2015, Chiang Mai, Thailand.
8. R. Sioshansi, 'A Stochastic Dynamic Programming Model for Co-Optimizing Storage Operations," invited colloquium at University of Texas at Austin Department of Electrical and Computer Engineering. May 6, 2015, Austin, TX.
9. R. Sioshansi, "Stochastic Dynamic Programming and Energy Storage," *Winter School 2015 in Energy Systems and Markets*. 22-28 March, 2015, Kvitfjell, Norway.
10. R. Sioshansi, "Non-Technical Barriers to Energy Storage Entering the Market," *University of Michigan Sustainable Systems Forum*, Invited Seminar Speaker. February 20, 2015, Ann Arbor, MI.
11. R. Sioshansi, "Wholesale and Retail Market Design for Incentivizing Renewable Energy Adoption," *The 1st Meeting of the ERIA Research Working Group 2014–2015 for Studies on "Financing Renewable Energy Development in EAS Countries: A Primer of Effective Policy Instruments"*. January 6, 2015, Jakarta, Indonesia.
12. R. Sioshansi, "Optimizing Offers for Cascaded Hydroelectric Generators in a Market with Centralized Dispatch," *INFORMS Annual Meeting*. November 9-12, 2014, San Francisco, CA.
13. R. Sioshansi, "Energy Storage and Renewable Integration: Needs, Opportunities, and Challenges," *University of Iowa Public Policy Center Conference on "Meeting the Renewable Energy Challenge"*, Invited Panelist. October 15-16, 2014, Iowa City, IA.
14. R. Sioshansi, "The Economics of Energy Storage," *International Summer School ENERstore 2014*. September 22-26, 2014, Technische Universität Dresden, Dresden, Germany.

15. R. Sioshansi and F. Wu, "Vehicle-Grid System Integration Policies: Electric Vehicle (EV) Infrastructure Location Optimization & Charging Load Estimation," *2014 US-China Clean Energy Research Center Annual Meeting*. August 11-12, 2014, Ann Arbor, MI.
16. R. Sioshansi, "Decision Support Tools for Energy Storage Investment and Operations," *2014 IEEE Power and Energy Society General Meeting*. July 27-31, 2014, National Harbor, MD.
17. R. Sioshansi, "Energy Storage," invited tutorial to the *Ohio Consumers' Counsel*. July 15, 2014, Columbus, OH.
18. R. Sioshansi, "The Role of Vehicle to Grid With Renewable Resources in Electricity Markets," *Armand Peugeot Chair 1st International Conference on "Electromobility: Challenging Issues"*, Invited Keynote Speaker and Roundtable Participant. December 19-20, 2013, Paris, France.
19. R. Sioshansi, "Welfare Effects of Energy Storage: Market Structure, Ownership, and the Unknown," invited seminar at Friedrich-Alexander-Universität. December 16, 2013, Nürnberg, Germany.
20. R. Sioshansi, "Economic Impact of Grid Energy Storage," *Presented at Emerging Technologies' Impact on U.S. Energy Security*, The MITRE Corporation. December 3-4, 2013, McLean, VA.
21. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Estimating Capacity Value of Energy Storage Using Dynamic Programming," *INFORMS Annual Meeting*. October 6-9, 2013, Minneapolis, MN.
22. X. Xi, R. Sioshansi, and V. Marano, "A Stochastic Dynamic Programming Model for Co-optimization of Distributed Storage," *INFORMS Annual Meeting*. October 6-9, 2013, Minneapolis, MN.
23. R. Sioshansi, "Capacity Cost Allocation and Distributed Renewables," *IET Renewable Power Generation Conference 2013*, Invited Keynote Speaker. September 19-20, 2013, Beijing, People's Republic of China.
24. R. Sioshansi and X. Xi, "Using Price-Based Signals to Control Plug-in Electric Vehicle (PEV) Charging," *2013 US-China Clean Energy Research Center Annual Meeting*. August 19-20, 2013, Beijing, People's Republic of China.
25. S. H. Madaeni and R. Sioshansi, "The Effects of Delayed Price-Responsive Demand in Reducing Wind-Uncertainty Costs," invited seminar at Institutet för Näringslivsforskning. May 31, 2013, Stockholm, Sweden.
26. R. Sioshansi, "Home Energy Management," *The Ohio State University/Battelle Memorial Institute Smart Grid Collaboration Meeting*. January 23, 2013, Columbus, OH.
27. S. H. Madaeni and R. Sioshansi, "Demand Response Can Improve the Emission Benefits of Wind," *The Economics of Energy Markets*. January 17-18, 2013, Toulouse, France.
28. R. Sioshansi and A. Tignor, "Utopia Electric: Do Centrally Committed Electricity Markets Provide Useful Price Signals?" *Electricity Optimization: Optimal Power System Topologies and Generation*. November 8, 2012, Washington, DC.
29. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Capacity Value of Photovoltaic Power," *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
30. R. Sioshansi and A. Tignor, "Do Centrally Committed Markets Provide Useful Price Signals?" *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
31. X. Xi, R. Sioshansi, and V. Marano, "A Nash Equilibrium Method to Control Plug-in Electric Vehicle Charging with Wind Integration," *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
32. X. Xi, R. Sioshansi, and V. Marano, "Optimal Location of Public Electric Vehicle Charging Infrastructure," *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
33. R. Sioshansi, "Electric Vehicle Adoption: Spatial and Demographic Effects," invited panelist at *Great Lakes Symposium on Smart Grid and the New Energy Economy*. September 24-26, 2012, Chicago, IL.
34. M. Roberts, R. Sioshansi, and M. Pham, "Spatial Analysis of PEV Adoption," *2012 US-China Clean Energy Research Center Annual Meeting*. August 27-28, 2012, Ann Arbor, MI.
35. R. Sioshansi, V. Marano, and X. Xi, "Price-based PEV Charging Control," *2012 US-China Clean Energy Research Center Annual Meeting*. August 27-28, 2012, Ann Arbor, MI.

36. R. Sioshansi, V. Marano, and X. Xi, "A Simulation-Optimization Model for Public PEV Charging Stations," *2012 US-China Clean Energy Research Center Annual Meeting.* August 27-28, 2012, Ann Arbor, MI.
37. R. Sioshansi, "Price and Investment Implications of Renewables," invited panelist at *Ohio Clean Energy Transmission Summit.* August 6, 2012, Columbus, OH.
38. S. H. Madaeni, R. Sioshansi, and P. Denholm, "The Capacity Value of Solar Generation in the Western United States," *2012 IEEE Power & Energy Society General Meeting.* July 22-26, 2012, San Diego, CA.
39. M. Muratori, V. Marano, R. Sioshansi, and G. Rizzoni, "Energy consumption of residential HVAC systems: a simple physically-based model," *2012 IEEE Power and Energy Society General Meeting.* July 22-26, 2012, San Diego, CA.
40. U. Helman and R. Sioshansi, "Valuing concentrating solar power with thermal energy storage: A survey of the literature and some extensions," *Advanced Workshop in Regulation and Competition: 25th Annual Western Conference.* June 27-29, 2012, Monterey, CA.
41. R. Sioshansi, "Impact of Renewable on System CO_2 Emission," invited presentation at Cummins Science & Technology Council Meeting. June 27, 2012, Columbus, IN.
42. X. Xi, R. Sioshansi, and V. Marano, "A Simulation-Optimization Model for the Location of Public Electric Vehicle Charging Infrastructure," invited colloquium at Institute for Future Energy Consumer Needs and Behavior and E.ON Energy Research, RWTH Aachen University. June 13, 2012, Aachen, Germany.
43. R. Sioshansi, "Transportation Electrification: What are the Benefits and Challenges?" invited seminar at IFP School. June 11-12, 2012, Rueil-Malmaison, France.
44. R. Sioshansi, "The Economics of Energy Storage: What can be Learned from the U.S. Experience?" invited seminar at IFP School. June 11-12, 2012, Rueil-Malmaison, France.
45. R. Sioshansi, "'Investment Analysis of Power Distribution Networks: The Case of Norway' by Rahmatallah Poudineh and Tooraj Jamasb," invited discussant, *5th International Workshop on "Empirical Methods in Energy Economics"*. June 7-8, 2012, Berlin, Germany.
46. A. Pielow, R. Sioshansi, and M. C. Roberts, "Modeling Short-run Electricity Demand with Long-term Growth Rates and Consumer Prices Elasticity in Commercial and Industrial Sectors," *5th International Workshop on "Empirical Methods in Energy Economics"*. June 7-8, 2012, Berlin, Germany.
47. R. Sioshansi, "Market and Policy Barriers to Energy Storage," *Renewable & Sustainable Energy Technology Workshop.* April 12-13, 2012, Los Angeles, CA.
48. M. Muratori, M. Roberts, R. Sioshansi, V. Marano, G. Rizzoni, "Modeling Residential Power Demand," *6th Annual UCEAO Conference on Securing Ohio's Energy and Economic Future.* April 2-3, 2012, Columbus, OH.
49. R. Sioshansi, and E. Nicholson, "Comparison of Centrally and Self-Committed Electricity Markets," *INFORMS Annual Meeting.* November 13-16, 2011, Charlotte, NC.
50. R. Sioshansi and P. Denholm, "Benefits of Co-Locating Wind and Concentrating Solar Power," *INFORMS Annual Meeting.* November 13-16, 2011, Charlotte, NC.
51. S. H. Madaeni, R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants," *INFORMS Annual Meeting.* November 13-16, 2011, Charlotte, NC.
52. R. Sioshansi, "EV Charging Infrastructure Siting," *2011 SJTU-UM Workshop on Renewable Energy and New Energy Vehicles.* October 20-21, 2011, Shanghai, People's Republic of China.
53. R. Sioshansi, "EV Charging Infrastructure Siting—Project Overview," *2011 Annual Technology Forum of US-China Clean Vehicles Consortium.* October 17-18, 2011, Beijing, People's Republic of China.
54. R. Sioshansi, "Advanced Energy Technologies: Overview of Research Activities," invited seminar at Battelle Memorial Institute. September 12, 2011, Columbus, OH.
55. M. Muratori, V. Marano, R. Sioshansi, and M. Roberts, "Domestic Power Demand Prediction and Modelling," *The 24th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems.* July 4-7, 2011, Novi Sad, Serbia.

56. R. Sioshansi, "Market Impacts and Interactions in the Energy/Climate Nexus," NSF Workshop on *Engineering & Social Response to the Energy-Climate Nexus*. June 23-24, 2011, Arlington, VA.
57. R. Sioshansi and P. Denholm, "The Value of Plug-In Hybrid Electric Vehicles as Grid Resources," *34th IAEE International Conference*. June 19-23, 2011, Stockholm, Sweden.
58. R. Sioshansi, "Methods of Modeling the Value of Concentrating Solar Power and Thermal Energy Storage," invited seminar at BrightSource Energy. May 23, 2011, Oakland, CA.
59. R. Sioshansi "Market Interactions Between Wind and Energy Storage: Do Wind and Storage Make Economic Sense?," invited seminar at Tulane Energy Institute, Tulane University. April 8, 2011, New Orleans, LA.
60. R. Sioshansi, "Addressing Computational Issues in Large-Scale Models," *EFRI-RESIN Workshop*. January 13-14, 2011, Tucson, AZ.
61. R. Sioshansi, "Increasing the Value of Wind with Energy Storage." *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
62. S. Madaeni and R. Sioshansi, "Evaluating the Impact of Demand Response and Stochastic Programming on the Cost of Wind," *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
63. R. Sioshansi, "The Impact of Electricity Tariffs on PHEVs," *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
64. S. Madaeni and R. Sioshansi, "Benefits of Demand Response and Stochastic Programming on Reducing Wind Integration Costs," *12th International Conference on Stochastic Programming*. August 16-20, 2010, Halifax, NS, Canada.
65. R. Sioshansi, V. Marano, and R. Fagiani, "Cost and Emissions Impacts of Plug-In Hybrid Vehicles (PHEVs) on the Electric Power Grid," *4th International Conference on Sustainable Energy and Environmental Protection*. June 29-July 2, 2010, Bari, Italy.
66. R. Fagiani, V. Marano, and R. Sioshansi, "Cost and Emissions Impacts of Plug-in Hybrid Electric Vehicles on Ohio Power Grid," *The 2nd International Symposium on Energy Engineering, Economics and Policy: EEEP 2010*. June 29-July 2, 2010, Orlando, FL.
67. R. Sioshansi, "Using Storage to Increase the Market Value of Wind Generation," *Advanced Workshop in Regulation and Competition: 23rd Annual Western Conference*. June 23-25, 2010, Monterey, CA.
68. R. Sioshansi, "Some Policy and Research Questions Related to Energy Storage," *Workshop on Electricity Storage in Paris–Supelec*. May 10, 2010, Gif-sur-Yvette, France.
69. R. Sioshansi, "Using Storage to Increase the Market Value of Wind Generation," *The Economics of Energy Markets*. January 28-29, 2010, Toulouse, France.
70. R. Sioshansi, "Welfare and Incentive Effects of Energy Storage," *INFORMS Annual Meeting*. October 11-14, 2009, San Diego, CA.
71. R. Sioshansi and P. Denholm, "Net Emissions Impacts of Plug-In Hybrid Electric Vehicles," *INFORMS Annual Meeting*. October 11-14, 2009, San Diego, CA.
72. P. Denholm and R. Sioshansi, "The Value of Compressed-Air Energy Storage (CAES) with Transmission-Constrained Wind," *INFORMS Annual Meeting*. October 11-14, 2009, San Diego, CA.
73. S. Oren, R. Sioshansi, and R. O'Neill, "Three part auctions versus self-commitment in day ahead electricity markets," *Workshop: Designing Electricity Auctions*. September 15-16, 2009. Stockholm, Sweden.
74. R. Sioshansi, "Modeling the Impacts of Plug-In Hybrid Electric Vehicles on Electric Power Systems," *20th International Symposium on Mathematical Programming*. August 23-28, 2009, Chicago, IL.
75. P. Denholm and R. Sioshansi, "Estimating the Transmission Value of Combining Wind with Energy Storage," *32nd IAEE International Conference*. June 21-24, 2009, San Francisco, CA.
76. R. Sioshansi and P. Denholm, "Estimating the Value of Energy Storage in Concentrating Solar Thermal Plants," *32nd IAEE International Conference*. June 21-24, 2009, San Francisco, CA.

77. R. Sioshansi, "Evaluating the Impact of Real-Time Pricing on the Cost and Value of Wind Generation," *Second Annual Power Systems Modeling Conference*. March 18-20, 2009, Gainesville, FL.
78. R. Sioshansi, "The Value of Plug-in Hybrid Electric Vehicles as Grid Resources," *Second Annual Power Systems Modeling Conference*. March 18-20, 2009, Gainesville, FL.
79. R. Sioshansi, "Evaluating the Impact of Real-Time Pricing on the Cost and Value of Wind Generation," *Fifth Annual Carnegie Mellon Conference on the Electricity Industry*. March 10-11, 2009, Pittsburgh, PA.
80. R. Sioshansi, "Evaluating the Impact of Real-time Demand Response on the Integration Cost of Wind," *INFORMS Annual Meeting*. October 12-15, 2008, Washington, DC.
81. R. Sioshansi and W. Short, "Evaluating the Impacts of Real-Time Pricing on the Usage of Wind Generation," *The Economics of Energy Markets*. June 20-21, 2008, Toulouse, France.
82. R. Sioshansi, "'Cournot versus Supply Functions: What does the data tell us?' by Bert Willems, Ina Rumiantseva, and Hannes Weigt," invited discussant, *The Economics of Energy Markets*. June 20-21, 2008, Toulouse, France.
83. R. Sioshansi and W. Short, "Demand Response via Real-Time Pricing to Increase Use of Operational Wind Energy Generators," *PSerc Public Teleseminar*. May 6, 2008.
84. R. Sioshansi and E. Nicholson, "Equilibrium Bidding in Unit Commitment Auctions," *INFORMS Annual Meeting*. November 4-7, 2007, Seattle, WA.
85. R. Sioshansi and A. Svoboda, "Optimal Hydro Bidding in a Market with Centralized Dispatch," *Advanced Workshop in Regulation and Competition: 20th Annual Western Conference*. June 27-29, 2007, Monterey, CA.
86. R. Sioshansi, S. Oren, and R. O'Neill, "The Cost of Anarchy in Self-Commitment Based Electricity Markets," *INFORMS Annual Meeting*. November 5-8, 2006, Pittsburgh, PA.
87. R. Sioshansi and S. Oren, "Do Supply Function Equilibrium Models Describe Behavior in Electricity Spot Markets: An Empirical Analysis of the ERCOT Market," *The Economics of Electricity Markets*. June 2-3, 2005, Toulouse, France.
88. R. Sioshansi and S. Oren, "Do Supply Function Equilibrium Models Describe Behavior in Electricity Spot Markets: An Empricial Analysis of the ERCOT Market," *UC Energy Institute Seminar*. March 11, 2005, Berkeley, CA.
89. S. Oren and R. Sioshansi, "Joint Energy and Reserves Auction with Opportunity Cost Payments for Reserves," *Proceedings of the Bulk Power Systems Dynamics and Control IV*. August 22-27, 2004, Cortina d'Ampezzo, Italy.
90. S. Oren and R. Sioshansi, "Joint Energy and Reserves Auction with Opportunity Cost Payment for Reserves," *The Economics of Energy Markets*. January 16-17, 2004, Toulouse, France.

Teaching Experience

Instructor

- ❑ Nonlinear and Dynamic Optimization (undergraduate); The Ohio State University; Spring 2013–Autumn 2015
- ❑ Restructured Electricity Market Design (graduate-level short course); IFP School; Summer 2012–2015
- ❑ Market Engineering and Applications (graduate); The Ohio State University; Winter 2011, Spring 2010, and Autumn 2015
- ❑ Advanced Nonlinear Optimization (graduate); The Ohio State University; Spring 2013, 2014
- ❑ Electric Vehicle Grid Integration (graduate-level short course); Supélec; Winter 2013
- ❑ Decision Analysis (graduate); The Ohio State University; Autumn 2012–2013
- ❑ Optimization Transition (undergraduate); The Ohio State University; Spring 2012
- ❑ Seminar in Industrial Engineering (graduate); The Ohio State University; Autumn 2011–Spring 2012
- ❑ Nonlinear Programming (graduate); The Ohio State University; Winter 2011
- ❑ Introduction to Applied Decision Analysis (graduate); The Ohio State University; Spring 2009 and 2010, Autumn 2011

- ❑ Fundamentals of Linear Optimization with Applications (undergraduate); The Ohio State University; Winter 2009, and Autumn 2009–2011
- ❑ Advanced Decision Analysis (graduate); The Ohio State University; Autumn 2008
- ❑ Market Engineering and Applications (undergraduate); University of California, Berkeley; Fall 2005, 2006

Teaching Assistant

- ❑ Nonlinear Programming (graduate); University of California, Berkeley; Spring 2004
- ❑ Mathematical Programming (graduate); University of California, Berkeley; Fall 2003
- ❑ Decision Analysis (undergraduate); University of California, Berkeley; Spring 2003

Professional Activities

- ❑ Advisory Work:
  - Member of United States Department of Energy's Electricity Advisory Committee (May, 2014–Present)
  - Invited presenter at 2012 Cummins Science & Technology Council Meeting
- ❑ Volume Editor, *Handbook of Clean Energy System*, Vol. 5 (Energy Storage).
- ❑ Editorial Board Member:
  - *Journal of Modern Power Systems and Clean Energy*
  - *Foundations and Trends in Energy Markets and Policy*
  - *IET Renewable Power Generation*
- ❑ Associate Editor:
  - *Decision Support Systems*
  - *IEEE Transactions on Power Systems*
  - *Journal of Energy Engineering*
- ❑ Referee:
  - *Decision Support Systems*
  - *Energy*
  - *Energy Economics*
  - *Environmental Science and Technology*
  - *European Journal of Operational Research*
  - *European Transactions on Electrical Power*
  - *IEEE Intelligent Systems*
  - *IEEE Signal Processing Magazine*
  - *IEEE Transactions on Power Systems*
  - *IEEE Transactions on Sustainable Energy*
  - *IIE Transactions*
  - *Journal of Regulatory Economics*
  - *Manufacturing and Service Operations Management*
  - *Mathematical Programming A*
  - *Naval Research Logistics*
  - *Operations Research*
  - *Proceedings of the IEEE*
  - *The Energy Journal*
  - *Transportation Research Part C: Emerging Technologies*
- ❑ Proposal reviewer:
  - Energy, Power, and Adaptive Systems; *National Science Foundation*; March, 2013.
  - Chemical, Bioengineering, Environmental, and Transport Systems CAREER; *National Science Foundation*; December, 2012.
- ❑ Task Force Chair, "Decision Support Tools for Energy Storage Investment and Operations," IEEE Power & Energy Society, Power System Operations Committee, Electricity Market Economics Subcommittee; June, 2014–Present.
- ❑ Conference Organization:
  - Scientific Committee Member, *Armand Peugeot Chair 3rd International Conference on Electromobility.* December 15-19, 2015, Singapore.

- Session Organizer and Chair, "Electric Transportation Systems Modelling," *INFORMS Annual Meeting*. November 1-4, 2015, Philadelphia, PA.
- Session Co-Organizer and Co-Chair, "Long-Term Electric Power System Planning Models," *INFORMS Annual Meeting*. November 1-4, 2015, Philadelphia, PA.
- Panel Organizer, "Decision Support Tools for Energy Storage Operations," *2015 IEEE PES General Meeting*. July 26-30, 2015, Denver, CO.
- Paper Reviewer, *Second International Conference on Transformations in Engineering Education*. January 5-8, 2015, Bengaluru, India.
- Judge, *2014 INFORMS ENRE Section Best Student Paper Award*. November 9-12, 2014, San Francisco, CA.
- Session Co-Organizer and Co-Chair, "Robust and Stochastic Modeling in Power System Operations and Planning," *INFORMS Annual Meeting*. November 9-12, 2014, San Francisco, CA.
- Session Co-Organizer and Co-Chair, "Market Issues for Hydro-Dominated Electricity Systems," *INFORMS Annual Meeting*. November 9-12, 2014, San Francisco, CA.
- Technical Programme Committee Member, *3rd IET Renewable Power Generation Conference*. September 24-25, 2014, Naples, Italy.
- Local Organizing Committee Member, *2014 Mixed Integer Programming Workshop*. July 21-24, 2014, Columbus, OH.
- Session Organizer and Chair, "Operations and Planning with Energy Storage," *INFORMS Annual Meeting*. October 6-9, 2013, Minneapolis, MN.
- Head Judge, *2013 INFORMS ENRE Section Best Student Paper Award*. October 6-9, 2013, Minneapolis, MN.
- Technical Programme Committee Member, *2nd IET Renewable Power Generation Conference*. September 9-11, 2013, Beijing, People's Republic of China.
- International Scientific Committee Member, *10th International Conference on the European Energy Market*. May 28-30, 2013, Stockholm, Sweden.
- Session Organizer and Chair, "Research Needs of the Electricity Industry," *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
- Cluster Chair, "ENRE Energy" *INFORMS Annual Meeting*. October 14-17, 2012, Phoenix, AZ.
- International Scientific Committee Member, *9th International Conference on the European Energy Market*. May 10-12, 2012, Florence, Italy.
- Cluster Chair, "ENRE Energy," *INFORMS Annual Meeting*. November 13-16, 2011, Charlotte, NC.
- Session Organizer and Chair, "Capacity Expansion," *INFORMS Annual Meeting*. November 13-16, 2011, Charlotte, NC.
- Cluster Chair, "Energy," *INFORMS Midwest Conference*. August 1-2, 2011, Columbus, OH.
- Panel Organizer and Chair, "Challenges in Vehicle Electrification," *INFORMS Midwest Conference*. August 1-2, 2011, Columbus, OH.
- Session Chair, "Optimal Power Plant Operations," *34th IAEE International Conference*. June 19-23, 2011, Stockholm, Sweden.
- Session Organizer and Chair, "Joint Session Energy/ENRE Energy: Impacts of Supply Uncertainty on Power System Planning and Operations," *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
- Session Organizer and Chair, "Power System Impacts of Electrified Transportation," *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
- Session Organizer and Chair, "Modeling Benefits of Demand Management in Power Systems," *INFORMS Annual Meeting*. November 7-10, 2010, Austin, TX.
- Session Organizer, "Energy Storage Applications in Electricity Markets," *32nd IAEE International Conference*. June 21-24, 2009, San Francisco, CA.

❑ Invited Panelist: *EFRI-RESIN Workshop*. January 13-14, 2011, Tucson, AZ.

❑ Faculty Advisor:

- INFORMS Student Chapter

- Alpha Pi Mu

❑ Senior Member: Institute of Electrical and Electronics Engineers (IEEE)

❑ Member:
- Institute for Operations Research and Management Sciences (INFORMS)
- International Association for Energy Economics (IAEE)

Grants and Funding

❑ National Science Foundation (PI: A. J. Conejo)
Project: EAGER: Toward Renewable Dominated Electric Energy Systems (RENDES) Duration: 2015-2017 ($)

❑ The Economic Research Institute for ASEAN and East Asia
Project: Wholesale and Retail Market Design for Incentivizing Renewable Energy Adoption
Duration: 2014-2015 ($8,000)

❑ Energy Foundation
Project: Electric Vehicle Industry Cluster in Ohio
Duration: Spring-Fall 2014 ($40,000)

❑ National Renewable Energy Laboratory
Project: Photovoltaic Capacity Credit Study
Duration: 2012-2015 ($139,886)

❑ National Science Foundation
Project: GRDS: Decomposition and Precomputation Algorithms for Large-Scale Equilibrium Computation Models of Energy Systems
Duration: Spring-Autumn 2012 ($41,000)

❑ U.S. Department of Energy (PI: G. Rizzoni)
Project: GATE: Energy Efficient Vehicles for Sustainable Mobility
Duration: 2011-2016 ($910,000)

❑ National Renewable Energy Laboratory
Project: Photovoltaic Capacity Credit Study
Duration: Spring-Autumn 2011 ($50,000)

❑ U.S. Department of Energy (PI: G. Rizzoni)
Project: U.S.-China Clean Energy Research Center-Clean Vehicles (CERC-CV)
Duration: 2011-2015 ($3,000,000)

❑ National Science Foundation
Project: CDI-Type II: Energy policy and investment analysis driven by large-scale integrated power system simulations
Duration: 2010-2016 ($1,675,000)

❑ National Renewable Energy Laboratory
Project: Analysis of co-located wind and concentrating solar power plants
Duration: 2010-2011 ($40,000)

❑ National Renewable Energy Laboratory
Project: CSP Capacity Credit Study
Duration: 2010-2011 ($50,000)

❑ National Renewable Energy Laboratory
Project: Concentrating Solar Power (CSP)/Thermal Storage Dispatch Study
Duration: Winter 2008 ($22,000)

❑ National Science Foundation (PI: S. Oren)
Project: Development of Course in Market Engineering with Application to Electricity Markets
Duration: 2004-2006 ($120,000)

❑ US Department of Energy
Project: Testing Strategic Bidding Models of Spot Electricity Markets
Duration: Summer 2004 ($22,000)

Awards and Fellowships

❑ Distinguished Faculty Award; Spring 2015. Awarded by graduating undergraduate seniors of Integrated Systems Engineering Department.

- ❑ 2015 College of Engineering Lumley Research Award. Awarded for research productivity over the last five years.
- ❑ The Campbell Watkins Energy Journal Best Paper; 2010. Awarded for best paper published in *The Energy Journal*, "The Value of Plug-In Hybrid Electric Vehicles as Grid Resources."
- ❑ Best Paper Award at the *4th International Conference on Sustainable Energy and Environmental Protection*, for the paper: R. Sioshansi, V. Marano, and R. Fagiani, "Cost and Emissions Impacts of Plug-In Hybrid Vehicles (PHEVs) on the Electric Power Grid."
- ❑ Outstanding Graduate Student Instructor Award; Spring 2006. Awarded by faculty of Industrial Engineering and Operations Research department at University of California, Berkeley.
- ❑ Best Graduate Student Instructor Award; Spring 2006. Awarded by undergraduate members of the Berkeley chapter of the Institute of Industrial Engineers.

Summary: Testimony Direct Testimony of Ramteen Sioshansi on behalf of the Office of the Ohio Consumers' Counsel electronically filed by Ms. Gina L Brigner on behalf of Michael, William J. Mr.