OCC EXHIBIT NO. ______

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Ohio Power Company for Authority to Establish a Standard Service Offer Pursuant to R.C. 4928.143, in the Form of an Electric Security Plan.	)))))	Case No. 16-1852-EL-SSO
In the Matter of the Application of Ohio Power Company for Approval of Certain Accounting Authority.	)))	Case No. 16-1853-EL-AAM

DIRECT TESTIMONY
OF
BARBARA R. ALEXANDER

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

May 2, 2017

TABLE OF CONTENTS

I. INTRODUCTION AND SUMMARY

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A1. My name is Barbara R. Alexander. I am the sole member of Barbara Alexander Consulting LLC located at 83 Wedgewood Drive, Winthrop, ME 04364.

Q2. ON WHOSE BEHALF ARE YOU TESTIFYING?

A2. I am testifying on behalf of the Office of the Ohio Consumer's Counsel (OCC).

Q3. PLEASE DESCRIBE YOUR PROFESSIONAL QUALIFICATIONS.

A3. I opened my consulting practice in March 1996, after nearly ten years as the Director of the Consumer Assistance Division of the Maine Public Utilities Commission (1986-1996). While there, I managed the resolution of informal customer complaints for electric, gas, telephone, and water utility services, and testified as an expert witness on consumer protection, customer service quality, and low-income issues in rate cases and other investigations before the Maine Public Utilities Commission.

My current consulting practice focuses on regulatory and statutory policies concerning consumer protection, service quality and reliability of service, customer service, smart grid and advanced metering policies and cost-benefit analysis of such programs, and low-income program design and funding issues associated with both regulated utilities and retail competition markets. I have testified in rate cases, rulemaking proceedings, and investigations before over 20 U.S. and Canadian regulators. My recent clients include the state consumer public advocate offices in Arkansas, Illinois, Maine, Maryland, Massachusetts, Pennsylvania, Washington, and West Virginia, as well as on behalf of national and state consumer advocates.

I have testified on proposals for advanced metering deployment in California, Oklahoma, Maine, Maryland, Michigan, and. In those proceedings, I evaluated the costs and benefits proposed for these investments in formal testimony.

I am a graduate of the University of Michigan (1968) and I received a J.D. from the University of Maine School of Law (1976).

I have attached my resume with a list of my publications and testimony as Attachment BRA-1.

Q4. PLEASE IDENTIFY THE ISSUES YOU WILL BE ADDRESSING IN YOUR TESTIMONY.

A4. My testimony will address Mr. Scott Osterholt's testimony on behalf of Ohio Power Company ("AEP Ohio" or the "Utility") for approval of a new surcharge to collect the proposed expenditures reflected in the Utility's Distribution Technology Investment Plan ("DTIP"). If the DTIP were approved by the Public

Utilities Commission of Ohio ("PUCO"), customers would be charged at least $207.5 million[1] for these investments during the first four years of this electric security plan ("ESP). Customers would be charged through a new rider on customer bills called the Distribution Technology Rider ("Technology Rider").

The projects and expenditures are composed of three initiatives that Mr. Osterholt proposes to support the Columbus Smart City ("Smart Columbus") federal grant award and two other initiatives unrelated to the Smart Columbus project. The three initiatives that Mr. Osterholt alleges are connected to or supporting the Smart Columbus federal grant include: (1) installation of electric vehicle ("EV") charging stations; (2) microgrid projects; and (3) "smart" street lighting technologies. The two projects unrelated to the Smart Columbus federal grant include a Next Generation Utility Communications System ("Next Gen") and investments to improve the physical security of the Utility's substations ("Substation Security"). I will address the reasonableness of the Utility's proposal for the Technology Rider, as well as my analysis of the three projects proposed for the Smart Columbus initiative. My testimony should be considered in concert with the testimony on these and related issues submitted by James Williams on behalf of the OCC.

[1] Direct Testimony of AEP Ohio Witness Osterholt at 6.

Q5. HAVE YOU CONDUCTED A TECHNICAL ANALYSIS OF THE SPECIFIC PROJECTS AND TECHNOLOGIES THAT AEP OHIO HAS PROPOSED IN THIS APPLICATION FOR FUNDING THROUGH THE TECHNOLOGY RIDER?

A5. No. My review focuses on the consumer perspective of whether it is appropriate to require customers to fund these projects pursuant to a new Technology Rider in this proceeding.

Q6. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS.

A6. The PUCO should reject AEP Ohio's proposed EV charging station, microgrid, and smart street lighting proposals. Not only are these projects undefined and unaccompanied by any means to evaluate their alleged benefits, but they will impose significant costs to the 1.3 million customers who would be required to subsidize these programs with increases to their bills for essential electric service. Many of the alleged benefits for these programs are more directly related to projected and unsupported impacts on generation supply prices and emission profiles, issues that are not directly within the purview of PUCO under Ohio's restructuring mandate. If the PUCO does not reject AEP Ohio's proposal, then the PUCO should defer its ruling until after it concludes its Power Forward process and addresses the policy issues that I have identified in my testimony.[2]

[2] Upon the advice of counsel, the PUCO expressly reserved consideration of grid modernization plans to a separate proceeding, now identified as Power Forward. See *In re Ohio Power Company*, Case No. 14-1693-EL-RDR, Second Entry on Rehearing (November 3, 2016), at 60.

Finally, among the many policy issues that should be explored and resolved is not only whether these initiatives are appropriate for recovery from distribution ratepayers, but whether or how those who are likely to receive direct and substantial benefits from these programs should contribute to the program costs.

The NextGen and Substation Security programs should be rejected as have little or nothing to do with grid modernization. The programs should be reviewed in the Utility's next base distribution rate case.

To be clear, AEP Ohio's DTIP proposal is not an infrastructure modernization "plan" and it is not subject to review in this proceeding pursuant to the PUCO's prior orders. To be included in an ESP, the DTIP must be an "infrastructure modernization plan" and directly relate to AEP Ohio's distribution reliability.[3]

In this proceeding, AEP Ohio has proposed several unrelated projects and has not linked their primary purpose to distribution service reliability.
Of the five initiatives in AEP Ohio's DTIP, it claims that three (the EV charging stations, smart street lighting, and 10 microgrid projects) ostensibly support the federal grant initiatives. However, these three projects were not integrated with or collaborated with the federal grant program. Instead, AEP Ohio committed $29.1 million, and AEP Ohio subsequently and independently developed these programs. In this

[3] See, R.C. 4928.143(B)(2)(h).

proceeding, AEP Ohio seeks to shift cost responsibility for its commitment to its captive customers – and in the process has bloated expenditures from $29.1 million to at least $207.5 million for the DTIP over the first four years of this ESP. The five initiatives in AEP Ohio's proposed DTIP are not an integrated part of the federal grant program and have no relation to each other as part of a comprehensive infrastructure modernization plan. Furthermore, the PUCO should reject AEP Ohio's proposals for these projects and this Technology Rider on the grounds that the utility has failed to demonstrate the proper nexus to an ESP filing.

In addition, upon the advice of counsel, I understand that the DTIP is not subject to review in this proceeding. The settlement that the PUCO approved in the *PPA Proceeding*[4] did not provide for the consideration of grid modernization plans in this ESP proceeding. Instead, the PUCO's Second Entry on Rehearing in the *PPA Proceeding* provides that grid modernization proposals are only to be considered in a separately

[4] See *In re Ohio Power Company*, Case No. 14-1693-EL-RDR, Second Entry on Rehearing (November 3, 2016), at 60, in which the Commission explicitly detailed the process for approving such grid modernization plans going forward:

> ***the Commission recently noted that we will undertake, in the near future, a detailed policy review of grid modernization. *In re FirstEnergy*, Case No. 14-1297-EL-SSO (*FirstEnergy ESP 4 Case*), Fifth Entry on Rehearing (October 12, 2016) at 95-96. ***Following*** this policy review, the Commission will address AEP Ohio's pending grid modernization application and, informed by the results of that review, we will grant approval of the grid modernization programs as we deem appropriate ***in light of the policy review***. [Emphasis added.]

docketed case and after the PUCO conducts a comprehensive review of grid modernization initiatives as a part of Power Forward. The three-phase review of Power Forward has just commenced and a comprehensive grid modernization policy has not been established. Thus, AEP Ohio's piecemeal grid modernization proposals should be rejected because they are not subject to review in this proceeding.

I have also identified several important high level policy issues and questions that the PUCO should explore prior to considering the types of projects and proposals submitted by AEP Ohio in this proceeding.

II. CONSUMER IMPACTS OF AEP OHIO'S PROPOSED DISTRIBUTION TECHNOLOGY RIDER

Q7. PLEASE DESCRIBE AEP OHIO'S PROPOSAL FOR THE NEW DISTRIBUTION TECHNOLOGY RIDER.

A7. AEP Ohio has proposed a new Technology Rider or surcharge that would allow the Utility to collect an estimated $207.5 million[5] from customers during the first four years of this ESP. Additionally, AEP Ohio has proposed that it should be able to significantly increase Technology Rider expenditures so long as they are authorized by the PUCO Staff during the four-year ESP term. In several areas the Utility has proposed projects that it identifies as "Phase I," indicating that the Technology Rider is not viewed as a temporary surcharge or rider and that an

[5] Direct Testimony of AEP Ohio Witness Osterholt, at 6, Table 1.

unidentified number of projects and expenses are intended to be proposed and costs collected from customers at a later unspecified date.[6]

The current proposal reflects three main categories of expenditures: (1) projects that are alleged to be related with the federal grant initiatives (EV charging stations; microgrids; smart lighting technologies); (2) NextGen, the installation of a new internal communication system; and (3) Substation Security, improvements to the physical security of the distribution substations. The breakdown of proposed capital and Operations and Maintenance ("O&M") expenses is as follows[7]:

Proposed Distribution Technology Investment Plan Direct Costs

Technology	Deployment	Timeline	Capital	O&M
Electric Vehicle Chargers	250 Level 2 Public Smart Chargers, 25 DC Fast Chargers, 1000 Residential Chargers	4 years for Phase 1	$6.4 million	$775,000 per year ongoing O&M
Microgrids	10 microgrids	4 years for Phase 1	$52 million	$1.5 million per year ongoing O&M
Smart Lighting	202,000 smart lighting controls, 1,000 LED replacements	4 years for Phase 1	$30 million	$2.1 million per year ongoing O&M
Next Generation Utility Communication System	Replacement of existing system	4 years	$69 million	No incremental increase in ongoing O&M; $1 million deployment O&M
Distribution Substation Security Technology	Technology deployed in up to 100 critical substations	4 years for Phase 1	$30 million	$400,000 per year ongoing O&M

[6] The Company has not been able to describe any details concerning its references to "Phase 2" and states that this "phase" will be "determined" after "considering the data from Phase 1." AEP Response to OCC-INT-2-297 and 2-298 (Attachment BRA-2 and BRA-3, respectively).

[7] AEP Ohio Witness Osterholt Direct Testimony, at 6, Table 1.

Q8. HAS AEP OHIO ESTIMATED CUSTOMER BILL IMPACTS ASSOCIATED WITH THE PROJECTS PROPOSED FOR COLLECTION FROM CUSTOMERS THROUGH THE TECHNOLOGY RIDER?

A8. No. When asked to provide an estimated customer class monthly bill impacts for each of the projects included in the Technology Rider, the Utility stated that it had not done such an analysis and has not provided any information on customer bill impacts based on customer classes, usage levels, or other demographics, such as the impact on low-income customers.[8] However, the Utility did include an estimate of the overall bill impact for residential and non-residential customers for the proposed Technology Rider[9] and its recommended programs and investments:

Distribution Technology Rider Rate Estimates

Monthly Charge ($)		
	Residential	Non-Residential
2017	0.11	0.49
2018	0.61	2.59
2019	1.20	5.11
2020	1.75	7.48
2021	2.08	8.88
2022	2.10	8.95
2023	2.03	8.66
2024	1.96	8.36

Under this estimate, residential customers' monthly bills will see a significant rate increase for projects that are undefined and for which benefits have yet to be properly evaluated and identified.

[8] AEP Ohio Response to OCC-INT-2-367 (Attachment BRA-4).

[9] AEP Ohio Witness Gill, Exhibit DRG-5.

III. THE PUCO SHOULD REJECT AEP OHIO'S PROPOSED TECHNOLOGY RIDER BECAUSE IT WOULD RESULT IN UNREASONABLE AND INAPPROPRIATE RATEMAKING.

Q9. HAS AEP OHIO PROVIDED SUFFICIENT JUSTIFICATION FOR ITS PROPOSAL TO CHARGE CUSTOMERS FOR THESE SPECIFIC PROJECTS IN THE NEW TECHNOLOGY RIDER?

A9. No. There are no statutory or policy grounds to support the Utility's proposal to isolate these particular projects and seek the collection of costs outside of a regular base rate case.

In general, investments associated with the distribution company's obligation to provide safe, reliable, and adequate service must be undertaken by the utility and its shareholders. The programs identified in the DTIP should be reviewed in a distribution base rate case, in which a utility has the opportunity to demonstrate that expenses were prudently incurred and that the investments are providing used and useful capabilities for consumers before the utility is authorized to collect the costs from consumers and a return on its investment.

In addition, these projects have no nexus to the ESP proceeding, which is primarily intended to address the obligation to provide default generation supply service. While Mr. Osterholt references R.C. 4928.143 in support of this

Technology Rider[10] that provision is not applicable on its face. Although Subsection (B)(2)(h) allows an ESP to include a "long-term energy delivery infrastructure modernization plan" that is linked to reliability, AEP Ohio has not proposed such a "plan." None of the projects included in the DTIP are related to each other or are part of any overall "plan" to improve AEP Ohio's distribution reliability.[11] The DTIP is nothing more than a combination of several unrelated projects that are not accompanied by any analysis that either links the proposed projects together or links these proposed projects to the Utility's obligation to provide adequate, reliable, safe, efficient, nondiscriminatory, and reasonably priced retail distribution electric service.[12]

Further, AEP Ohio's proposed DTIP actually violates the Utility's obligation to comply with certain policies of the State of Ohio, including avoiding anticompetitive subsidies,[13] ensuring a diversity of supplies and suppliers,[14] and protecting at risk populations.[15] As I explain in my testimony, approval of AEP Ohio's proposed DTIP raise important questions about the potential for providing subsidies in the form of guaranteed cost recovery to the Utility for its EV charging

[10] Direct Testimony of Mark Osterholt at 47.

[11] While it is possible that strategically located and operated microgrid projects could improve reliability in certain circumstances, such an investment by ratepayers would need to be more thoroughly explored in terms of costs, benefits, and analysis of alternatives to achieve the least cost approach. AEP Ohio has not undertaken such an analysis or even recognized that it should be done prior to investing in ten undefined microgrid projects that would be paid in full by ratepayers.

[12] R.C. 4928.02(A).

[13] R.C. 4928.02(H).

[14] R.C. 4928.02(C).

[15] R.C. 4928.02 (L).

station and microgrid proposals to the detriment of market-based solutions and non-utility vendors. These subsidies also could affect entry by third parties into Ohio's electric vehicle charging station and microgrid markets, affecting a diversity of suppliers. Moreover, low-income and at-risk populations would be required to fund these proposals without receiving proportionate benefits. Importantly, requiring all distribution customers to fund these programs for the benefit of relatively few customers raises serious concerns about the allocation of costs and the recovery of costs in a fair and reasonable manner.

Q10. ARE THERE ADDITIONAL DEFECTS IN AEP OHIO'S PROPOSAL FOR CHARGING CUSTOMERS FOR THE SPECIFIC PROJECTS INCLUDED IN THE PROPOSED DTIP?

A10. Yes. Even if the concept of charging customers for the Technology Rider was appropriate (but it is not appropriate), the EV, microgrid and street lighting projects are not candidates for approving cost recovery from distribution customers at this time. As I will document further in my testimony, the proposals that are alleged to be linked to the federal grant project lack essential requirements for consideration by the PUCO. Furthermore, these projects raise significant policy issues that should be resolved prior to the consideration of whether these or similar projects should be included in rates for essential distribution service to customers. I also identify those policy questions that should be resolved prior to undertaking any type of cost recovery.

The other two projects included in the proposed Technology Rider involve collection of costs from customers associated with a new NextGen communications system and proposed investments in Substation Security. These projects are unrelated to any of the federal grant initiatives and should be undertaken, if at all, in the normal course of business by the distribution utility. following a prudence review and a determination of cost to be collected from customers determined in a future base rate case. It is premature for the Utility to ask customers to pay for these projects before any prudence review.[16] OCC Witness Mr. James Williams addresses the concerns with these two projects in more detail.

IV. AEP OHIO'S PROJECTS LACK ESSENTIAL DETAILS IN DESIGN AND IMPLEMENTATION.

Q11. ARE FEDERAL GRANT INITIATIVES A VALID JUSTIFICATION FOR AEP OHIO'S CAPTIVE CUSTOMERS TO PAY FOR THE DTIP PROGRAMS?

A11. No. AEP Ohio committed $29.1 million to support federal grant initiatives without defining the projects its commitment would support. The $ 207.5 million

[16] The Utility intends that these two projects for cost recovery in the DTIP result in a prudence determination of the projects at this time. See, AEP Ohio Response to OCC-INT-2-366 (substation investments) (Attachment BRA-5) and AEP Response to OCC-INT-2-363 (NextGen UCS) (Attachment BRA-6).

AEP Ohio seeks from its captive customers has little, if any, relationship to AEP Ohio's ill-defined commitment of $29.1 million.

Moreover, AEP Ohio's commitment does not include any contribution of shareholder funds, but is contingent upon the PUCO's approval of cost recovery from captive customers.[17] In this proceeding, AEP Ohio seeks to shift cost responsibility for its commitment to its captive customers – and in the process has bloated expenditures from $29.1 million to at least $207.5 million for the DTIP over the first four years of this ESP. The Utility's proposals and the manner in which it seeks to recover the costs of these undefined projects raise serious and potentially improper subsidization issues.

Q12. WHAT ARE YOUR CONCERNS ABOUT IMPROPER SUBSIDIZATION?

A12. AEP Ohio would require its captive distribution service customers to pay for its DTIP programs, which would provide the Utility with a return of and on its investment.

Q13. WHY IS THIS A CONCERN?

A13. Some of these programs, notably the EV and microgrid programs, are aimed at after the meter operations. Typically these operations would be supplied by unaffiliated third parties competing in the market. It is unfair for a utility, backed by customer funding, to compete in such a market. Serious anti-competitive issues can arise that can impede the competitive market, to the detriment of

[17] AEP Ohio Response to OCC-INT-2-300 (Attachment BRA-7).

customers relying upon the market to bring innovation and reasonable pricing. My concern is that AEP Ohio will be able to receive a return of and on its investment, regardless of the revenues produced by an electric vehicle charging station or a microgrid,[18] while third party vendors offering the same programs do not have this guarantee. The subsidy is a barrier to third party vendors' entry into Ohio's market.

Moreover, it shifts the risk economic success of the programs to AEP Ohio's captive customers. Several other states have rejected or halted utility investment in EV charging stations, for example, in part for exactly these reasons.[19] In this vein, AEP Ohio is a franchised electric distribution utility with exclusive rights and obligations to serve customers within its service territory.[20] It is legitimate to question whether this obligation to serve should extend to the deployment of EV charging stations, microgrids or other projects that can be implemented through a competitive market. AEP Ohio's proposal could stifle the development of a competitive market and corresponding advancements in innovation for providing these types of services for customers.

[18] These revenues are speculative. As I testify below, AEP Ohio has not demonstrated a need for it proposed EV charging stations or microgrids.

[19] See., e.g., Public Service Commission of the State of Missouri, *In the Matter of the Application of Union Electric Co., d/b/a Ameren Missouri for Approval of a Tariff Setting a Rate for Electric Vehicle Charging Stations*, File No. ET-2016-0246, Report and Order (April 19, 2017).

[20] R.C. 4933.82.

Related to the subsidization concern is that AEP Ohio proposal fails to include any consideration of whether those who stand to directly benefits from these investments should be required to help pay for them. For instance, AEP Ohio proposes to offer "free" EV charging stations to residential customers, and free usage at public stations.[21]

While it is inappropriate for all customers to pay for these services, this aspect of AEP Ohio's proposal is even more troubling in light of the well-known fact that EVs are purchased primarily by higher income customers.[22] Thus, lower income customers would subsidize the use of these charging stations in the form of higher prices for their essential electric service.

In addition, although the Utility alleges that it would locate and design microgrids to serve lower income communities, it was unable to offer any information on how this intent will be implemented and has not yet identified any "low income communities" or organizations that it will consult or consider at this time.[23] It is likely that low income customers also could subsidize the benefits of the proposed microgrids to others through an increase in their electric rates. This is particularly a concern, where, as here, the Utility has failed to identify the location and/or

[21] AEP Ohio Response to OCC-INT-2-334; 2-332 (Attachment BRA-8 and BRA-9, respectively).

[22] A study by the Energy Institute at Haas examined the household income of those who obtain federal clean energy tax credits, including those who obtained the federal tax credit for the purchase of an EV. According to their analysis, 90% of those who received the EV tax credit had household income in excess of $200,000. http://ei.haas.berkeley.edu/research/papers/WP262.pdf

[23] AEP Ohio Response to OCC-INT-2-309 (Attachment BRA-10).

design of its proposed microgrid projects or promised any means by which its costs will be allocated to those who benefit directly from the microgrid projects. In addition, AEP Ohio proposes that all distribution customers pay for the smart street lighting proposal. This cost traditionally is tariffed and borne by the municipalities who wish to illuminate their streets. The PUCO should scrutinize AEP Ohio's proposal to collect this type of investment from all distribution service customers and consider the implications of whether all customers should be required to subsidize costs that have historically been primarily borne by municipalities.

Q14. AEP OHIO REPEATEDLY DESCRIBES ITS PROJECTS AS "PHASE 1" AND STATES THAT IT WOULD PROPOSE EXPANSIONS OF THESE PROGRAMS TO A LARGER GEOGRAPHIC AREA IN THE FUTURE AS "PHASE 2." PLEASE PROVIDE YOUR CONCERN WITH THIS CHARACTERIZATION.

A14. AEP Ohio has not provided any criteria that would support any evaluation of "Phase 1" or that would allow consideration of additional expenditures to be collected from customers under its apparently permanent Technology Rider in "Phase 2." In other words, the concept of any "phases" with its proposed expenditures or projects is nonexistent. The Utility has not identified any evaluation criteria or process to consider the impact of "Phase 1." Nor has it identified the basis for what would be considered a successful implementation of "Phase 1."

While AEP Ohio has estimated certain customer and environmental benefits associated with its projects included in "Phase 1," whether the results of its proposed customer paid expenditures actually achieve these benefits is not recognized as a condition that must be met before costs are collected from customers. AEP Ohio has even proposed that the PUCO Staff could authorize expansion of Phase I and the increase of costs to consumers without additional consent from the PUCO or any other public process.[24] And the Utility has not proposed any process or methodology for determining the appropriateness of continuing or expanding the amount of money collected from customers in "Phase 2." It is as if, if the PUCO approves Phase 1, there is a pre-approved blank check written by customers for future expenditures.

Q15. SHOULD AEP OHIO'S PROPOSAL FOR ELECTRIC VEHICLE CHARGING STATIONS BE APPROVED IN THIS PROCEEDING?

A15. No. AEP Ohio has proposed that the PUCO approve customer funding of 250 Level 2 public EV charging stations, 25 Direct Current fast EV charging stations, and 1,000 residential charging stations located at the customer's premises. This proposal is estimated to cost $6.4 million in capital costs and $750,000 in O&M annually for four years. In addition, according to the AEP Ohio proposal, the PUCO Staff could authorize an increase in the number of chargers at any time. This proposal is insufficiently defined and raises important policy issues that are not addressed or resolved by the Utility's application:

[24] Direct Testimony of Scott Osterholt at 20.

1. AEP Ohio's application did not include or reference any information on the deployment of EVs in the greater Columbus area or the demographics for EV owners or the location of such vehicles in this or any other geographic area served by AEP Ohio.[25] As a result, the public need for charging stations cannot be assessed, and a determination of whether the stations are used and useful cannot be made.

2. AEP Ohio did not include any information about the current location or types of EV charging stations installed in the greater Columbus area in its application and when asked for this information, referenced a Department of Energy website for such data.[26] While the Utility's testimony states that there are "limited" EV charging stations available in Columbus, AEP Ohio is unable to actually provide any information specifically about the location or type of EV charging stations in its service territory or in the City of Columbus.[27] Again, without such information, the need for charging stations is not established. And the PUCO is unable to assess whether there are other third-party EV station owners who

[25] AEP Ohio Response to OCC-INT-2-303 (Attachment BRA-11).

[26] ARP Ohio Response to OCC-INT-2-304 (Attachment BRA-12).

[27] AEP Response to OCC-INT-2-314 (Attachment BRA-13).

are able to provide the same services at the location or a nearby location.

3. AEP Ohio has not identified any specific interactions with or input from other organizations or entities that fund or deploy EV charging stations.[28] As a result, there is no information available concerning the need for or policy implications associated with captive utility customers subsidizing EV charging stations and the effect of utility ownership (subsidized by customers) on the competitive market for such charging stations. This lack of interaction and coordination with private entities and the lack of any interaction or coordination with the "electrification" project in the federal grant program raise significant questions about whether AEP Ohio's recommendations should be pursued without additional investigation and consideration of policy, funding, and long-term sustainability.

4. AEP Ohio has no specific information on the location for its proposed charging stations. Nor has it developed any criteria that would govern the future placement of the various types of charging stations that it proposes.[29] Nor can the Utility document why it has

[28] AEP Response to OCC-INT-2-317 (Attachment BRA-14).

[29] AEP Ohio Response to OCC-INT-2-324 (Attachment BRA-15); 2-328 (Attachment BRA-16).

selected the number and type of EV charging stations reflected in this proposal, only claiming that its approach reflects the "pyramid concept" of EV charging station needs supported by many other organizations.[30] This raises questions about whether the utility is proposing more EV charging stations than necessary, a question that is particularly important in part because AEP Ohio's proposed investment would be backed by customer funding without any risk to the Utility's shareholders.

5. While AEP Ohio has proposed that it will locate its EV charging stations for "all segments of the population, including low income customers," the Utility cannot provide any details about this statement, referring to unidentified plans that will be developed in the future.[31] This concern is particularly important because of the obvious barrier in terms of higher cost to purchase an EV (and the need to file a federal tax return to obtain the EV tax credit). Assuming that EV chargers are deployed where EV owners live and work, the use of customer funds to support this proposal is likely to eliminate locations in or near low income neighborhoods because of the probable low or nonexistent rate of EV ownership in these neighborhoods.

[30] AEP Ohio Response to OCC-INT-2-325 (Attachment BRA-17).

[31] AEP Ohio Response to OCC-INT-2-322 (Attachment BRA-18); 329 (Attachment BRA-19).

6. AEP Ohio has proposed that the use of these public charging stations will be "free" for some period, followed by an unidentified analysis of deployment costs, ongoing maintenance costs, usage factors, and time of day usage factors.[32] However, this vague approach would not allow for any testing of various fee schedules or other EV owner contribution to these facilities. As discussed above, this approach is likely to have an adverse competitive impact on privately owned charging stations that presumably charge for their services.

7. When asked how the it will manage the "demand" or usage factor for its subsidized EV charging stations, AEP Ohio states that it will include demand reduction capability in the charging stations, but the equipment and actual methodology for implementing this feature is not yet identified.[33] The Utility states that it will further define the details of the demand response feature of its deployment of EV charging stations as "part of the initial planning for the roll out…,"[34] but this is the type of essential information that should be considered by the PUCO prior to its approval for this program. In my opinion, the notion that the Utility can turn the charging

[32] AEP Ohio Response to OCC-INT-2-334 (Attachment BRA-8); 2-332 (Attachment BRA-9).

[33] AEP Ohio Response to OCC-INT-2-320 (Attachment BRA-20).

[34] AEP Ohio Response to OCC-INT-2-337 (Attachment BRA-21).

stations on and off to manage the usage to reflect demand response conditions is particularly questionable because such an approach would require EV owners to understand when they can use the AEP Ohio EV charging stations, a feature that may not exist for other publicly available or privately owned charging stations. Furthermore, AEP Ohio's approach would likely eliminate or reduce the ability to use the charging stations during hot afternoons (assuming this would coincide with peak demand), a period when many EV owners are likely to seek to charge their vehicles in public areas to return home after work.

8. AEP Ohio cannot document any specific plan or methodology to locate its proposed EV charging stations.[35] The Utility's vague reference to a "deployment plan" that does not exist and its "expertise" in this regard is troubling since the Company cannot identify any experience with the design or deployment of the types of EV charging stations included in this proposal.[36]

9. AEP Ohio's proposal to fund privately owned charging stations at residential customer premises is particularly troubling. As documented previously, EV owners that take advantage of a

[35] AEP Ohio Response to OCC-INT-2-324 (Attachment BRA-15); 2-328 (Attachment BRA-16).

[36] AEP Ohio Response to OCC-INT-2-321 (Attachment BRA-22).

federal tax credit have a significantly higher income than taxpayers generally. As a result, the Utility's subsidy proposal is highly likely to flow to higher income consumers.[37] This result will cause lower income customers to pay higher prices for their essential electric service to support a subsidy for EV chargers that may have little or no impact in promoting EV purchases.

10. AEP Ohio's basis for estimating that EV deployment will result in lower electricity prices for its customers is based on unsupported theory that more kWhs sold coupled with a "higher fixed asset utilization" will result in lower volumetric prices for customers.[38] This assumption or prediction would require an analysis of the number of EVs that will be purchased by customers, how and when those EVs will be charged, and what value the overall usage will have on "asset utilization" for generation supply units in the wholesale market, and how that "asset utilization" would impact retail volumetric electricity prices. AEP Ohio has not provided any of this information or documented the basis for any of its assumptions in this regard. The lack of any specific data that links AEP Ohio's proposed EV charging station deployment plan with these potential results suggests that there are no reasonable

[37] See, fn. 32.

[38] AEP Ohio Response to OCC-INT-2-316 (Attachment BRA-23).

grounds to conclude any particular benefits to distribution service customers at this time. The PUCO should not charge customers millions of dollars for generalized and speculative public benefits.

11. AEP Ohio has failed to even recognize the issue of whether the distribution utility should play a role in promoting the purchase and use of EVs as compared to, for example, other transportation options that would lower vehicle emissions, such as hybrid vehicles and mass transit. PUCO should not approve AEP Ohio's proposal to focus entirely or primarily on promoting EVs without considering whether the Utility should pick winners and losers in this rapidly developing market of lower emission transportation options.

12. The suggestion by AEP Ohio that installing more EV charging stations will result in more EV purchases is too simplistic to rely upon without far more information. Information concerning who buys EVs, what transportation patterns are used by EV owners, and information about the existing network of charging stations in the City of Columbus, none of which is evidently known by AEP Ohio or taken into account when developing its EV charging proposals. When asked to provide the documentation for this assumption, the Utility provided citations to two articles in which the theory of

"range anxiety" was discussed.[39] Under this assumption, the Utility relies on the notion that customers would buy more EVs if they could be assured that their battery would not die and that EV charging stations would be plentiful wherever they wanted to drive. However, the two citations relied upon by the Utility raise additional concerns and do not provide any specific information on what type of actions might actually alleviate this "anxiety" or result in a more widespread purchase of EVs:

a. The Science Direct article referenced in the Utility's data response addresses one aspect of "range anxiety," but states that the biggest impediment is the issue of the driving range before a charge is needed, an issue not related at all to AEP's proposal:

> Range concerns were demonstrated through a poll by the Union of Concerned Scientists which identified that the number one concern with purchasing EVs was the range and the second the ability to charge (Evarts, 2013). The two issues are intertwined in the simple questions of, "Do I have enough charge to get there and do I have enough charge to get back?" A survey found that 71.7% of the respondents were more inclined to purchase a

[39] AEP Ohio Response to OCC-INT-2-370 (Attachment BRA-24).

(PHEV) if charging stations were located at either their place of work or their trip destination (Krupa et al., 2014). While PHEVs are different from BEVs, with BEVs requiring a charger and PHEVs having an ICE for backup, a lack of chargers even for PHEVs will reduce the battery benefit and thus the economic benefit. To complicate recharging, not only is the availability of charging stations critical but the types of chargers at the stations must match that required for the vehicle. To increase use of EVs, the number, location and types of chargers need to grow together to increase charger availability.

b. The second citation in the data response is a summary of an initiative of the U.S. Department of Energy to promote a national network for fast charging stations for EVs. This program announcement does not reflect any studies or documentation about the assumption that more charging stations will encourage more EV purchases. Furthermore, there is no evidence of AEP Ohio's coordination with or participation in this national initiative and program.

Q16. HAVE OTHER STATES ADDRESSED THE PROPER UTILITY ROLE IN FUNDING AND DEPLOYING ELECTRIC VEHICLE CHARGING STATIONS AND THE CONSUMER IMPACTS?

A16. A number of other state utility commissions have considered proposals for utility deployment of the various types of EV charging stations. Several state commissions have rejected the distribution utility's role in funding EV charging stations, raising serious concerns about whether this type of investment is properly within the purview of "utility" service.[40] Where approved, however, the programs, conditions and findings differ markedly from AEP Ohio's proposal. When asked for precedent concerning AEP Ohio's proposal for its subsidy for residential charging stations, the Utility provided three citations, two of which are from Washington state and the third from Georgia.[41] These materials reflect a more low-scale experimental approach with required evaluation protocols compared to AEP Ohio's proposal:

1. According to the AEP Ohio response to OCC RPD-2-117 (attached herein as Attachment BRA-26) is a Washington Utilities and Transportation Commission Staff Memo on a Puget Sound Energy ("PSE") proposal for a one-time $500 rebate to a residential customer that installs an EV charging station:

---

[40] See, e.g., the summary of several recent state decisions rejecting ratepayer funding for EV charging stations in https://midwestenergynews.com/2017/04/24/another-midwest-utility-dealt-a-setback-on-electric-vehicle-charging-stations/

[41] AEP Ohio Response to OCC-INT-2-335 (Attachment BRA-25).

> <u>The most significant revision to the proposed electric vehicle charger incentive is the addition of a data collection and analysis plan to assess the impact of electric vehicle charging on PSE's system</u>. Customers do not need to notify PSE when they purchase an electric vehicle, so by offering an electric vehicle charger incentive, PSE is able to identify customers with electric vehicles and track charging patterns. PSE plans to test multiple approaches to data collection: the installation of a limited number of "smart" chargers, collection of 15-minute interval meter data, and pre- and post-installation billing analysis. PSE has indicated that it will re-evaluate the study design after the first program year. Staff believes that this study will generate data that will benefit PSE's system planning efforts. [Emphasis added]

2. Attachment BRA-26 is an Avista Utilities EV residential charging station proposal that included a tariff that sets forth the fees for charging and did not include any request for cost recovery at that time:

> <u>Notably, Avista has not requested recovery or deferral of costs associated with its Pilot Program with this filing. Accordingly, it is not necessary for us to make a decision on these issues at this juncture. To that end, our approval of</u>

> <u>Avista's EVSE Pilot Program does not constitute pre-approval of the inclusion of capital expenditures in Avista's rate base or the recovery of program operations and maintenance costs.</u> It also does not constitute a finding that such expenditures are eligible for the incentive rate of return established by RCW 80.28.360. Instead, we recognize that the primary purpose of this Pilot Program is to allow Avista to better understand EV charging behavior and the impacts of EV charging on its system, and to promote electric vehicle adoption in Avista's service area consistent with state policy. [Emphasis added]
>
> As a condition of approving the rate for DC fast charging provided in this tariff, we require Avista to report quarterly, beginning August 1, 2016, the locations of DC fast chargers, their utilization rates, and their revenue contribution to fixed and variable costs for the duration of the Pilot Program. Any future request for rate recovery must include a demonstration by Avista that its DC fast charging service provides benefits to ratepayers, and is consistent with state policy promoting the development of DC fast charging infrastructure.

> Avista must also compare its DC fast charging rate to other service providers, and assess the amount of overall fixed and variable costs recovered through user payments. Avista states that the DC fast charging rate is based on the market rate for comparable service from unregulated market participants. Staff and stakeholders agree with Avista that the unknown utilization of the planned charging stations is a barrier to designing cost-based rates. Avista further contends that a cost-based rate may not be competitive with the market, and could inhibit use of DC fast chargers and EV adoption in Avista's service territory. Until more information becomes available, we find it reasonable to adopt a market-based rate for DC fast chargers in the Pilot Program. [Emphasis added]
>
> Because Avista's Pilot Program is not subsidized by a regulated service at this time, we are unable to determine whether the proposed rate of $0.30 per minute for DC fast charging – which will be collected directly from the user – is fair, just, reasonable, and sufficient. If Avista proposes to include its Pilot Program in rates in a future proceeding, Avista will bear the burden of demonstrating that the rate it charges for DC fast charging meets this standard.

Attachment BRA-26 provided a reference to a Georgia Power proposal, dated October 2014, which includes a proposed customer rebate of $250 for the installation of a Level 2 residential and business customers to install EV chargers, as well as the deployment of 50 community charging stations in which payment for usage will be allocated to offset the costs of the program. The actual results of this proposal by Georgia Power with regard to the Georgia Commission's consideration or decision are not included in this response.

Furthermore, the Georgia Power proposal should be viewed in light of the $5,000 tax credit available to Georgia taxpayers for the purchase of an EV that was in effect at the time of this proposed EV charging proposal by Georgia Power.[42] Most importantly, however, the design and scope and scale of this proposed program by Georgia Power is significantly different from the larger and unsupported EV charging station program proposed by AEP Ohio.

Q17. SHOULD AEP OHIO'S PROPOSAL FOR INSTALLING SMART STREET LIGHTING TECHNOLOGIES BE APPROVED IN THIS PROCEEDING?

A17. No. AEP Ohio proposes to install 202,000 smart lighting controls and 1,000 LED replacements at an estimated capital cost of $30 million and $2.1 million in annual O&M costs during the first four years of the ESP. This proposal is not limited to the federal grant area, but is proposed for deployment throughout its

[42] This Georgia EV tax credit expired for qualifying vehicles purchased after July 1, 2015. See, https://epd.georgia.gov/air/alternative-fuels-and-tax-credits.

service territory. The actual location of these installations has not yet been determined.[43] This proposal suffers from many of the same defects as the EV charging station proposal, including:

1. AEP Ohio's cost estimates are "high level" based on a vendor proposal.[44] As a result, there is no basis for any firm estimate of costs for this project that should be relied upon at this time.

2. The Utility has yet to develop or propose an LED lighting tariff and has not identified any future filing date for such a tariff.[45]

3. AEP Ohio has not undertaken any analysis of future upgrades or investments in street lighting planning in general and cannot identify whether this proposal actually might be cost effective at this time.[46] While the Utility alleges benefits in the form of lower power consumption, AEP Ohio is not able to calculate any potential kWh or KW reduction from its street lighting proposal at this time.[47] The Utility's intent to deploy this expensive street lighting technology throughout its gridSmart footprint is particularly troubling in light of the lack of any data on the actual

[43] AEP Ohio Response to OCC-INT-2-359 (Attachment BRA-27).

[44] AEP Ohio Response to OCC-INT-2-360 (Attachment BRA-28).

[45] AEP Ohio Response to OCC-INT-2-274 (Attachment BRA-29).

[46] AEP Ohio Response to OCC-INT-2-311 (Attachment BRA-30).

[47] AEP Ohio Response to OCC-INT-2-361 (Attachment BRA-31); 2-313 (Attachment BRA-32).

benefits that will result from such technologies and investments.[48] The PUCO should not approve customer funding of this investment unless AEP Ohio can show such investment is prudent and is used and useful in providing service to Ohio consumers and the associated charges are just and reasonable.

4. AEP Ohio admits that this type of investment could be undertaken in the normal course of maintaining and upgrading its distribution system. However, it defends this proposal to collect Technology Rider costs from customers on the basis that it allows the faster realization of benefits.[49] However, the lack of any experience and actual data on benefits compared to costs suggests that a prudent approach would be for AEP Ohio to conduct further investigations and testing about consumer impacts to obtain the necessary data before full-scale deployment. The Utility offers no significant reason why it cannot pursue such an investigation and take future steps for deployment (if shown to be cost effective) under traditional ratemaking policies.

[48] AEP Ohio Response to OCC-INT-2-312 (Attachment BRA-33); 2-358 (Attachment BRA-34).

[49] AEP Ohio Response to OCC-INT-2-357 (Attachment BRA-35).

Q18. SHOULD AEP OHIO'S PROPOSED INVESTMENT IN TEN UNIDENTIFIED MICROGRID PROJECTS BE APPROVED IN THIS PROCEEDING?

A18. No. AEP Ohio has proposed to design and install ten microgrid projects over four years at an estimated capital cost of $52 million and annual O&M costs of $2.1 million. In general, this proposal lacks sufficient detail and justification for approval in this proceeding.

1. AEP Ohio has not yet designed the proposed microgrid projects or determined their locations, stating that all of this essential information will be decided "at a future time."[50] When asked about the specific designs of the proposed 10 microgrid projects, the Utility states that each project will reflect "specific needs."[51] AEP Ohio has no specific proposals for the design or location of these facilities at this time.

2. AEP Ohio has no specific experience in the design, construction, or operation of a microgrid in its distribution system, but states that AEP Service Corp. has conducted research on a microgrid test site.[52]

[50] AEP Ohio Response to OCC-INT-2-296 (Attachment BRA-36).

[51] AEP Ohio Response to OCC-INT-2-340 (Attachment BRA-37); 2-341 (Attachment BRA-38).

[52] AEP Ohio Response to OCC-INT-2-308 (Attachment BRA-39).

3. While the Utility alleged that it would locate and design microgrids to serve lower income communities, it was unable to offer any information on how this intent will be implemented and has not yet identified any "low income communities" or organizations that it will consult or consider at this time.[53]

4. While the Utility has promised a "qualitative assessment"[54] of the proposed microgrid projects, AEP Ohio has not developed or proposed an evaluation plan for the proposed microgrid projects, either generally or specifically.[55] In other words, the criteria by which these unknown projects at unknown locations will be evaluated are unknown.

5. The allegation by Mr. Osterholt that these microgrid projects will reduce peak system demand that would result in cost saving benefits[56] should be rejected on the grounds that the proposed ten projects are not designed or located with criteria for evaluating any cost savings. And while net benefits to customers should be assessed, the proper test should be whether the investment is prudent and used and useful in providing service to customers.

---

[53] AEP Ohio Response to OCC-INT-2-309 (Attachment BRA-40).

[54] AEP Ohio Response to OCC-INT-2-343 (Attachment BRA-41).

[55] AEP Ohio Response to OCC-INT-2-342 (Attachment BRA-42).

[56] AEP Ohio Response to OCC-INT-2-347 (Attachment BRA-43).

6. The Utility's proposal appears to assume that the utility should design, own, and operate microgrid projects, as compared to a market approach. That is an assumption that has not been explored by the PUCO, and the Utility has not yet determined whether it will bid out these projects to third parties.[57]

7. AEP Ohio's cost estimates for these ten microgrid projects are "high level" and "refined estimates" will be created "once the scope of each microgrid being considered is developed."[58] As a result, there is little justification for the cost estimates provided by AEP for ten microgrid projects that are not yet designed or located.

V. RECOMMENDATIONS ON AEP OHIO'S PROPOSALS AND POLICY ISSUES THAT SHOULD BE CONSIDERED BY THE PUCO .

Q19. ARE THERE IMPORTANT POLICY ISSUES THAT SHOULD BE CONSIDERED AND ADDRESSED PRIOR TO APPROVAL OF CUSTOMER FUNDING FOR PROJECTS OF THIS TYPE?

A19. Yes. AEP Ohio's proposals raise important policy issues affecting consumers, relating to the role of the distribution utility and the proper method of recovery of

[57] AEP Ohio Response to OCC-INT-2-307 (Attachment BRA-44).

[58] AEP Ohio Response to OCC-INT-2-353 (Attachment BRA-45).

approved program costs. AEP Ohio's proposals and its method of cost recovery should be considered in the context of the PUCO's Power Forward proceeding before they can be approved in this proceeding. The PUCO should outright reject the Technology Rider in this proceeding, as a matter of consumer protection, as I recommend. If the PUCO does not reject AEP Ohio's proposals, it should defer ruling on the proposals until after the Power Forward initiative has concluded.

Q20. WHY SHOULD AEP OHIO'S PROPOSALS SUBMITTED AS A PART OF THE DTIP FIRST BE CONSIDERED IN THE POWERFORWARD INITIATIVE?

A20. The PUCO ordered that the Power Forward initiative precede approval of any individual utility proposal for grid modernization. In its Second Entry on Rehearing in the *PPA Proceeding*, the PUCO explicitly detailed the process for approving such grid modernization proposals going forward:

> ***the Commission recently noted that we will undertake, in the near future, a detailed policy review of grid modernization. *In re FirstEnergy*, Case No. 14-1297-EL-SSO (*FirstEnergy ESP 4 Case*), Fifth Entry on Rehearing (October 12, 2016) at 95-96. ***<u>Following</u>*** this policy review, the Commission will address AEP Ohio's pending grid modernization application and, informed by the results of that review, we will grant

> approval of the grid modernization programs as we deem appropriate ***in light of the policy review***.[59] *(Emphasis added.)*

Thus, completion of a comprehensive policy review of grid modernization issues is the PUCO's condition precedent to consider an individual Ohio utility's specific grid modernization proposal.

Q21. WHAT ARE SOME OF THE MOST IMPORTANT POLICY ISSUES REGARDING AEP OHIO'S PROPOSAL THAT THE PUCO SHOULD CONSIDER AS A PART OF POWER FORWARD?

A21. I summarize some of the most important policy issues below and urge the PUCO to explore these and other potentially important policy issues prior to further consideration of these or similar proposals from Ohio's distribution utilities:

<u>With regard to the EV Charging Station proposal:</u>

1. What data should be developed concerning the penetration of EVs in Ohio at this time, such as the growth in sales, the demographics of EV owners, the geographic location of EV sales and sale trends? Is there a demonstrated need for charging stations?

2. What information is available or should be gathered concerning the deployment of current EV charging stations of the various designs and capabilities? Who owns the charging stations? What fees are

[59] *PPA Proceeding*, Second Entry on Rehearing (November 3, 2016), at 60.

currently being charged? What is the usage factor and profile of usage for existing charging stations?

3. Is it proper to use utility customer funding to support the deployment of EV charging stations?

4. Would a rebate be more effective in stimulating wide installation of EV charging stations compared to a one-time investment by utility customers?

5. How should those who will benefit from these programs contribute to or fund EV charging stations?

6. Should utilities conduct small scale pilots to fund and deploy certain types of charging stations and, if so, with what criteria and evaluation protocols?

7. Should customer funded EV charging stations be required to be implemented with demand or time varying rate structures? Should privately owned or publicly owned charging stations be required to charge based on time of use rates?

8. Should all customers subsidize the costs for those customers who chose to purchase EVs?

9. Does utility funding and ownership in EV charging stations stifle the development of a competitive market for these types of services?

10. Can the market for charging stations develop independently of any subsidies?

11. Who should bear the risk of the developing EV market?

<u>With regard to Smart Street Lighting:</u>

1. Should utilities be required to develop an investment plan that evaluates the various "smart" street lighting investments and other technologies for deployment in their service territories, with an evaluation of the costs and benefits of alternatives?

2. How can utilities with deployment of smart meters and two-way communication system upgrade the operation of the street lighting system? How would this approach compare to utilities without universal deployment of smart meters and two-way communication systems?

3. Should utilities be required to conduct small-scale pilot programs concerning optional street lighting improvements to determine the least cost approach and document costs and benefits?

4. How should street lighting improvement costs be collected? Should all customers subsidize the costs or should they be paid by street lighting customers?

<u>With regard to Microgrid Projects:</u>

1. What role should utilities play in the development and implementation of microgrid projects as compared with or in cooperation with the private or governmental public sector? Should utility funded projects be required to obtain public funding to cover a portion of the costs?

2. What criteria should govern the interconnection of public or privately owned microgrids with the utility's distribution network?

3. What are the criteria that would govern the location of microgrids and how would those criteria be weighed to determine the appropriate locations?

4. Should utilities be required to conduct pilots or small-scale testing of various microgrid design concepts prior to larger scale deployment?

5. Should utility customers fund microgrid development? If so, what evaluation criteria should be developed to determine the costs to be funded by customers? Should microgrids funded by ratepayers be evaluated primarily for their impact on reliability and storm restoration resiliency?

6. How should utility proposals and customer funding for microgrids be coordinated with or required to take advantage of U.S. Department of Energy funding for microgrid demonstration grants and resulting evaluation results?[60]

7. What impact will microgrids have on the competitive deployment of after the meter energy storage services and renewables (e.g. wind and solar) within the confines of the microgrid? That is, how can competitive providers compete against captive customer funded Utility programs? This issue also raises concerns about the

[60] For example, the U.S. Department of Energy has funded several microgrid demonstration projects and research on the costs and benefits of microgrids. This information and the results of the federally funded projects should be taken into account in developing microgrid programs and experiments in Ohio to avoid duplication of research and to take advantage of recommendations reflected in this research. See, https://www.energy.gov/oe/services/technology-development/smart-grid/role-microgrids-helping-advance-nation-s-energy-system [Page visited April 21, 2017].

role of the distribution utility and/or its affiliates that may seek to enter this business and monetize the capacity resources, real time energy, and ancillary services that such microgrids may provide.

8. How should microgrid after-the-meter services revenues from the RTO's markets be accounted for to protect captive customers' investments in these services or offset funding from ratepayers?

VI. CONCLUSION

Q22. BASED ON YOUR EVALUATION OF AEP OHIO'S "SMART COLUMBUS" PROJECTS, HOW DO YOU RECOMMEND THAT THE PUCO PROCEED?

A22. The PUCO should reject AEP Ohio's proposal to establish the Technology Rider and fund its proposed projects through that Rider. At the highest level, AEP Ohio's proposals are not consistent with the criteria for an ESP, do not reflect a proper distribution modernization "plan," are not linked directly to improved reliability of service, and do not conform to the Commission's previously stated process for considering grid modernization investments. More specifically, the proposed projects are vague, undefined, and raise serious issues about whether distribution service customers should pay for these projects at all due to their implications for competitive markets or how the costs of the projects, even if appropriate, should be recovered from those who stand to benefit. AEP

Ohio's proposal for the three projects allegedly associated with the federal grant initiative is vague and unsupported with any specific information or plan to govern their implementation. Costs are high level estimates and there is insufficient information to determine what (if any) benefits customers will receive.

Should the PUCO seek to further examine or consider projects of this type, I recommend that it do so in its Power Forward proceeding and consider the preliminary policy questions that I have identified in my testimony.

Q23. DOES THIS COMPLETE YOUR TESTIMONY?

A23. Yes. However, I reserve the right to supplement my testimony in the event that additional testimony is filed, or if new information or data in connection with this proceeding becomes available.

CERTIFICATE OF SERVICE

I hereby certify that a true copy of the foregoing *Direct Testimony of Barbara R. Alexander. on Behalf of the Office of the Ohio Consumers' Counsel* was served via electronic transmission to the persons listed below on this 2nd day of May 2017.

/s/ William J. Michael
William J. Michael
Assistant Consumers' Counsel

SERVICE LIST

Bojko@carpenterlipps.com
perko@carpenterlipps.com
mfleisher@elpc.org
cmooney@ohiopartners.org
paul@carpenterlipps.com
mleppla@theOEC.org
tdougherty@theOEC.org
lhawrot@spilmanlaw.com
dwilliamson@spilmanlaw.com
charris@spilmanlaw.com
ibatikov@vorys.com
whitt@whitt-sturtevant.com
campbell@whitt-sturtevant.com
glover@whitt-sturtevant.com
tony.mendoza@sierraclub.org
dborchers@bricker.com
eakhbari@bricker.com
sechler@carpenterlipps.com
cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com
werner.margard@ohioattorneygeneral.gov
Robert.eubanks@ohioattorneygeneral.gov

stnourse@aep.com
msmckenzie@aep.com
fdarr@mwncmh.com
mpritchard@mwncmh.com
Kurt.Helfrich@ThompsonHine.com
Stephanie.Chmiel@ThompsonHine.com
Michael.Austin@ThompsonHine.com
mkurtz@BKLlawfirm.com
kboehm@BKLlawfirm.com
jkylercohn@BKLlawfirm.com
rick.sites@ohiohospitals.org
mwarnock@bricker.com
dparram@bricker.com
rdove@attorneydove.com
rsahli@columbus.rr.com
mjsettineri@vorys.com
glpetrucci@vorys.com
ibatikov@vorys.com
joliker@igsenergy.com
mdortch@kravitzllc.com
amy.spiller@duke-energy.com
Elizabeth.watts@duke-energy.com
joe.halso@sierraclub.org

Attorney Examiner:

Greta.see@puc.state.oh.us
Sarah.parrot@puc.state.oh.us

BARBARA R. ALEXANDER
Consumer Affairs Consultant
83 Wedgewood Dr.
Winthrop, ME 04364

Telephone: (207)395-4143
E-mail: barbalex@ctel.net

Recent Clients:

AARP (Oklahoma, New York, Montana, Maine, New Jersey, California, Vermont, District of Columbia, Maryland, Ohio, Delaware, Virginia, Mississippi, Idaho, Connecticut)
Pennsylvania Office of Consumer Advocate
Washington Public Counsel (Attorney General)
The Energy Project (Washington)
The Public Utility Project of New York
Delaware Division of Public Advocate
Maryland Office of People's Counsel
Citizens' Utility Board (Illinois)
The Utility Reform Network (TURN) (California)
Oak Ridge National Laboratory, Department of Energy
COPE No. 378 (British Columbia, Canada)
Massachusetts Ratepayer Advocate (Attorney General)

Areas of Expertise:

- Default Service, Consumer Protection, Service Quality, and Universal Service policies and programs associated with the alternative rate plans and mergers;
- Consumer Protection and Service Quality policies and programs associated with the regulation of competitive energy and telecommunications providers;
- The regulatory policies associated with the regulation of Credit, Collection, Consumer Protection, Low Income, and Service Quality programs and policies for public utilities;
- Rate design and pricing policies applicable to residential customers; and
- Advanced Metering Infrastructure and Grid Modernization costs and benefits, time-based pricing proposals, and performance standards.

Prior Employment

DIRECTOR

1986-96

Consumer Assistance Division
Maine Public Utilities Commission — *Augusta, Maine*

One of five division directors appointed by a three-member regulatory commission and part of commission management team. Direct supervision of 10 employees, oversight of public utility consumer complaint function, appearance as an expert witness on customer services, consumer protection, service quality and low income policy issues before the PUC. Chair, NARUC Staff Subcommittee on Consumer Affairs.

SUPERINTENDENT

1979-83

Bureau of Consumer Credit Protection
Department of Professional and Financial Regulation — *Augusta, Maine*

Director of an independent regulatory agency charged with the implementation of Maine Consumer Credit Code and Truth in Lending Act. Investigations and audits of financial institutions and retail creditors, enforcement activities, testimony before Maine Legislature and U.S. Congress.

Education

JURIS DOCTOR

1973-76
University of Maine School of Law — *Portland, Maine*

Admitted to the Bar of the State of Maine, September 1976. Currently registered as "inactive."

B.A. (WITH DISTINCTION) IN POLITICAL SCIENCE — 1964-68
University of Michigan — *Ann Arbor, Michigan*

Publications and Testimony

"How to Construct a Service Quality Index in Performance-Based Ratemaking", The Electricity Journal, April, 1996

"The Consumer Protection Agenda in the Electric Restructuring Debate", William A. Spratley & Associates, May, 1996

Direct Testimony on behalf of the Telecommunications Workers Union, Telecom Public Notice 96-8, Price Cap Regulation and Related Issues, Canadian Radio-Television and Telecommunications Commission, September, 1996. [Analysis of and recommendations concerning the need to regulate service quality in move to price cap regulation]

Direct Testimony on behalf of Public Counsel Section, Office of Attorney General, Docket No. UE-960195, Application by Puget Sound Power and Light Co. And Washington Natural Gas Co. For Approval of Merger), Washington Utilities and Transportation Commission, September, 1996 [Need for and design of a Service Quality Index for both electric and gas business units as part of a multi-year rate plan]

Consumer Protection Proposals for Retail Electric Competition: Model Legislation and Regulations", Regulatory Assistance Project, Gardiner, ME, October, 1996

Direct and Rebuttal Testimony on behalf of the Citizens Utility Board (IL), Docket 96-0178, Illinois Commerce Commission, CUB v. Illinois Bell Telephone Co., January 22, 1997; July, 1997. [Analysis of recent service quality performance and recommendations for changes in current service quality performance plan]

Direct and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, Restructuring Proceedings before the Pennsylvania PUC: PECO Energy; Pennsylvania Power and Light Co.; GPU Energy; Duquesne Light Co.; West Penn Power Co., UGI-Electric, Pennsylvania Power Co., Pike County Light and Power Co. (1997 and 1998). [Specific consumer protection, consumer education and supplier-utility-customer interactions necessary for move to electric restructuring]

"The Transition to Local Telecommunications Competition: A New Challenge for Consumer Protection", Public Counsel Section, Washington Attorney General, October, 1997. [Reprinted in part in NRRI Quarterly Bulletin, Vol. 19, N0.1, Spring, 1998]

Direct and Surrebuttal Testimony on behalf of the New Jersey Division of Ratepayer Advocate, Restructuring Proceedings before the New Jersey Board of Public Utilities: Public Service Electric and Gas, Jersey Central (GPU), Rockland Electric Co., Atlantic Electric Co.,March-April, 1998. [Phase-in and customer enrollment, Code of Conduct, consumer protections associated with the provision of Provider of Last Resort service]

Oppenheim, Gerald (NCLC) and Alexander, Barbara, Model Electricity Consumer Protection Disclosures, A Report to the National Council on Competition and the Electric Industry, April 1998.

Direct and Reply Testimony on behalf of the Maryland Office of People's Counsel, Investigation into Certain Unauthorized Practices (Slamming and Cramming), Case. No. 8776, before the Maryland Public Service Commission, 1998 and 1999.

Direct Testimony on behalf of the Maryland Office of People's Counsel, Universal Service Issues, Case No. 8745, before the Maryland Public Service Commission, November 20, 1998.

"Cramming is the Last Straw: A Proposal to Prevent and Discourage the Use of the Local Telephone Bill to Commit Fraud," NRRI Quarterly Bulletin, Fall. 1998.

Alexander, Barbara, Retail Electric Competition: A Blueprint for Consumer Protection, U.S. Department of Energy, Office of Energy and Renewable Energy, Washington, D.C., October 1998.

Alexander, Barbara, "Consumer Protection Issues in Electric Restructuring for Colorado: A Report to the Colorado Electricity Advisory Panel," on behalf of the Colorado Office of Consumer Counsel, February 1999.

Testimony on Proposed Interim Rules (Consumer Protection, Customer Enrollment, Code of Conduct, Supplier Licensing) on behalf of the New Jersey Division of Ratepayer Advocate before the New Jersey BPU, May 1999.

Direct Testimony on behalf of AARP, West Virginia PUC Investigation into Retail Electric Competition (consumer protection, universal service, Code of Conduct), June 15, 1999.

Direct and Surrebuttal Testimony on behalf of the Pennsylvania OCA, Natural Gas Restructuring proceedings (8 natural gas utilities): consumer protection; consumer education; code of conduct, before the Pennsylvania PUC, October 1999-April 2000.

Comments on Draft Rules addressing Slamming and Cramming (Docket No. RMU-99-7) on behalf of the Iowa Office of Consumer Advocate, before the Iowa Utilities Board, October 1999.

Alexander, Barbara, "Door to Door Sales of Competitive Energy Services," LEAP Letter, January-February 2000 [Wm. A. Spratley & Associates, Columbus, OH]

Direct Testimony on behalf of the Maine Office of Public Advocate, Central Maine Power Company Alternative Regulation Plan [Docket 99-666] on service quality issues, before the Maine PUC, May 2000.

Direct Testimony on behalf of AARP, Universal Service Programs and Funding of low-income programs for electric and natural gas service, before the New Jersey Board of Public Utilities, Docket No. EX000200091, July, 2000.

Comments (on behalf of NASUCA and AARP) on Uniform Business Practices Reports, May and September 2000.

Direct Testimony on behalf of the Pennsylvania OCA, Verizon-Pennsylvania Structural Separation Plan on service quality, customer service and consumer protection issues [Docket No. M-00001353] before the Pennsylvania PUC, October 2000.

Direct and Rebuttal Testimony on behalf of the Maine Office of Public Advocate, Verizon-Maine Alternative Form of Regulation on service quality issues [Docket No. 99-851] before the Maine PUC, January and February 2001.

Direct and Rebuttal Testimony on behalf of the Citizens Utility Board, Nicor Gas Customer Select Pilot Program, on consumer protection and regulation of competitive natural gas suppliers [Docket Nos. 00-0620 and 00-0621] before the Illinois Commerce Commission, December 2000 and February 2001.

Direct and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate on consumer protection and service quality issues associated with the pending merger between GPU Energy and FirstEnergy, before the Pennsylvania PUC, Docket Nos. A-110300F0095 and A-110400F.0040 (February and March, 2001)

Direct and Surrebuttal Testimony on behalf of the New Jersey Division of Ratepayer Advocate on consumer protection, service quality, and universal service issues associated with the pending merger between GPU Energy and FirstEnergy, before the New Jersey Board of Public Utilities, Docket No. EM00110870 (April 2001).

Alexander, Barbara, "Default Service: What Should be Done When the Experiment Goes Awry?" (April 2001)

Responsive Testimony on behalf of the New Jersey Division of Ratepayer Advocate on service quality issues associated with a Plan for Alternative Regulation by Verizon-New Jersey, before the New Jersey Board of Public Utilities, Docket No. To01020095 (May 2001).

Direct and Surrebuttal Testimony on behalf of the New Jersey Division of Ratepayer Advocate on service quality, consumer protection, and universal service issues associated with the pending merger between Conectiv and Pepco, before the New Jersey Board of Public Utilities, BPU Docket No. EM101050308 (September and November 2001).

Direct Testimony on behalf of the Public Interest Advocacy Centre (and others) on service quality regulation in the context of price cap rate plans, before the Canadian Radio-Television and Telecommunications Commission, Docket No. CRTC 2001-37 (August 2001).

Alexander, Barbara, "Default Service: What Should be Done when the Experiment Goes Awry?" An Update to the April 2001 paper (October 2001).

Expert Witness Report, Sparks v. AT&T and Lucent Technologies, October 2001 [National class action lawsuit concerning the leasing of residential telephones]

Expert Witness Report, Brown v. Reliant Energy, November 2001 [Claim of negligence in death of elderly resident after disconnection of electric service]

Comments on behalf of the Pennsylvania Office of Consumer Advocate on consumer protection, disclosure, and education program Guidelines applicable to local exchange telephone competition, before the Pennsylvania PUC, January 2002.

Alexander, Barbara, "Default Service for Retail Electric Competition: Can Residential and Low-Income Customers be Protected When the Experiment Goes Awry?" (April 2002) Available at www.ncat.org/liheap/pubs/barbadefault3.doc

Comments on behalf of AARP before the California PUC on CARE (low income program) concerning Rapid Deployment, Rulemaking 01-08-027 (2001 and 2002).

Comments on behalf of Citizens Utility Board before the Illinois Commerce Commission on Proposed Rule to Allow the Use of Credit Scoring to Determine When a Deposit May be Required, ICC Docket No. 01-0644, June 24, 2002.

Comments on behalf of Consumer Groups before the Texas PUC on Rulemaking Proceeding to Amend Requirements for Provider of Last Resort Service, Docket No. 25360, June 28, 2002.

Direct Testimony on behalf of the New Jersey Division of Ratepayer Advocate before the Board of Public Utilities on Joint Petition of New Jersey-American Water Co. and Thames Water Aqua Holding for Approval of a Change in Control of New Jersey-American Water Co., Docket No. WM01120833, July 18, 2002.

Alexander, Barbara, Consumer Education Programs to Accompany the Move to Retail Electric Competition, prepared for the National Association of State Utility Consumer Advocates (NASUCA), July 2002. Available at www.nasuca.org

Direct Testimony on behalf of New Jersey Division of Ratepayer Advocate before the Board of Public Utilities on Petition of NUI Utilities d/b/a Elizabethtown Gas Co. for Approval of Increased Base Tariff Rates and Charges for Gas Service, Docket No. GR02040245, September 6, 2002.

Alexander, Barbara, An Analysis of Residential Energy Markets in Georgia, Massachusetts, Ohio, New York, and Texas, prepared for the National Energy Affordability and Accessibility Project, National Center for Appropriate Technology, September 2002. Available at www.ncat.org/neaap

Direct and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC on Philadelphia Gas Works' Gas Restructuring Filing, Docket No. M-00021612, September 2002 and November 2002.

Direct Testimony on behalf of Consumer Groups before the Texas PUC on Notice and Request of Mutual Energy CPL and Mutual Energy WTU for Approval of Changes in Ownership and Affiliation, Docket No. 25957, October 15, 2002.

Comments on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Advanced Notice of Proposed Rulemaking for Revision of Chapter 54 Pertaining to Electric Generation Supplier Licensing, Docket No. L-00020158, March 5, 2003.

Direct and Surrebuttal Testimony on behalf of the New Jersey Division of Ratepayer Advocate before the New Jersey BPU on Jersey Central Power & Light's base rate case proceeding (service quality and reliability of service), Docket No. ER02080506, ERT02080507, and ER02070417, December 2002 and February 2003.

Alexander, Barbara, "Managing Default Service To Provide Consumer Benefits In Restructured States: Avoiding Short-Term Price Volatility" (National Center for Appropriate Technology, June 2003). Available at: http://neaap.ncat.org/experts/defservintro.htm

Comments and Reply Comments on behalf of New Jersey AARP before the New Jersey Board of Public Utilities on Basic Generation Service, Docket No. EO03050394 (August and September 2003).

Direct and Surrebuttal Testimony on behalf of the New Jersey Division of the Ratepayer Advocate before the New Jersey BPU on rate case proceedings for New Jersey-American Water Co., Elizabethtown Water Co., and Mt. Holly Water Co. (service quality and low-income programs and policies), Dockets Nos. WR03070509-WR03070511 (December 2003).

Comments on behalf of the Texas Legal Services Center and other Consumer Groups before the Public Utility Commission of Texas, Proposed Revisions to Chapter 25, Substantive Rules Applicable to Electric Service Providers, Project No. 27084 (December 2003).

Alexander, Barbara, "Natural Gas Price Volatility: Regulatory Policies to Assure Affordable and Stable Gas Supply Prices for Residential Customers," (2004), available at http://www.ncat.org/liheap/news/Feb04/gaspricevol.htm

Alexander, Barbara, "Montana's Universal Systems Benefit Programs and Funding for Low Income Programs: Recommendations for Reform: A Report to AARP" (January 2004).

Comments and Reply Comments on behalf of the Colorado Office of Consumer Counsel before the Public Utilities Commission of Colorado, In the Matter of the Proposed Repeal and Reenactment of all Rules Regulating Gas Utilities (Docket No. 03R-520G) and Electric Utilities (Docket No. 03R-519E) (February and September 2004).

Direct, Rebuttal, and Supplemental Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of Duquesne Light Co. for Approval of Plan for Post-Transition Period POLR Services, Docket No. P-00032071 (February-April 2004).

Comments on behalf of AARP before the California PUC, Order Instituting Rulemaking on the Commission's Own Motion to Establish Consumer Rights and Consumer Protection Rules Applicable to All Telecommunications Utilities, R. 00-02-004 (March 2004).

Comments and Reply Comments on behalf of AARP before the Maine PUC, Inquiry into Standard Offer Supply Procurement for Residential and Small Commercial Customers, Docket No. 2004-147 (April 2004).

Comments on behalf of Wisconsin Citizens' Utility Board before the Wisconsin Public Service Commission's Gas Service Standards, Docket No. 1-AC-210 (July 2004).

Comments on behalf of the Colorado Office of Consumer Counsel before the Public Utilities Commission of Colorado, In the Matter of the Proposed Repeal and Reenactment of all Rules Regulating Telephone Utilities and Providers (Docket No. 03R-524T) (September 2004).

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Investigation if Metropolitan Edison Co., Pennsylvania Electric Co. and Pennsylvania Power Co. Reliability Performance, Docket no. I-00040102, [customer service and reliability performance] (June 2004).

Direct and Surrebuttal Testimony on behalf of the Vermont Department of Public Service before the Vermont Board of Public Utilities, Investigation into Successor Alternative Regulatory Plan for Verizon Vermont, Docket 6959 [Service Quality] (November 2004 and March 2005).

Alexander, Barbara, "Vermont Energy Programs for Low-Income Electric And Gas Customers: Filling The Gap" (November 2004), Prepared for AARP Vermont.

Direct and Surrebuttal Testimony on behalf of Wisconsin Citizens' Utility Board before the Wisconsin Public Service Commission, Application of Wisconsin Power and Light Co. for Authority to Increase Retail Electric, Natural Gas and Ripon Water Rates, Docket No. 6680-UR-114 [customer service, credit and collection programs and expenses, low income programs, fixed bill program] (April 2005).

Comments on behalf of the Maine Office of Public Advocate before the Maine Public Utilities Commission, Inquiry into Revisions to Chapter 81, Residential Utility Service Standards for Credit and Collection Programs, and Chapter 86, Disconnection and Deposit Regulations for Nonresidential Utility Service, Docket No. 2005-005 (April and May 2005).

Direct and Rebuttal Testimony on behalf of AARP Montana before the Montana Public Service Commission, Northwestern Energy Electric Cost Tracker, Docket No. D2004.6.90 [Default Service cost recovery policies and integration with low income programs] (December 2004 and July 2005).

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utilities Commission, Joint Application of PECO Energy Co. and Public Service Electric and Gas Co. for Approval of the Merger of Public Service Enterprise Group, Inc. with and into Exelon Corporation, Docket No. A-110550F0160 [customer service, reliability of service, low income programs] (June 2005).

Direct Testimony on behalf of Illinois Citizens' Utility Board, City of Chicago, and Community Action for Fair Utility Practice, before the Illinois Commerce Commission, Petition to Initiate Rulemaking with Notice and Comment for Approval of Certain Amendments to Illinois Administrative Code Part 280 Concerning Deposit Requests and Deposit Refunds by Utilities, Docket No. 05-0237 (June 2005).

Direct Testimony on behalf of The Utility Reform Network (TURN) before the California Public Utilities Commission, Order Instituting Rulemaking on the Commission's Own Motion to Establish Consumer Rights and Consumer Protection Rules Applicable to All Telecommunications Utilities, Docket R-00-02-004 (August 2005).

Alexander, Barbara, Red Flags for Consumer Protection Policies Governing Essential Electric and Gas Utility Services: How to Avoid Adverse Impacts on Low-Income Consumers, prepared under contract with Oak Ridge National Laboratory Energy Division (October 2005).

Comments on behalf of Texas Office of Public Utility Counsel, Texas Legal Services Center, Texas Ratepayers' Organization to Save Energy and AARP Texas, before the Texas PUC, Evaluation of Default Service for Residential Customers and Review of Rules Relating to the Price to Beat and Provider of Last Resort, Project No. 31416 (March 2006) [Default service policies]

Rebuttal and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, In the Matter of the Petition of the Pennsylvania Power Co. for Approval of an Interim Provider of Last Resort Supply Plan, Docket No. P-00052188 [Default Service policies] (December 2005 and January 2006).

Direct and Rebuttal Testimony on behalf of the Maine Office of Public Advocate before the Maine PUC, Investigation into Verizon Maine's Alternative Form of Regulation, Docket No. 2005-155 [Retail Service Quality] (January and May 2006).

Alexander, Barbara, "State Developments Changing for Default/Standard Retail Electric Service," Natural Gas & Electricity, September 2006.

Direct and Rebuttal Testimony on behalf of the Government and Consumer Parties (CUB, Attorney General of Illinois) before the Illinois Commerce Commission, Petition to Initiate Rulemaking with Notice and Comment for Approval of Certain Amendments to Illinois Administrative Code Part 280, Docket No. 06-0379 (May and September 2006). [Consumer Protection rules]

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, In Re Application of UGI Utilities, Inc., UGI Utilities Newco, Inc., and Southern Union Co., Docket Nos. A-120011F2000, A-125146, A-125146F5000 (June 2006). [Customer Service, Service Quality, and Universal Services]

Direct and Rebuttal Testimony on behalf of the Maryland Office of People's Counsel before the Maryland PSC, In The Competitive Selection of Electricity Supplier/Standard Offer or Default Service for Investor-Owned Utility Small Commercial Customers and, Delmarva Power and Light and Potomac Electric Power Residential Customers, Case No. 9064 (August and September 2006). [Default Service policies]

Direct and Rebuttal Testimony on behalf of the Maryland Office of People's Counsel before the Maryland PSC, In The Matter of the Optimal Structure of the Electric Industry of Maryland, Case No. 9063 (October and November 2006). [Default service policies]

Comments on behalf of AARP Maine before the Maine PUC on various dockets and notices concerning the implementation of Standard Offer Service for residential customers, Docket Nos. 2006-314, 2006-557, and 2006-411 (July-November 2006). [Default service policies]

Comments on behalf of AARP District of Columbia before the District of Columbia PSC, In the Matter of the Development and Designation of Standard Offer Service in the District of Columbia, Case No. 1017 (2006). [Default service policies]

Comments on behalf of AARP New Jersey before the New Jersey Board of Public Utilities, In the Matter of the Establishment of a Universal Service Fund Pursuant to Section 12 of the Electric Discount and Energy Competition Act of 1999, Docket No. EX00020091 (August 2006) [Recommendations for USF program changes]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Joint Application of Equitable Resources, Inc. and the People's Natural Gas Co., d/b/a Dominion Peoples, for Approval of the Transfer of All Stock Rights of the Latter to the Former and for the Approval of the Transfer of All Stock of Hope Gas, Inc., d/b/a/ Dominion Hope to Equitable Resources, Inc., Docket No. A-122250F5000 (September and October 2006). [Customer Service, Service Quality, and Universal Service issues)

Direct Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Pennsylvania PUC v. Natural Fuel Gas Distribution Corp., Docket No. R-00061493 (September 2006) [Supplier Purchase of Receivables Program]

Direct Testimony on behalf of AARP Montana before the Montana Public Service Commission, Joint Application of NorthWestern Energy and BBI to purchase NorthWestern Energy, Docket No. 2006.6.82 [December 2006] [Conditions for approval of merger; low income and customer service programs]

Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition by PPL Electric Utilities Corp. for Approval of a Competitive Bridge Plan, Docket No. P-00062227 (December 2006) [Default Service policies]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Application of Duquesne Light Company for a Certificate of Public Convenience Under Section 1102(a)(3) of the Public Utility Code Approving the Acquisition of Duquesne Light Holding, Inc. by Merger, Docket A-110150F0035 (December 2006 and January 2007) [Conditions for approval of merger; low income and customer service programs]

Testimony before the House Least Cost Power Procurement Committee, Illinois General Assembly, on HB 1510, on behalf of AARP [March 22, 2007]

Rebuttal and Surrebuttal Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of Duquesne Light Co. for Approval of Default Service Plan for January 1, 2008 to December 31, 2010, Docket No. P-00072247 [April 2007] [Default Service policies]

Comments and Reply Comments on behalf of AARP New Jersey before the Board of Public Utilities BGS Working Group concerning BGS procurement policies and proposed demand response program, (March-May 2007) [Default Service policies]

Comments on behalf of AARP New Jersey to the New Jersey BPU Staff on draft proposed USF regulations (May 2007) [Low income program design and implementation]

Alexander, Barbara, Smart Meters, Real Time Pricing, And Demand Response Programs: Implications For Low Income Electric Customers (May 2007)

Direct and Surrebuttal Testimony on behalf of Maine Office of Public Advocate before the Maine Public Utilities Commission, Re: Joint Application for Approvals Related to Verizon's Transfer of Property and Customer Relations to Company to be Merged with and into FairPoint Communications, Inc., Docket 2007-67 (July and September 2007) [Service Quality and Customer Service Conditions for Merger]

Testimony on behalf of AARP Montana before the Montana Public Service Commission, In the Matter of Montana Dakota Utilities Co., Public Service Commission Investigation and Direction on Electric and Natural Gas Universal System Benefits, Docket No. D2006.1.2 (July 30, 2007) [Design and funding for low income programs]

Direct and Surrebuttal Testimony on behalf of Maine Office of Public Advocate before the Maine Public Utilities Commission, Central Maine Power Co. Chapter 120 Information (Post ARP 2000) Transmission and Distribution Utility Revenue Requirement and Rate Design And Request for Alternative Rate Plan, Docket No. 2007-215 (August 30, 2007 and February 2008) [AMI deployment]

Direct and Reply Testimony on behalf of AARP Maryland before the Maryland Public Service Commission, In the Matter of the Commission's Investigation of Investor-Owned Electric Companies' Standard Offer Service for Residential and Small Commercial Customers in Maryland, Case No. 9117, Phase I and II (September 2007) [Default Service policies]

Testimony on behalf of AARP Maryland before the Maryland Public Service Commission, In the Matter of the Commission's Investigation of Advanced Metering Technical Standards, Demand Side Management Competitive Neutrality, and Recovery of Costs of Advanced Meters and Demand Side Management Programs, Case 9111 (November 2, 2007) [Default Service policies; AMI deployment]

Comments on behalf of AARP District of Columbia before the D.C. Public Service Commission, In the Matter of The Application Of Potomac Electric Power Co. For Authorization to Establish A Demand Side Management Surcharge and an Advanced Metering Infrastructure Surcharge And to Establish a DSM Collaborative and an AMI Advisory Group, Formal Case No. 1056 (August 10, September 10, November 13, 2007, April 2008) [Default Service policies; AMI deployment]

Comments on behalf of AARP District of Columbia before the D. C. Public Service Commission, Re: The Petition of the Office of the People's Counsel for the District of Columbia for an Investigation into the Structure of the Procurement Process for Standard Offer Service, Formal Case No. 1047 (November 2007) [Default Service policies]

Direct, Rebuttal and Surrebuttal testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of the West Penn Power Co. d/b/a Allegheny Power for Approval of its Retail Electric Default Service Program and Competitive Procurement Plan for Service at the Conclusion of the Restructuring Transition Period, Docket No. P-00072342 (February-March 2008) {Default service procurement policies]

Testimony on behalf of AARP before the Virginia Commission on Electric Utility Restructuring in the General Assembly on HB 1523 and SB 311 (January 2007) [Electric Utility Integrated Resource Planning]

Testimony on behalf of AARP before the Ohio House of Representatives on SB 221 (February 2008) [Default Service procurement policies for post-transition period]

Alexander, Barbara, The Federalization Of Energy Prices: How Policies Adopted By The Federal Energy Regulatory Commission Impact Electricity Prices For Residential Customers: A Plain Language Primer (March 2008)

Comments on behalf of AARP before the New Jersey Board of Public Utilities, In the Matter of the Universal Service Fund, Docket Nos. EO07110888 and EX00020091 (April 2008) [low income program; automatic enrollment]

Direct and Surrebuttal testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, PUC v. Columbia Gas of Pennsylvania, Inc., Docket No. R-2008-2011621 (May and June 2008) [rate case: retail gas competition and Purchase of Receivables program]

Direct Testimony on behalf of Public Counsel and the Energy Project before the Washington Utilities and Transportation Commission, WUTC v. Puget Sound Energy, Inc., Docket Nos. UE-072300 and UG-072301 (May 2008) [revisions to Service Quality Index; storm cost recovery; fixed customer charge; low income program funding]

Direct Testimony on behalf of Public Counsel and the Energy Project before the Washington Utilities and Transportation Commission, In the matter of the Application of Puget Holdings LLC and Puget Sound Energy for an Order Authorizing Transaction, Docket No. U-072375 (June 2008) [Conditions for Sale: customer service; low income programs]

Direct Testimony on behalf of Local 223, UWUA before the Michigan Public Service Commission, In the Matter of the application of Detroit Edison Co. for authority to increase its rates, Case No. U-15244 (July 2008) [Customer Service standards; Advanced Metering proposal]

Reply Testimony on behalf of AARP before the Mississippi Public Service Commission, Proceeding to Review Statewide Energy Generation Needs, Docket No. 2008-AD-158 (August 2008) [Integrated Resource Planning]

Comments on behalf of Local 223, UWUA before the Michigan Public Service Commission, In the matter, on the Commission's own Motion, to investigate the development of minimum functionality standards and criteria for advanced metering infrastructure (AMI), Case No. U-15620 {August 2008) [Advanced Metering policies and standards]

Direct and Rebuttal Testimony on behalf of Illinois Citizens Utility Board and AARP before the Illinois Commerce Commission, Citizens Utility Board, Citizens Action/Illinois and AARP vs. Illinois Energy Savings Corp. d/b/a U.S. Energy Savings Corp., Complaint pursuant to 220 ILCS 5/19-110 or 19-115, Docket 08-0175. (August and November 2008) [Investigation of marketing activities and licensing conditions of an alternative gas supplier]

Direct Testimony on behalf of Ohio Partners for Affordable Energy before the Public Utilities Commission of Ohio on filings by electric utilities pursuant to SB 221: Market Rate Option plan filed by FirstEnergy (Case No. 08-936-EL-SSO), Electric Security Plan filed by FirstEnergy (Case No. 08-935-EL-SSO), and Electric Security Plan filed by AEP Ohio (Case No.08-917-EL-SSO & Case No. 08-918-EL-SSO) (September-November 2008) [Default Service procurement policies; energy efficiency and smart meter proposals]

Reply, Surrebuttal, and Supplemental Testimony on behalf of Maryland Office of People's Counsel before the Maryland Public Service Commission, In the Matter of Appropriate Forms of Regulating Telephone Companies, Case No. 9133 (August and October 2008; July 2009) [service quality performance conditions for alternative rate regulation of Verizon-MD]

Comments on behalf of AARP before the Idaho Public Utilities Commission, In the Matter of the Application Of Idaho Power Co. for a Certificate of Public Convenience and Necessity to Install Advanced Metering Infrastructure (“AMI”) Technology Throughout its Service Territory, Case No. IPC-E-08-16 (December 2008) [Smart Meter costs and benefits]

Direct and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Joint Application for the Authority and Necessary Certificates of Public Convenience to Transfer all of the Issued and Outstanding Shares of Capital Stock of the Peoples Natural Gas Co. d/b/a Dominion Peoples, Currently owned by Dominion Resources, Inc. to Peoples Hope Gas Companies LLC, an Indirect Subsidiary of Babcock & Brown Infrastructure Fund North America LP, and to Approve the Resulting Change in Control of the Peoples Natural Gas Co. d/b/a Dominion Peoples, Docket No. A-2008-2063737 (December 2008 and July 2009) [Proposed conditions relating to Service Quality and Universal Service programs]

Rebuttal Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of PPL Electric Utilities Corp. for Approval of a Default Service Program and Procurement Plan, Docket No. P-2008-2060309 (January 2009) [Retail Market Programs]

Rebuttal Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of PECO Energy Co. for Approval of its Default Service Program and Rate Mitigation Plan, Docket No. P-2008-2062739 (January 2009) [Retail Market Programs]

Comments on behalf of AARP before the Mississippi Public Service Commission, In Re: Order Establishing Docket to Consider standards established by the Energy Independence and Security Act of 2007, Docket No. 2008-ad-477 (February 2009) [PURPA Policies; Integrated Resource Planning; Time-Based Pricing]

Co-Author of Comments on behalf of The Utility Reform Network (TURN) before the California Public Utilities Commission, Order Instituting Rulemaking to consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission’s own Motion to Actively Guide Policy in California’s Development of a Smart Grid System, Docket R. 08-12-009 (2009 and 2010) [Smart Grid policies]

Direct and Rebuttal Testimony on behalf of the Attorney General of the Commonwealth of Massachusetts before the Department of Public Utilities, Investigation by the Department of Public Utilities on its Own Motion into the Preparation and Response on Fitchburg Gas & Electric Co. d/b/a Unitil to the December 12, 2008 Winter Storm, D.P.U. 09-01-A (March and April 2009) [Investigation of storm restoration practices]

Testimony on behalf of UWUA Local 132 before the California Public Utilities Commission, Southern California Gas Co. Advanced Metering Infrastructure, Docket No. A.08-09-023 (April 2009) [Advanced metering deployment]

Direct and Rebuttal Testimony on behalf of the Delaware Public Service Commission Staff before the Delaware Public Service Commission, In the Matter of the Investigation into the Business and Marketing Practices of Horizon Power and Light, LLC, Docket No. 355-08 (April and June 2009) [Investigation into marketing and contract practices of licensed electricity supplier]

Testimony on behalf of AARP before the District of Columbia Public Service Commission, In the Matter of the Application of Potomac Electric Power Co. for Authority to Establish a Demand Side Management Surcharge and an Advanced Metering Infrastructure Surcharge and to Establish a DSM Collaborative and an AMI Advisory Group, Formal Case No. 1056 (June 2009) [Advanced Metering proposal]

Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of Metropolitan Edison Co. and Pennsylvania Electric Co. for Approval of its Default Service Program, Docket Nos. P-2009-2093053 and P-2009-2093054 (June 2009) [Default Service policies]

Alexander, Barbara, with the Assistance of Mitchell, Cynthia and Court, Gill, <u>Renewable Energy Mandates:</u>

An Analysis Of Promises Made And Implications For Low Income Customers, Prepared under contract with Oak Ridge National Laboratory UT-Battelle, LLC, Purchase Order No. 4000091296 (June 2009).

Direct Testimony on behalf of the People of the State of Illinois and AARP before the Illinois Commerce Commission, Petition of Commonwealth Edison Co. to Approve and Advanced Metering Infrastructure Pilot, Docket No. 09-0263 (July 2009). [Advanced Metering pilot design and scope]

Direct Testimony on behalf of the Attorney General of the Commonwealth of Massachusetts before the Massachusetts Department of Public Utilities, Massachusetts Electric Company & Nantucket Electric Company d/b/a National Grid, Smart Grid Pilot Proposal, Docket No. 09-32 (August 2009) [Advanced Metering pilot design]

Direct Testimony on behalf of the Attorney General of the Commonwealth of Massachusetts before the Massachusetts Department of Public Utilities, Fitchburg Gas and Electric Co., d/b/a/ Unitil, Smart Grid Pilot Proposal, Docket No. 09-31 (August 2009) [Advanced Metering pilot design]

Direct Testimony on behalf of AARP before the Maryland Public Service Commission, In the Matter of Potomac Electric Power Company and Delmarva Power and Light Company Request for the Deployment of Advanced Meter Infrastructure, Case No. 9207 (October 2009) [Advanced Metering deployment costs and benefits; dynamic pricing proposals]

Direct Testimony on behalf of AARP before the Maryland Public Service Commission, Application of Baltimore Gas and Electric Company for Authorization to Deploy A Smart Grid Initiative and to Establish a Tracker Mechanism For the Recovery of Costs, Case No. 9208 (October 2009) [Advanced Metering deployment costs and benefits; dynamic pricing proposals]

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania PUC, Petition of PPL Electric Utilities Corporation Requesting Approval of a Voluntary Purchase of Accounts Receivables Program and Merchant Function Charge, Docket No.P-2009-2129502 (October 2009) [Retail competition policies: purchase of receivables programs]

Direct and Cross Reply Testimony on behalf of The Energy Project (Washington) before the Washington Utilities and Transportation Commission, In the Matter of the Petition of Avista Corporation, D/B/A Avista Utilities, For an Order Authorizing Implementation of a Natural Gas Decoupling Mechanism and to Record Accounting Entries Associated With the Mechanism. Docket No. UG-060518 (*consolidated)* (August and September 2009) [Natural gas decoupling proposal; impact on low income customers]

Direct Testimony on behalf of the Attorney General of the Commonwealth of Massachusetts before the Massachusetts Department of Public Utilities, NSTAR Electric Co. Smart Grid Pilot Proposal, Docket No. 09-33 (November 2009) [Advanced Metering pilot design]

Direct Testimony on behalf of Public Counsel Section, Attorney General of Washington, before the Washington Utilities and Transportation Commission, In the Matter of the Joint Application of Verizon Communications Inc. and Frontier Communications Corporation For an Order Declining to Assert Jurisdiction Over, or, in the Alternative, Approving the Indirect Transfer of Control of Verizon Northwest Inc., Docket No. UT-090842 (November 2009) [Service Quality Conditions]

Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of Duquesne Light Company for Approval of Default Service Plan for the Period January 1, 2011 through May 31, 201, Docket No. P-2009-2135500 (January 2010) [Retail Competition policies]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of The Citizens Utility Board (CUB), The City Of Chicago, and The People Of The State Of Illinois (Attorney General), before the Illinois Commerce Commission, Revision of 83 Ill. Adm. Code 280, Docket No. 06-0703 (January 2010, October 2010, February 2011) [Consumer Protection policies governing electric, natural gas, and water utility service]

Direct and Surrebuttal Testimony on behalf of Maine Office of Consumer Advocate, before the Maine PUC, Central Maine Power Co., Petition Requesting That the Commission Issue an Order to Modify CMP's Service Quality Indicators by Eliminating Or Changing the Current MPUC Complaint Ratio and to Waive Penalties, Docket No. 2009-217 (February and July 2010) [Evaluation of Request for Waiver of Penalty]

Direct, Rebuttal and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of UGI Utilities, Inc.—Gas Division for Approval to Voluntarily Implement a Purchase of Receivables Program and Merchant Function Charge And Of a Potential Affiliated Interest Agreement Between UGI Utilities, Inc.—Gas Division And Affiliated Entities, Docket No. P-2009-2145498 (April and May 2010) [Purchase of Receivables Program Conditions]

Direct Testimony on behalf of the Massachusetts Attorney General, before the Massachusetts Department of Public Utilities, Western Massachusetts Electric Co. Smart Grid Pilot Proposal, Docket D.P.U. 09-34 (May 2010) [Smart Meter and Pricing Pilot evaluation and conditions]

Direct, Rebuttal and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of PECO Energy Company for Approval of its Natural Gas Supplier Purchase of Receivables Program, Docket No. P-2009-2143588 (March, April, and May 2010) [Purchase of Receivables Program Conditions]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of Columbia Gas of Pennsylvania, Inc. for Approval to Voluntarily Implement a Modified Purchase of Receivables Program Pursuant to SEARCH Filing Requirement and Interim Purchase of Receivables Guidelines, Docket No. P-2009-2099333 (February and March 2010) [Purchase of Receivables Program Conditions]

Direct, Rebuttal and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of PECO Energy Company for Approval of its Revised Electric Purchase of Receivables Program, Docket No. P-2009-2143607 (February and March 2010) [Purchase of Receivables Program Conditions]

Alexander, Barbara, "Dynamic Pricing? Not So Fast. A Residential Consumer Perspective," The Electricity Journal (July 2010) (http://dx.doi.org/10.1016/j.tej.2010.05.014) [Opposition to Mandatory Time-Based Pricing for residential customers]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Joint Application of West Penn Power Company doing business as Allegheny Power Company, Trans-Allegheny Interstate Line Company and FirstEnergy Corporation for a Certificate of Public Convenience Under Section 1102(A)(3) of the Public Utility Code Approving a Change of Control of West Penn Power Company and Trans-Allegheny Interstate Line Company, Docket Nos.A-2010-2176520 and A-2010-2176732 (August, September and October 2010) [Service Quality, Customer Service, and Universal Service Program Conditions]

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate, before the Pennsylvania PUC, Petition of T.W. Phillips Gas and Oil Co. for Approval of Purchase of Receivables Program, Docket No. P-2009-2099192 (August 2010) [Purchase of Receivables Program Conditions]

Direct Testimony on behalf of AARP, before the Maryland PSC, Application of Baltimore Gas and Electric Company for Authorization to Deploy a Smart Grid Initiative and to Establish a Tracker Mechanism and For the Recovery of Costs, [Petition for Rehearing] Case No. 9208 (August 2010) [Smart Meter Costs and Benefits; Consumer Protections]

Alexander, Barbara, Who Owns And Can Monetize The Greenhouse Gas Emission Reductions That Result From the DOE Low-Income Weatherization Assistance Program? Prepared under contract with Oak Ridge National Laboratory UT-Battelle, LLC, Purchase Order No. 4000091296 (September 2010)

Direct Testimony on behalf of Consumer Advocate Division before the Public Service Commission of West Virginia, Monongahela Power Co. and the Potomac Edison Co., both doing business as Allegheny Power Co., and FirstEnergy Corp. and Trans-Allegheny Interstate Line, Case No. 10-0713-E-PC (October 14, 2010) [Merger: Service Quality, Customer Service, and Universal Service Program Conditions]

Rebuttal Testimony on behalf of the Office of People's Counsel, before the Maryland Public Service Commission, In the Matter of the Merger of FirstEnergy Corp. and Allegheny Energy, Case No. 9233 (October 22, 2010) [Default Service Policies]

Direct Testimony on behalf of Consumer Advocate Division before the Public Service Commission of West Virginia, Appalachian Power co. and Wheeling Power Co., Case No. 10-0699-E-42T (November 10, 2010) [Base Rate Case: reforms to ameliorate rate impacts on low income customers; remote disconnection tariff proposal]

Direct and Rebuttal Testimony on behalf of AARP, before the Illinois Commerce Commission, Commonwealth Edison Co. Petition for Approval of an Alternative Rate Regulation Plan, Docket No. 10-0257 (November and December 2010) [Analysis of consumer protections and risks in alternative rate plan]

Rebuttal Testimony on behalf of the Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Pennsylvania PUC v. Peoples Natural Gas Co., LLC 2010 Base Rate Proceeding, Docket No. R-20102201702 (February 23, 2011) [Purchase of Receivables program]

Expert Report of Barbara Alexander on Behalf of Plaintiffs, Benjamin Berger, individually and on behalf of all other similarly situated and the general public, vs. The Home Depot USA, Inc, U.S. District Court, Central District of California, Western Division, Case SACV 10-678 SJO (PLAX)**,** March 1, 2011 (Negative Option Sales Method for "tool rental protection")

Direct Testimony on behalf of the Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Joint Application for all the Authority and the Necessary Certificates of Public Convenience to Transfer All of the Issued and Outstanding Shares of Capital Stock of T.W. Phillips Gas and Oil Co., currently owned by TWP, Inc., to LDC Holdings II LLC, an indirect Subsidiary of SteelRiver Infrastructure Fund North America LP, and to Approve the Resulting Change in Control of T.W. Phillips Gas and Oil Co., Docket No. A-2010-2210326 (March 31, 2011) [Service Quality, Customer Service, and Universal Service Program Conditions]

Comments on behalf of AARP before the Public Service Commission of the District of Columbia, Pepco's Proposed AMI Consumer Education Plan, Formal Case No. 1056 (March 30, 2011)

Comments on behalf of AARP before the Public Service Commission of the District of Columbia, Notice of Proposed Rulemaking, Reliability of Service, Formal Case No. 766, 982, 991, and 1002 (April 11, 2011) [Restoration of Service for Major Outage Events]

Direct and Rebuttal testimony on behalf of the Attorney General of Arkansas before the Arkansas Public Service Commission, In The Matter Of The Application Of Oklahoma Gas And Electric Company For Approval Of The Deployment Of Smart Grid Technology In Arkansas And Authorization Of A Recovery Rider And Regulatory Asset, Docket No. 10-109-U (May and June 2011) (Smart Grid costs and benefits; cost recovery; conditions)

Alexander, Barbara, "Retail Electric Competition: Default Service Policies and Residential Customer Migration," Report to AARP (May 2011).

Direct Testimony on behalf of AARP before the Maryland Public Service Commission, In the Matter of Potomac Electric Power Co and Delmarva Power and Light Co. Request for the Deployment of Advanced Meter Infrastructure, Case No. 9207 (June 16, 2011) (Analysis of amended AMI business case; costs and benefits; conditions)

Direct and Reply Comments on behalf of Citizens Utility Board of Oregon before the Public Utility Commission of Oregon, Docket No. UM 1415 (September and October 2011) (Rate Design; time-varying rates)

Alexander Barbara, "The Status of AMI and Dynamic Pricing Programs In Georgia, Alabama, Arkansas, Florida, Louisiana, And Mississippi," Report for AARP (October 2011).

Direct Testimony on behalf of AARP before the Oklahoma Corporation Commission, In The Matter Of The Application of Oklahoma Gas And Electric Company, For An Order Of The Commission Authorizing Applicant To Modify Its Rates, Charges, And Tariffs For Retail Electric Service In Oklahoma, Cause No. PUD 201100087 (November 9, 2011 and November 16, 2011) (revenue requirement and rate design)

Comments on behalf of AARP before the Maryland Public Service Commission, Proposed Revisions to Reliability and Customer Service Regulations, RM 43 (November 16, 2011) (reliability performance standards and customer call center standards)

Direct Testimony on behalf of AARP before the Public Service Commission of the District of Columbia, In the Matter of The Application for Potomac Electric Power Co. for Authority to Increase Existing Retail Rates and Charges for Electric Distribution Service, Formal Case No. 1087 (December 14, 2011) (AMI cost recovery, Reliability Infrastructure Mechanism surcharge, customer care costs)

Direct Testimony on behalf of AARP and the People of the State of Illinois before the Illinois Commerce Commission, Commonwealth Edison Company, Approval of Multi-Year Performance Metrics Pursuant to Section 16-108(f) and (f-5) of the Public Utilities Act, Docket No. 11-0772 (January 30, 2012) (Performance Metrics relating to AMI deployment; remote disconnection of service)

Direct, Rebuttal, and Surrebuttal Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Joint Petition of Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, West Penn Power Company, Approval of Default Service Programs, Docket Nos. P-2011-2273650, et al. (February, March and April 2012) (Retail Opt-in Auction, Customer Referral Programs)

Direct Testimony on behalf of the Massachusetts Office of the Attorney General before the Massachusetts Department of Public Utilities, Western Massachusetts Electric Co. 2011 Winter Storm Investigation, Docket No. D.P.U. 11-119-C (March 9, 2012) (Analysis of communications with customers and state and local officials in storm restoration)

Direct Testimony on behalf of AARP and the People of the State of Illinois before the Illinois Commerce Commission, Ameren Utilities, Approval of Multi-Year Performance Metrics Pursuant to Section 16-108(f) and (f-5) of the Public Utilities Act, Docket No. 12-0089 (March 19, 2012) (Performance Metrics for AMI Deployment; remote disconnection of service)

Direct and Rebuttal Testimony on behalf of the Massachusetts Office of the Attorney General before the Massachusetts Department of Public Utilities, National Grid 2012 Smart Grid Pilot Proposal, Docket No. D.P.U. 11-129 (April and May 2012) [Analysis of proposed smart meter and dynamic pricing pilot proposal]

Comments on behalf of AARP before the Maryland Public Service Commission, Dynamic Pricing Implementation Working Group Report, Case Nos. 9207 and 9208 (May 14, 2012) [Design and implementation of Peak Time Rebate programs for Pepco and BGE]

Comments on behalf of AARP before the Public Service Commission of the District of Columbia, Notice of Proposed Rulemaking, Major Event Outage Restoration Plans, Formal Case No. 766, 982, 991, and 1002 (May 29, 2012) [Regulatory reporting requirements for major event outage restoration plans]

Direct Testimony on behalf of The Utility Reform Network (TURN) before the Public Utilities Commission of the State of California, In the Matter of the Application of Pacific Gas and Electric Company Smart Grid Pilot Deployment Project, Application 11-11-017 (May 16, 2012) [Analysis of proposed customer education pilot]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of PECO Energy Co. for Approval of its Default Service Program, Docket No. P-2012-2283641 (April and May 2012) [Retail Opt-In Auction and Customer Referral Programs]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Equitable Gas Co. Request for Approval of Tariffs, Docket Nos. R-2012-2304727, R-2012-2304731, and R-2012-2304735 (July 25, 2012) [Purchase of Receivables Program]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of PPL Electric Utilities, Inc. for Approval of a Default Service Program and Procurement Plan for the Period June 1, 2013 through May 31, 2015, Docket No. P-2012-2302074 (July and August 2012) [Retail Opt-In Auction and Customer Referral Programs]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of Duquesne Light Co. for Approval of Default Service Plan for the Period June 1, 2013 through May 31, 2015, Docket No. P-2012-2301664 (July, August, and September 2012) [Retail Opt-In Auction and Customer Referral Programs]

Affidavit and Expert Report on behalf of Plaintiffs, Bellermann v. Fitchburg Gas & Electric Co., Commonwealth of Massachusetts, Civil Action No. 09-00023 (August 23, 2012) [Analysis of utility storm restoration response]

Direct Testimony on behalf of the Public Utility Law Project (New York) before the New York State Public Service Commission, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation For Electric and Gas Service, Case No. 12-E-0201 and 12-G-0202 (August 31, 2012) [Rate case: low income programs, credit and collection policies, service quality]

Comments on behalf of AARP before the Maryland Public Service Commission, In the Matter of the Electric Service Interruptions in the State of Maryland due to the June 29, 2012 Derecho Storm, Case No. 9298 (September 10, 2012) [Analysis of customer communications in major storm restoration for Pepco and BGE]

Comments on behalf of the Ohio Partners for Affordable Energy before the Ohio Public Utility Commission, In the Matter of the Commission's Review of its Rules for Competitive Retail Natural gas Service, Case No. 12-925-GA-ORD, and In the Matter of the Commission's Review of its Rules for Competitive Retail Electric Service, Case No. 12-1924-EL-ORD (January 2013) [retail market regulations, consumer protections, licensing, disclosures]

Direct and Cross Rebuttal Testimony on behalf of Texas Legal Services Center and Texas Ratepayers' Organization to Save Energy before the Public Utility Commission of Texas, Petition by Homeowners United for Rate Fairness to Review Austin Rate Ordinance No. 20120607-055, PUC Docket No. 40627 (February 2013) [low income programs]

Testimony on behalf of AARP before the Connecticut Senate Finance Revenue and Bonding Committee in opposition to proposal for auction of electric customers to retail suppliers, SB 843 (March 4, 2013)

Comments and Reply Comments on behalf of AARP before the Ohio Public Utility Commission, In the Matter of the Commission's Investigation of the Retail Electric Service Market, Case No. 12-3151-EL-COI (March and April 2013) [retail market reforms, default service, and consumer protections]

Direct Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of UGI Utilities, Inc.—Electric Division for Approval of a Default Service Plan and Retail Market

Enhancement Programs for 2014-2017, Docket Nos. P-2013-235703 (June 2013) [Retail Market Enhancement programs; referral program]

Direct Testimony on behalf of the Government of the District of Columbia before the District of Columbia Public Service Commission, In the Matter of the Application of the Potomac Electric Power Co. for Authority to Increase Existing Retail Rates and Charges for Electric Distribution Service, Formal Case No. 1103 (August 2013) [low income discount program]

Comments and Reply Comments on behalf of AARP before the Arizona Corporation Commission, Generic, In The Matter of The Commission's Inquiry Into Retail Electric Competition, Docket No. E-00000W-13-0135 (July and August 2013) [implementation of retail electric competition]

Comments on behalf of AARP before the Delaware Public Service Commission, Rulemaking for Retail Electric Competition, PSC Regulation Docket No. 49 (September 2013) [consumer protection regulations for retail electric competition]

Direct Testimony on behalf of AARP before the New Jersey Board of Public Service, In the Matter of the Petition of Public Service Electric and Gas Co. for Approval of the Energy Strong Program, Docket No. EO13020155 and GO13020156 (October 2013) [reliability programs; cost recovery mechanism]

Direct Testimony on behalf of Canadian Office and Professional Employee's Union, Local 378, before the British Columbia Utilities Commission, Re: Fortis BC Energy, Inc. Application for Approval of a Multi-Year Performance Based Ratemaking Plan for 2014 through 2018, Project No. 3698719 (December 2013) [Service Quality Index]

Direct Testimony on behalf of Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of PPL Electric Corp. for Approval of a New Pilot Time-of-Use Program, Docket No. P-2013-2389572 (January 2014) [Design of pilot TOU program; bid out to competitive energy supplier]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of FirstEnergy Companies (Met-Ed, Penelec, Penn Power, and West Penn) for Approval of a Default Service Programs, Docket Nos. P-2013-2391368, et al. (January-March 2014) [Retail market enhancement programs, referral program]

Direct, Rebuttal, and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of PPL Electric Utilities for Approval of a Default Service Program and Procurement Plan for June 2013-May 2015, Docket No. P-2013-2389572 (January-May 2014) [Retail market enhancement programs, referral program]

Direct and Rebuttal Testimony on behalf of AARP before the Corporation Commission of Oklahoma, Application of Public Service Company of Oklahoma for Adjustment to Rates and Charges and Terms and Conditions of Service for Electric Service in the State of Oklahoma, Cause No. PUD-201300217 (March and May 2014) [AMI cost/benefit analysis and cost recovery; riders and surcharges; customer charge; low income program]

Direct and Reply Testimony on behalf of the District of Columbia Government through its Department of Environment before the Public Service Commission of the District of Columbia, In the Matter into the Investigation into the Issues Regarding the Implementation of Dynamic Pricing in the District of Columbia, Formal Case No. 1114 (April and May 2014) [Dynamic pricing policies and programs for residential customers]

Comments on behalf of AARP before the Delaware Public Service Commission, Rulemaking for Retail Electric Competition, PSC Regulation Docket No. 49 (Revised) (June 2, 2014) [consumer protection regulations for retail electric competition]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of Duquesne Light Company for Approval of Default Service Plan For the Period June 1, 2015 through May 31, 2017, Docket No. P-2014-2418242 (July and August 2014) [retail market enhancement programs, referral program]

Direct and Rebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Petition of PECO Energy Co. for Approval of its Default Service Plan for the Period June 1, 2015 through May 31, 2017, Docket No. P-2014-2409362 (June 2014) [retail market enhancement programs, referral program]

Alexander, Barbara, "An Analysis of State Renewable Energy and Distributed Generation Mandates on Low Income Consumers: Recommendations for Reform" (Oak Ridge National Laboratory, DOE, September 2014)

Direct and Surrebuttal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Pennsylvania PUC v. West Penn Power, Metropolitan Edison, Penn Power, and Penelec, Dockets Nos. R-2014-2428742-24287245 (November 2014 and January 2015) [FirstEnergy rate cases: customer service; reliability of service; estimated billing protocols; proposed Storm Damage Expense Rider; tariff revisions]

Comments on behalf of Delaware Division of the Public Advocate before the Delaware Public Service Commission, Rulemaking for Retail Electric Competition, PSC Regulation Docket No. 49 (Revised) (January 2015) [consumer protection regulations for retail electric competition]

Reply Testimony of Barbara Alexander before the Public Service Commission of Maryland, In the Matter of the Investigation into the Marketing, Advertising and Trade Practices of Major Energy Electric Services, LLC and Major Energy Services, LLC, Case No. 9346(b) (March 2015) [unfair and deceptive practices; compliance with MD statutes and regulations for electric generation supplier]

Reply Testimony of Barbara Alexander before the Public Service Commission of Maryland, In the Matter of the Investigation into the Marketing, Advertising and Trade Practices of XOOM Energy Maryland LLC, Case No. 9346(a) (March 2015) [unfair and deceptive practices; compliance with MD statutes and regulations for electric generation supplier]

Direct, Surrebuttal and Supplemental Surrebutal Testimony on behalf of the Pennsylvania Office of Consumer Advocate before the Pennsylvania Public Utility Commission, Commonwealth of Pennsylvania by Attorney General Kathleen Kate, through the Bureau of Consumer Protection and Tanya McCloskey, Acting Consumer Advocate v. Respond Power, Docket No. C-2014-2427659 (May-October 2015) [unfair and deceptive practices; compliance with PA statutes and regulations for electric generation supplier]

Direct Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission, on behalf of the Pennsylvania Office of Consumer Advocate and Bureau of Consumer Protection, Attorney General, Commonwealth of Pennsylvania by Attorney General Kathleen Kate, through the Bureau of Consumer Protection and Tanya McCloskey, Acting Consumer Advocate v. IDT Energy, Inc., Docket No. C-2014-2427657 (April 2015) [unfair and deceptive practices; compliance with PA statutes and regulations for electric generation supplier]

Affidavit of Barbara Alexander before the Pennsylvania Public Utility Commission, on behalf of the Pennsylvania Office of Consumer Advocate and Bureau of Consumer Protection, Attorney General, Commonwealth of Pennsylvania by Attorney General Kathleen Kate, through the Bureau of Consumer Protection and Tanya McCloskey, Acting Consumer Advocate v. Blue Pilot Energy, LLC, Docket No. C-2014- 2427655 (June 2015) [unfair and deceptive practices; compliance with PA statutes and regulations for electric generation supplier]

Direct Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission, on behalf of the Pennsylvania Office of Consumer Advocate and Bureau of Consumer Protection, Attorney General, Commonwealth of Pennsylvania by Attorney General Kathleen Kate, through the Bureau of Consumer Protection and Tanya McCloskey, Acting Consumer Advocate v. Blue Pilot Energy, LLC, Docket No. C-2014- 2427655 (September 2015) [unfair and deceptive practices; compliance with PA statutes and regulations for electric generation supplier]

Reply Testimony of Barbara Alexander before the Public Service Commission of Maryland, In the Matter of the Investigation into the Marketing, Advertising and Trade Practices of Blue Pilot Energy, Case No. 9346(c) (July 31, 2015) [unfair and deceptive practices; compliance with MD statutes and regulations for electric generation supplier]

Direct Testimony of Barbara Alexander before the Washington Utilities and Transportation Commission, on behalf of Public Counsel and the Energy Project, WUTC v. Avista Utilities, Dockets UE-150204 and UG-150205, (July 2015) [Analysis of request for smart meter (AMI) deployment and business case.]

Direct, Rebuttal, and Surrebuttal Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission on behalf of the Office of Consumer Advocate, Joint Petition of Metropolitan Edison Company, Pennsylvania Electric Co., Pennsylvania Power Co., and West Penn Power Co. [FirstEnergy] for Approval of their Default Service Program and Procurement Plan for the Period June 1,2017 through May 31, 2019, Docket Nos. P-2015-2511333, et. al. (January-February 2016) [Retail Market Enhancement Programs: standard offer program and shopping for low income customers]

Alexander, Barbara and Briesemeister, Janee, Solar Power on the Roof and in the Neighborhood: Recommendations for Consumer Protection Policies (March 2016).

Direct, Rebuttal, and Surrebuttal Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission on behalf of the Office of Consumer Advocate, Petition of PPL Electric Utilities Corp. for Approval of a Default Service Program and Procurement Plan for the Period June 1, 2017 through May 31, 2021, Docket No. P-2015-2526627 (April-May 2016) [Retail Market Enhancement Programs: standard offer program and shopping for low income customers]

Direct, Rebuttal, and Surrebuttal Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission on behalf of the Office of Consumer Advocate, Petition of PECO Energy Co. for Approval of its Default Service Program for the Period from June 1, 2017 through May 31, 2019, Docket No. P-2016-2534980 (June-July 2016) [Retail Market Enhancement Programs: standard offer program and shopping for low income customers]

Direct, Rebuttal Testimony of Barbara Alexander before the Pennsylvania Public Utility Commission on behalf of the Office of Consumer Advocate, Petition of Duquesne Light Co. for Approval of Default Service Plan for the Period June 1, 2017 through May 31, 2021, Docket No. P-2016-2543140 (July-August 2016) [Retail Market Enhancement Programs: standard offer program and shopping for low income customers]

Briesemeister, Janee and Alexander, Barbara, Residential Consumers and the Electric Utility of the Future, American Public Power Association (June 2016)

Direct Testimony of Barbara Alexander before the Washington Utilities and Transportation Commission on behalf of the Public Counsel and The Energy Project, Washington UTC v. Avista Corp. d/b/a Avista Utilities, Dockets UE-160228 and UG-160229 (August 2016) [Base Rate Case and AMI Project analysis of costs and benefits]

Alexander, Barbara, *Analysis of Public Service Co. of Colorado's "Our Energy Future" Initiative: Consumer Concerns and Recommendations,* AARP White Paper (December 2016), attached to the Direct Testimony of Corey Skluzak on behalf of the Colorado Office of Consumer Counsel, Docket No. 16A-0588E (Exhibit CWS-35).

Presentations and Training Programs:

- Presentation on Consumer Protection Policies for Solar Providers, New Mexico Public Regulatory Commission, Santa Fe, NM, January 2017
- Presentation on Residential Rate Design Policies, National Energy Affordability and Energy Conference, Denver, CO., June 2016
- Presentation on "Regulatory-Market Arbitrage: From Rate Base to Market and Back Again," before the Harvard Electricity Policy Group, Washington, D.C., March 2016.
- Presentation on Residential Rate Design and Demand Charges, NASUCA, November 2015.
- Alexander, Barbara, "Residential Demand Charges: A Consumer Perspective," presentation for Harvard Electricity Policy Group, Washington, D.C., June 2015.
- Presentation on "Future Utility Models: A Consumer Perspective," for Kleinman Center for Energy Policy, U. of Pennsylvania, August 2015.
- Presentation, EUCI Workshop on Demand Rates for Residential Customers, Denver, CO [May 2015]
- Presentation, Smart Grid Future, Brookings Institute, Washington, DC [July 2010]
- Participant, Fair Pricing Conference, Rutgers Business School, New Jersey [April 2010]
- Presentation on Smart Metering, National Regulatory Conference, Williamsburg, VA [May 2010]
- Presentation on Smart Metering, Energy Bar Association Annual Meeting, Washington, DC [November 2009]
- Presentation at Workshop on Smart Grid policies, California PUC [July 2009]
- National Energy Affordability and Energy Conference (NEAUC) Annual Conference
- NARUC annual and regional meetings
- NASUCA annual an regional meetings
- National Community Action Foundation's Annual Energy and Community Economic Development Partnerships Conference
- Testimony and Presentations to State Legislatures: Virginia, New Jersey, Texas, Kentucky, Illinois, and Maine
- Training Programs for State Regulatory Commissions: Pennsylvania, Georgia, Kentucky, Illinois, New Jersey
- DOE-NARUC National Electricity Forum
- AIC Conference on Reliability of Electric Service
- Institute of Public Utilities, MSU (Camp NARUC) [Instructor 1996-2006]
- Training Programs on customer service and service quality regulation for international regulators (India and Brazil) on behalf of Regulatory Assistance Project
- Georgia Natural Gas Deregulation Task Force [December 2001]
- Mid Atlantic Assoc. of Regulatory Utility Commissioners [July 2003]
- Illinois Commerce Commission's Post 2006 Initiative [April 2004]
- Delaware Public Service Commission's Workshop on Standard Offer Service [August 2004]

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-297 Regarding the Osterholt Testimony and his use of the term "Phase 2" (see, e.g., page 5, line 14), please provide the details and meaning of the "Phase 2" Smart Columbus initiative, including the timing of Phase 2, the nature of the projects and their associated budgets, and the location of the Phase 2 projects.

RESPONSE

As stated in Osterholt testimony on page 11, lines 1-7, "…Phase I will serve as a demonstration project that will allow the Company to prove the value of these technologies and refine and improve their performance. Therefore, much as gridSMART Phase 1 was a proving ground for the larger deployment proposed as part of gridSMART Phase 2, the Smart Columbus deployment proposed here will facilitate a larger deployment…". After considering the data from Phase 1, the Company will determine aspects of Phase 2.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-298 Is the Phase 2 initiative as referenced in the Osterholt Testimony intended to be linked to the Smart Columbus project and the project area or in other areas of AEP Ohio's service territory?

RESPONSE

Please see the Company's response to INT-2-297.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-367 Regarding the Gill Testimony, for each of the four investments proposed for the Smart Columbus project (EV charging stations; microgrids; NextGen communication system; and substation physical security), using the cost estimates included in this filing, provide a separate average monthly bill impact analysis for each project category for each customer class for each of the four years of the demonstration project.

RESPONSE

The Company has not performed the requested analysis.

Prepared by: David R. Gill

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-366 Does AEP Ohio expect the Commission to make a prudence determination about the proposed expenditures for substation security included in this proposal?

RESPONSE

Yes. It is the Company's intent the Commission approve the estimated spend for the distribution substation physical security plan in this proceeding. As with other Company riders, the spend in the Distribution Technology Rider is subject to a Commission prudency review and audit.

Prepared by: Andrea E. Moore

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-363 Does AEP Ohio expect that the Commission will make a prudence determination about the proposed NextGen communication system and the estimated capital cost of $69 million and $1 million O&M in this proceeding?

RESPONSE

Yes. It is the Company's intent the Commission approve the estimated spend for the communication system in this proceeding. As with other Company riders, the spend in the Distribution Technology Rider is subject to a Commission prudency review and audit.

Prepared by: Andrea E. Moore

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-300 Has AEP made any corporate or shareholder contribution to the Smart Columbus project? If so, please identify the amount and date of such contribution or any pledge or intent to make such contributions in the future.

RESPONSE

AEP has committed to considerable capital investment with the Smart Columbus project. AEP Ohio is not proposing use of shareholder funds without cost recovery.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-334 What level of revenue is included in the Company's analysis of cost recovery for the charging stations?

RESPONSE

As supported by Company witness Osterholt, AEP Ohio proposes to allow PEV owners to use Company-installed public charging stations free of charge during an initial period. Therefore WP DRG-8 contains no revenue to the Company from users of the public charging stations for this initial period.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-332 Referring to the Osterholt Testimony at page 16, line 23, with regard to your proposal to allow the public to use the Company owned charging stations free of charge during an initial period, how will the Company evaluate the usage of these stations to submit a schedule for charges to the Commission if there is no information on the impact of any level of charge?

RESPONSE

The Company expects to better understand the final deployment costs for the electric vehicle charging stations, ongoing maintenance costs, the total number of hours utilized, and the time of the day that the chargers stations are used. These factors will help AEP Ohio establish a basis for how the Company should charge for these services in the future.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-309 Referring to the Osterholt Testimony at page 9, lines 19-20, describe specifically how AEP Ohio would locate or design microgrids to include "consideration for facilities that serve lower income communities." In your response, identify any microgrid projects known to AEP or Mr. Osterholt that reflect such criteria in Ohio or elsewhere.

RESPONSE

AEP Ohio intends to collaborate with customers and communities in the selection of areas where microgrids will be installed. Low income communities can be considered as a part of that process.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-303 Identify any studies conducted or relied upon by AEP Ohio and Mr. Osterholt of the demographics of the individuals or organizations that purchase electric vehicles in the Smart Columbus initiative area.

RESPONSE

The Company set EV charging station goals based on Smart Columbus. The Company will examine and consider all demographics and endeavor to serve all populations.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-304 How many electric vehicle charging stations of each type (Level 1, Level 2 or DC fast chargers) are currently installed in the Smart Columbus footprint? Identify their location and ownership.

RESPONSE

For readily available information, the Alternative Fuels Data Center (AFDC) data from within DOE is the best reference. http://www.afdc.energy.gov/data_download/

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-314 Referring to the Osterholt Testimony at page 12, line 8-9, identify:
a. The basis for the statement that "there are limited charging stations available."
b. The basis for the statement that this is a "significant impediment to adoption of electric vehicle technology."
c. All other "impediments" to adoption of electric vehicle technology, such as the cost of electric vehicles compared to household income in the Smart Columbus area.

RESPONSE

a.) This statement refers to the fact that there are a finite, or limited, amount of charging stations at the present time. As AFDC data supports, there are relatively few charging stations available in the Smart Columbus region.
b.) As Mr. Osterholt states in testimony on page 12, lines 9-13: "Although PEV owners often install charging stations in their homes, the lack of charging stations outside the home continues to be a phenomenon commonly known as 'range anxiety,' in which consumers decline to purchase PEVs because they fear they will be unable to travel outside a limited area around their home due to the lack of publically available charging stations."
c.) The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. Further, the Company also objects to a request to identify all communications, to the extent such communications are not documented. Without waiving the foregoing objection(s) or any general objection the Company may have, the Company states as follows. AEP Ohio plans to respond to impediments, or barriers, to assist customers in PEV adoption. Deploying EV charging stations would be one way to address such an impediment.

Prepared by: Counsel
Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-317 Has AEP Ohio communicated with privately owned charging station companies concerning Mr. Osterholt's proposal?
a. If so, for each discussion, provide its date, method of communication, participating individuals, and memoranda or minutes of the meeting (including any electronic communications about the nature and results of the communications or meetings).
b. If not, why not?

RESPONSE

The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. The Company also objects to this request as seeking information that is neither relevant nor reasonably calculated to lead to the discovery of admissible evidence. Further, the Company also objects to a request to identify each discussion, to the extent such discussions are not documented. Without waiving the foregoing objection(s) or any general objection the Company may have, the Company states as follows.

(a) Through conferences, discussions with trade organizations and individual conversations, multiple AEP Ohio personnel have communicated with various firms and groups associated with the charging industry.

(b) N/A.

Prepared by: Counsel
Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-324 Referring to the Osterholt Testimony at page 15, lines 14-16, please describe how AEP Ohio will identify locations for charging stations that can support added load on the system without distribution investments. In your response, provide the locations that AEP Ohio has identified that will be able to support load on the system without additional distribution investments in the Smart Columbus project area.

RESPONSE

The Company is developing the deployment plan and will use its expertise to target placement of electric vehicle charging stations where there is minor or no costs to upgrade the distribution grid. Please see OCC-INT-2-321 for additional details on the Company's experience.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-328 Referring to the Osterholt Testimony at page 16, lines 13-14, what criteria will AEP Ohio use to "develop a plan for charging station installations to best promote PEV adoption"?

RESPONSE

Recognizing that a primary goal of the proposed deployment is to encourage PEV adoption, the Company plans to use all the information available (AEP Ohio, Smart Columbus, US DOT, etc.) to best select installation locations. As referenced in INT-2-321 and INT-2-324, those plans are in process.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-325 Referring to the Osterholt Testimony at page 15, lines 21-23, provide the basis for the proposal to install 250 Level 2 public smart charging stations, 25 public DC Fast Charger charging stations, and develop 1,000 residential charging stations. In your response, provide the criteria or basis for these specific numbers for each category of charging stations and any documentation that reflects the actual need for these specific numbers of each type of charging station in the Smart Columbus project area.

RESPONSE

This is an informed estimate based on population and existing resources, with the intent to learn from deployment and utilization of these assets. Many organizations (EPRI, DOE, others) recognize a "pyramid" concept for EVSE, where DCFC is the top third by height, public level 2 is the middle third, and home/workplace level 2 are in the bottom third. The Company's proposal aligns with this concept.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-322 Referring to the Osterholt Testimony at page 15, line 7, identify how AEP Ohio will deploy charging stations to "all segments of the population", including low income residential customers. In your response, identify how AEP Ohio will decide to locate charging stations based on "all segments of the population."

RESPONSE

As stated on Osterholt testimony on page 16, lines 13-18, AEP Ohio is developing these plans and is considering deployment to segments of all populations.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-329 Referring to the Osterholt Testimony at 15, how will this plan to "best promote PEV adoption" comply with the intent to ensure that charging stations are located to serve disadvantaged communities and the need to avoid additional distribution investments, as described in your Testimony?

RESPONSE

Please see the Company's response to INT-2-322.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-320 Referring to the Osterholt Testimony at page 14, lines 13-18, please describe how AEP Ohio is going to "manage" the demand associated with electric charging stations and how that management will "offset costs with additional revenues associated with demand response….". In your response, demonstrate how this estimated benefit will be included in the cost recovery methodology proposed by the Company.

RESPONSE

AEP Ohio plans to deploy demand reduction (DR) capability into most or all of the planned deployment of electric charging stations. As stated in testimony from Company witness Osterholt, AEP Ohio is uniquely positioned for the management of DR for numerous reasons but most specifically based on being the only entity that has insight on locations where there is distribution congestion. While the electric charging station equipment has not yet been selected, the DR functionality will likely be able to reduce the charging output at times when DR is needed and/or shut off completely. Like gridSMART Phase 1, the Company would envision the ability to group the DR equipment so calling events can be targeted to the area where the DR is needed. The Company will study DR for future Commission proposals.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-337 Referring to the Osterholt Testimony at page 18, please describe the demand reduction program that is referenced in the justification for the investment in residential Level 2 charging stations. In your response, identify any documents or studies that describe the proposed demand response program and its cost /benefit analysis. If such program does not yet exist, when will AEP Ohio file this program for Commission review and approval?

RESPONSE

The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. Without waiving the foregoing objection(s) or any general objection the Company may have, the Company states as follows.

The demand reduction referenced in Mr. Osterholt's testimony on page 19 is describing the functionality of the electric vehicle chargers and those chargers having demand reduction capabilities. AEP Ohio gained significant DR experience in gridSMART Phase 1 project. These DR benefits were well recognized and captured in the final technical report submitted to the US DOE and publically available. There are numerous other benefits of the electric vehicle charger program as referenced in the Osterholt testimony starting on page 12, line 17. As part of the initial planning for the roll-out of the residential electric vehicle charging stations, the Company would further define the details of the DR program.

Prepared by: Counsel
Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-321 Referring to the Osterholt Testimony at page 14, lines 19-23, please describe any experience and expertise by AEP Ohio in operating charging stations safely and to ensure that there is no damage to the power delivery equipment. In your response, identify where and when AEP Ohio has operated any charging station: also identify any other operations of charging stations by other entities that has been unsafe or damaged power delivery equipment.

RESPONSE

In Osterholt testimony on page 14, lines 19-23, the Company is referring to charging station equipment as it relates to other grid infrastructure (circuits, substations, etc.). The Company is well suited to optimize the system with the addition of PEV charging stations, while being focused on safety, as the Company has previously deployed PEV equipment during gridSMART Phase 1.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-316 Referring to the Osterholt Testimony at page 13, line 1, provide the basis for the statement that using electric vehicle charging stations "could lower costs for meeting customers' needs." In your response, provide the analysis that shows what level of electric vehicle charging would result in any "lower costs" to consumers, identify the "needs" in this sentence, and when these lower costs are likely to occur.

RESPONSE

The generation component of off-peak usage is generally less expensive than the generation component of on-peak usage. Therefore, if the Company can optimize additional EV load, we will have more energy sold and higher fixed asset utilization – this equals lower volumetric prices for customers.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-370 Referring to the Osterholt Testimony, page 12, line 11, identify any studies of documents that support "range anxiety."

RESPONSE

The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. Without waiving the foregoing objection(s) or any general objection the Company may have, the Company states as follows.

Many publically available sources support range anxiety. Two reasonable information sources to consider are:
http://www.sciencedirect.com/science/article/pii/S0965856415002451
https://cleantechnica.com/2016/07/21/obama-admin-announces-4-5-billion-doe-loan-guarantees-electric-vehicle-charging-infrastructure/

Prepared by: Counsel
Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-335 Please identify and describe any other utility program known to Mr. Osterholt or AEP Ohio in which the utility invests in and installs residential charging stations for electric vehicles.

RESPONSE

The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. Without waiving the foregoing objection(s) or any general objection the Company may have, the Company responds as follows.

Several residential programs were reviewed by the Company. The publicly available information can be found on the individual utility websites.
https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/Case.aspx?year=2013&docketNumber=131585
https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/CaseItemList.aspx?item=documents&year=2016&docketNumber=160082
http://www.psc.state.ga.us/factsv2/Document.aspx?documentNumber=155507

Prepared by: Counsel
Scott S. Osterholt

Section 1
Electric Vehicle Charging Infrastructure Pilot

1.1 Market Assessment

Adoption of electric passenger vehicles has increased in the state of Ohio and across the U.S. as a result of a number of factors, including declining cost, improved battery technology, plug-in electric vehicle (PEV) range and performance, policy support, and environmental benefits. However, there are considerable impediments to PEV adoption, some of which can be greatly alleviated through large scale investment in PEV charging infrastructure, commonly referred to as electric vehicle supply equipment (EVSE).

As of 2014, there were less than 4,000 registered PEVs in the state of Ohio, or 0.33 PEVs per thousand people, compared to nearly 10 million registered passenger cars and trucks. This penetration is in the bottom quintile across the states.[1] Over the first six months of 2016, approximately 65,000 PEVs were purchased in the U.S. as compared to a typical annual total of approximately 17 million passenger vehicles purchased, or slightly less than 1 percent of the overall market.

1.1.1 Electric Vehicle Cost

PEVs have a considerably higher upfront purchase cost relative to a similarly-sized and equipped internal combustion engine (ICE) vehicle. This is primarily due to low economies of scale, the cost of the battery, and the electric motor and related control systems. For example, the purchase of a Nissan's PEV, the LEAF, is approximately $30,000, while the similar ICE Nissan Versa is only $18,000, a premium of 67%. While savings can be anticipated over the operating life of the PEV relative to the ICE vehicle, this higher upfront cost takes precedence for many car buyers who forego an PEV purchase as a result.

This cost relationship is anticipated to improve as a result of a drop in the cost of batteries. Over the last few years, the cost of a lithium-ion battery pack for an PEV has been reduced from over $600 per kWh installed capacity to under $400 per kWh. By 2020 if not earlier, researchers predict costs will lower to about $200 per kWh, which would then make the total ownership costs of PEVs competitive with internal combustion engine vehicles without federal tax incentives, assuming gasoline prices at or above $2.60 per gallon. By 2025, battery costs are projected to decrease to about $160 per kWh.[2]

[1] Based on data reported by the Department of Energy.
[2] Hensley, Russell, et al, "Battery technology charges ahead," McKinsey Quarterly, July 2012. http://www.mckinseyquarterly.com/Battery_technology_charges_ahead_2997.

1.1.2 Electric Vehicle Performance

PEVs include both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). BEVs rely exclusively on an internal electric engine to power the vehicle, as they do not have a secondary propulsion system powered by an ICE. The typical BEV has a driving range of under 100 miles on a full charge. This is sufficient to handle customer driving needs on most days but is not practical for those who regularly commute longer distances or for the occasional longer trip. PHEVs comprise both electric engines and ICEs. Accordingly, PHEVs do not have a driving range limited by battery charge, as the ICE takes over once the battery is depleted. However, PHEVs typically have smaller battery packs and lower electric driving ranges. As battery capability and cost is anticipated to improve, the adoption barrier of limited electric range will be mitigated as a result of larger battery packs at lower cost. However, the increased availability of public and workplace charging equipment will be essentially to more completely remove this impediment.

Figure 2-1 depicts the average reported daily miles driven of PEV users (percentage values shown are the percent of total respondents) from one readily available report, focusing on the Austin-San Antonio region of Texas. The data is particularly relevant to the AEP service area as the Austin region is often viewed as comparable to the Columbus metro area, both in terms of density and residential/commercial mix.

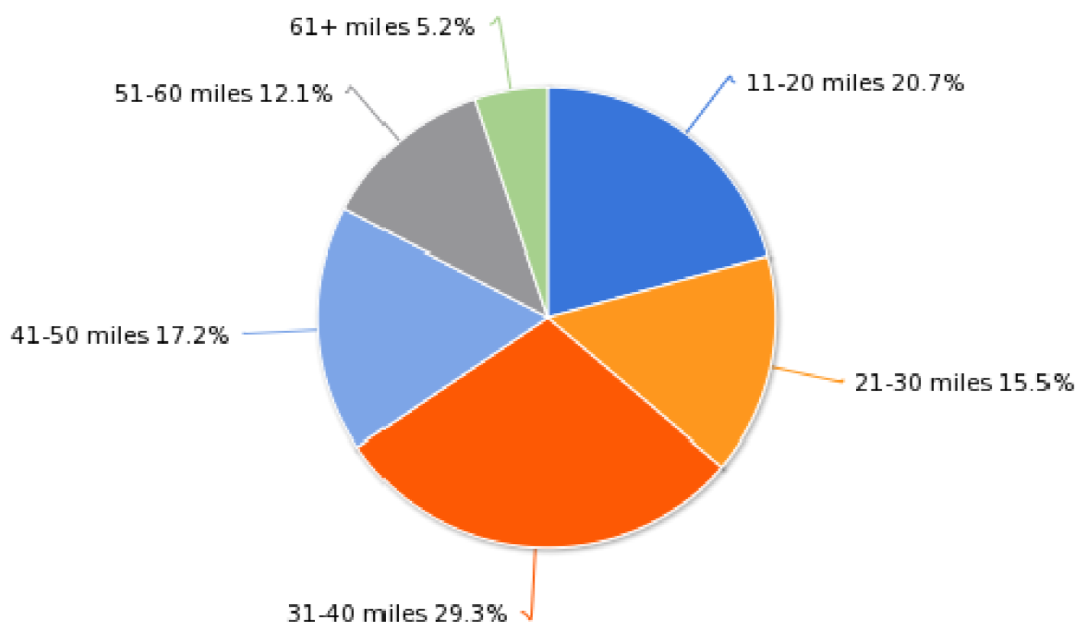


Figure 2-1: Reported Daily PEV Commutes for Central Texas Region

Average daily commute in Columbus, Ohio is reported to be approximately 21 minutes (as reported in the 2010 Census), making a round trip well within the range of a typical BEV.

Figure 2-2 below depicts the reported typical PEV charging duration of respondents (percentage values represent the percentage of respondents in each category).

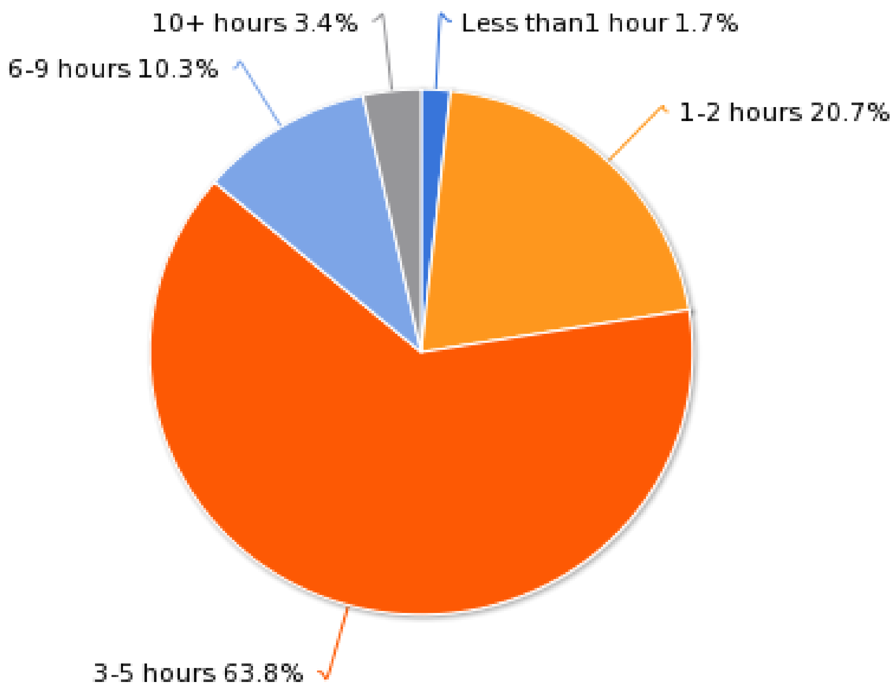


Figure 2-2: Reported Average Daily Charging Duration

Surveyed PEV owners report PEVs deliver rapid, quiet acceleration and are generally more fun to drive than conventional vehicles. The electric motor, which is four times more efficient than the internal combustion engine, can deliver this performance with fewer moving parts and less maintenance than a conventional vehicle.[3]

1.1.3 Federal and State Policy Support

The U.S. government has provided some policy support for PEVs for several years, providing income tax credits that are dependent on PEV adoption, with credits declining on the basis of a schedule of adoption thresholds per manufacturer. Federal tax credits of up to $7,500 per PEV purchase, depending on the battery capacity, are currently available, and the U.S. Department of Energy continues to fund large programs supporting the adoption of electric vehicles.

The State of Ohio has implemented a grant program, primarily providing loans, to fund alternative transportation fuel initiatives, including fueling infrastructure, fuel conversion, and education and promotion efforts. Funding for fiscal year 2016 has been set at $2.9 million. However, the program includes a variety of fuels, diluting any impact on transportation electrification.

[3] Excerpted from the 2012 Regional Plan and Final Report by the Texas River Cities Plug-in Electric Vehicle Initiative.
https://cleancities.energy.gov/files/u/projects_and_partnerships/project_material/supporting_material/252/texas_river_cities_readiness_plan.pdf

1.1.4 Market Barriers to PEV Adoption

The adoption of PEVs is limited by a number of factors that must be overcome for PEVs to reach significant market share and have a greater impact on emissions and power markets. These include a significant purchase cost differential versus ICE vehicles, limited range of most PEVs, and limited charging infrastructure.

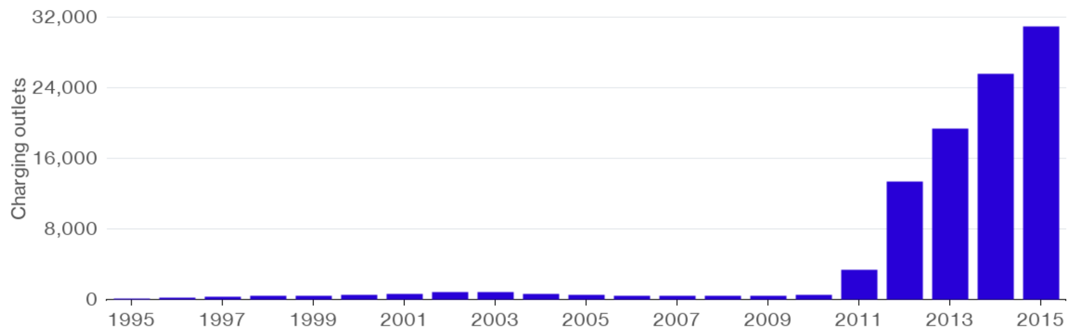
Despite federal tax credits that continue to be available for PEV purchases, the up-front cost differential versus ICE vehicles remains a significant impediment to adoption. While a decline in battery costs will narrow this gap slightly, the achievement of significant economies of scale may prevent sufficient efficiencies to closing the gap. The reduced operating cost from on-going operation of PEVs versus ICE vehicles provides an offset to this up-front cost differential; however, the fact that most consumers make such purchase decisions on unreasonably high implied discount factors, the up-front cost differential will continue to far outweigh lower operating costs over the life of the vehicle.

In addition, when gasoline prices were in the $4 per gallon vicinity, the lifecycle costs of PEVs versus gasoline-powered vehicles appeared likely to close over the next few years. However, gasoline prices having dropped back to the range of $2 per gallon over the 2014-2016 period, the anticipated increase in PEV market share has not materialized.

The available range of typical PEVs is a significant factor limiting the market of potential adoptees, a factor commonly referred to as “range anxiety”. A February 2015 national survey provides some discussion regarding desired PEV range capability. 27 percent of survey respondents suggested PEVs would have to travel 100 miles on a single charge to be considered. The majority of respondents, or 56 percent, said that the vehicles would have to be capable of going 300 miles on a charge. Nine percent said that, regardless of the range, they would not consider buying an PEV.[4] While technology is improving, the perception of limited range and the reality of limited public EVSE installations is a significant factor, aside from up-front cost differentials, in the lack of PEV adoption.

A key element to PEV adoption that is tied closely to the range anxiety issue is the dearth of public and workplace charging stations. The U.S. Department of Energy reports there are now over 14,000 electric vehicle charging stations nationwide, comprising almost 36,000 outlets. Figure 2-2 below depicts the rapid development of charging infrastructure through 2015.

[4] Consumer Views on Plug-in Electric Vehicles - National Benchmark Report. National Renewable Energy Laboratory, January 2016. http://www.nrel.gov/transportation/news/2016/25668.html?print



Source: U.S. Department of Energy

Figure 2-2: Electric Vehicle Charging Outlets in the U.S.

However, the national survey noted above revealed that only approximately 10 percent of drivers were aware of charging stations that they passed by regularly, were at their places of work, or at stores that they frequented. Nearly 80 percent were not aware of *any* charging stations in their area.[5] Given the significant push toward electric vehicles in several other states, the situation in Ohio is undoubtedly even less favorable for PEVs.

There are many different reasons for installing public EVSE, most hinging on the anticipation of future PEV penetration and addressing the range anxiety their employees and customers. A common question among organizations considering installing EVSE infrastructure is whether to wait for more demand to install charging stations or build the infrastructure to prepare for future demand. However, to some degree, the demand for PEVs is impacted by the availability of EVSE infrastructure at public and highly visible locations, potentially resulting in the development of sufficient numbers of neither. The complementary nature of PEVs and EVSE infrastructure is commonly referred to as "network effects".

1.1.5 Electric Vehicle Charging Equipment Costs and Characteristics

Level 1 EVSE connects the vehicle to alternative current (AC) electricity at 110 volts, usually providing power to the vehicle at approximately 1.4 kW. This results in 3 to 5 miles of driving range gained per hour of charging, taking between two to ninety hours to charge an empty battery depending on battery size. This is sufficient to recharge the battery overnight for the average daily driving distance of 29 miles, in about 6.4 hours of continuous charging. Level 1 EVSE is provided as standard equipment with the purchase of an PEV, such that this level of charging is available to households with a standard 110 volt receptacle near the PEV parking location. Multiple unit dwellings (MUDs), where 110 volt receptacles are often not available at parking locations, make charging overnight impractical even for Level 1 technology.

[5] Ibid.

Level 2 EVSE connects at 220 volts AC, typically recharging PEVs at 3.3 kW to 6.6 kW and taking between 1.3 to 2.7 hours to recharge the typical average driving distance of 29 miles. Other than residential installations in single family homes (SFH), Level 2 EVSE is also commonly found in MUDs, workplace, fleet and public locations. However, in these applications the Level 2 EVSE usually includes more robust housings and mounting hardware, and in some cases added software functionality. Also, the installation usually involves more extensive trenching, conduit lengths, supply panel and utility distribution upgrades, which adds considerable cost compared to residential EVSE installs in single family homes.

DC Fast Charging EVSE provides direct current (DC) electricity at high voltage, delivering power at 50 kW or more and gaining 165 miles driving range per charging hour or more. DC Fast Charging EVSE is relatively expensive and usually found only in commercial fleet or public locations. However, as opposed to public Level 2 EVSE, the charging time of the vehicle is greatly reduced to as low as 15 minutes to significantly recharge the battery. For this reason, DC Fast Charging EVSE is a critical enabler of practical, longer distance PEV driving.

Installation costs of the EVSE varies considerably across the three typical voltage levels identified above. Table 1-1 below provides estimates of installed costs across the three EVSE types, with an additional variability for Level 2 systems depending on their location.

Table 1-1
EVSE Installation Costs[6]

EVSE Type	Total Cost per Port
Residential Level 1	$1,500
Level 2 (Workplace)	$5,000-$10,000
Level 2 (Public)	$10,000-$20,000
DC Fast Chargers	$50,000-$75,000

1.2 Program Rationale

Electric utilities are increasingly taking action to support the adoption of PEVs. To increase the number of charging stations and PEV owners' confidence in driving range, a number of utilities are now installing and operating their own publically available charging stations to ensure there are enough charging stations to support significant growth in PEV ownership. These programs vary in scope from a handful of strategically-placed DC Fast Chargers to thousands of Level 2 stations.

There are a number of reasons why it may make sense for utilities to be more directly involved in the development of charging station infrastructure.

[6] Adapted from an Avista Corp. report Submitted to the Washington Utilities and Transportation Commission in January 2016.

- Public utilities are well-positioned to take a long-term approach to PEV charging infrastructure development based on their similar long-term approach to building power plants and delivery facilities.
- Public utilities are accustomed to making large-scale investments and amortizing the investment over a long period of time, receiving an approved rate of return when capital is invested. This allows utilities to consider installations in areas that are underserved by the private sector.
- Public utilities are uniquely positioned to set up fast-charging stations with minimal demand charges, as they have the experience and existing capability to manage the impact of such demands on the power delivery system.
- Public utilities have the expertise to operate charging stations safely and ensure that no damage occurs to power delivery equipment. This expertise may also allow EVSE to be operated more efficiently, reducing cost to the PEV owners.
- Public utilities are an important part of the country's infrastructure and regulatory and political landscape and are accustomed to working with the regulatory agencies and political leadership to address the nation's energy goals.

A utility-owned PEV infrastructure program can rapidly address the lack of EVSE in Ohio and greatly increase the availability of workplace and multi-family housing charging. The increased availability of EVSE infrastructure is necessary to facilitate regional PEV travel, increase PEV range confidence, and achieve higher PEV adoption rates. Residential charging at Level 1 and Level 2 is adequate to meet the daily driving needs of many PEV drivers. However, the availability of workplace charging is of major importance as a catalyst for adoption, as it can allow more PHEV owners to drive to and from work using electricity in both directions and BEV owners to extend their commuting range. The U.S. DOE showed that twenty times as many employees drove PEVs when charging was made available at the workplace, compared to the average worker.[7] Hence, the decision to own an PEV can hinge on the availability of workplace charging.

In 2016, the City of Columbus was selected as the winner of the Department of Energy Smart City Challenge and was awarded $50 million for Smart Transportation improvements. At the core of the Columbus strategy is greater use of and availability of PEVs. In their grant application, the City states as one of the primary goals, to "(e)xpand the usage of electric and smart vehicles through changes to policy and practice and the expansion of our Smart Grid in order to serve our energy and climate change objectives." AEP's contemplation of the Electric Vehicle Charging Infrastructure Pilot is in concert with its role as a stakeholder and partner in the Columbus Smart City efforts.

[7] U.S. Department of Energy (2014). Workplace Charging Challenge Progress Update 2014: Employees Take Charge. November, 2014.

Higher PEV adoption will reduce transportation-related emissions, reduce vehicle fuel and maintenance costs, and reduce the average cost of electricity to electric customers.

PEVs produce fewer greenhouse gas (GHG) emissions than a new ICE vehicle—nearly 80 percent less, and a recent study by the Electric Power Research Institute (EPRI) and the Natural Resources Defense Council (NRDC) found that PEVs will provide even greater GHG reductions by 2050.[8,9] Reductions across other pollutants, including carbon monoxide, volatile organic compounds, and particulate matter are estimated to be considerably greater, on a percentage basis.

At $3.00 per gallon of gasoline, the average household spends over $2,800 in gasoline costs each year to drive its ICE vehicles. Driving PEVs the same number of miles at current electricity prices would cost under $500 per year – a savings of over $2,300 per year, per household. This translates to a gasoline-equivalent fuel cost of $0.53 per gallon for electric vehicles. In addition, maintenance costs are estimated to be reduced by $3,100 over the life of a PEV, compared to a generic conventional ICE vehicle. Electricity prices are also much more stable than gasoline, which has exhibited volatile price swings over the last several years.

PEVs have the potential to nearly double a typical home's electricity usage. Accordingly, PEVs offer utilities an opportunity to increase the demand for electricity, especially during off-peak hours when there can be significant under-utilized electric generating capacity. In order to meet peak load demands during summer months, utilities generally have significant amounts of generating capacity that is unused or under-utilized during most of the year, especially during the late evening and early morning hours. If under-utilized capacity is used more frequently, the fixed capital costs will be spread out over more sales, reducing rates for all customers.

Finally, while the U.S. has begun producing a portion of its petroleum needs domestically, PEVs have the potential to greatly reduce petroleum imports into the U.S., thereby improving the import-export balance and the U.S. economy.

1.3 Pilot Program Design

The need to overcome barriers to PEV adoption and achieve the substantial, long-term benefits discussed above have led AEP-Ohio to propose a EVSE Pilot Program to accomplish the following objectives:

- Install a small number of EVSE sites in beneficial locations, in order to immediately support PEV adoption
- Develop experience and best practices information to deploy an effective EVSE program on a larger scale and support EVSE development by others

[8] Union of Concerned Scientists. 2014. How do EVs compare with Gas-Powered Vehicles? Better Every Year…http://blog.ucsusa.org/how-do-electric-cars-compare-with-gas-cars-656?_ga=1.256439747.939001574.1443819974.

[9] EPRI and NRDC. 2015. Environmental Assessment of a Full Electric Vehicle Portfolio. http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002006881.

- Develop information on charging profiles for residential, workplace and public charging locations, in order to better estimate system impacts and facilitate long range planning
- Design useful demand response experiments to maximize the benefits of PEV charging capacity to the electric system

1.3.1 EVSE Equipment Description

AEP-Ohio is targeting the following number of EVSE installations to be installed over a two-year period:

Table 1-2
Proposed EVSE Installations

EVSE Type	Year 1	Year 2	Year 3	Total
Level 2 Installations	30	50	60	140
DC Fast Chargers	4	6	8	18

Estimated expenditures for up-front capital cost and operation and maintenance (O&M) over the two-year pilot are shown in Table 1-3. O&M costs include software vendor fees, other IT costs, and company overhead.

Table 1-3
Estimated Program Expenditures

EVSE Type	Year 1	Year 2	Year 3	Total
Capital Cost	$645,000	$918,400	$936,800	$2,500,200
O&M Cost	126,600	192,072	194,144	512,816
Total	$771,600	$1,110,472	$1,130,944	$3,013,016

EVSE will be purchased and owned by AEP, with an expected depreciable life of ten years. One or more EVSE vendors will be selected for the pilot following requests for proposals. Standard Level 2 EVSE will be capable of charging at a minimum of 3 kW output power. In addition, "smart charger" Level 2 EVSE will be capable of data collection, network communications, and demand response. Data collection will include amperage, voltage, date, time, and battery state. DC Fast Charging EVSE will generally be capable of 50 kW output power.

O&M activities requiring field technicians will be accomplished by qualified contractors, selected through a request for qualifications process.

1.3.2 EVSE Site Host Arrangement

AEP anticipates soliciting interest from prospective non-residential customers that wish to host EVSE installation on their property. AEP will evaluate potential hosts for suitability and execute a Site Agreement with selected EVSE Site Hosts, including will provisions for a property easement. EVSE will then be constructed on the property by AEP's EVSE vendor.

For all Level 2 EVSE, AEP anticipates that the term of the Site Agreement will be ten years or until such time that either the Customer or AEP terminates the agreement and removes the EVSE from the Customer's location. At the end of the term of the EVSE Site Agreement, AEP will work with the Customer on potentially replacing or upgrading the EVSE and signing a new EVSE Site Agreement, removing the EVSE, or provide the Customer the option to purchase the EVSE from the Company.

1.3.3 PEV Charging Arrangement

In many workplace and public locations the cost of electricity is relatively small, such that the total cost to enable and transact payments may be too great relative to the cost of charging electricity for a limited period. Accordingly, AEP envisions that charging electricity would be free, with costs recovered through the EVSE deployment rider (costs socialized to all AEP Ohio customers). However, in some public Level 2 and DC Fast Charging EVSE locations, the EVSE may need to be managed for optimal use, possibly including port availability control and a reasonable payment by the PEV driver. This would encourage customers to not block the use of this equipment for other users.

DC Fast Charging EVSE locations are more likely to require payment by the PEV driver. This helps ensure availability for drivers that depend on it to make a longer trip, rather than others using it for "free" local driving needs that can be met by charging at home or at work. AEP will file a future tariff to codify the pricing for EVSE usage, which may vary for differing EVSE types.

1.3.4 Demand Response Plan

EVSE charging will be designed to be controlled as part of a demand response program. It is anticipated that charging may be curtailed briefly during system peak events. This will be designed with the primary goal to convincingly demonstrate the extent to which on-peak load can be shifted to off-peak and collect information regarding the resulting impact on charging behavior.

1.4 Program Benefits

AEP's EVSE Pilot Program is designed to improve adoption of PEVs across Ohio and to achieve the following benefits for all rate payers and the communities in AEP's service area:

- **Reduced vehicle emissions.** PEVs are estimated to emit approximately 20 percent of the CO^2 emissions of ICE vehicles.
- **Reduced vehicle fuel costs.** PEVs can be expected to cost less than $0.60 per gasoline-gallon equivalent in electricity costs, providing a significant boost in average incomes and a reduction in petroleum imports.

- **More efficient PEV charging.** As the Pilot reflects installation of only Level 2 or DC Fast Chargers, it can be anticipated that these facilities will co-opt the installation of some Level 1 installations, resulting in an overall improvement in charging efficiency.
- **Reduced average electric system costs.** PEV adoption enabled through increased and enhanced EVSE infrastructure will bring with it additional load, which will tend to be weighted toward off-peak load and therefore cheaper to serve. It will also be highly controllable, which will provide both demand response and ancillary support capabilities. As solar PV adoption increases, AEP's EVSE strategy can readily evolve toward EVSE that are more highly utilized during daytime hours, when excess renewable generation may become available.
- **Standardization and establishment of interoperability of EVSE.** PEV owners expect readily available access to EVSE infrastructure, allowing them to fuel their vehicles wherever they drive. Furthermore, they expect the charging process to be essentially the same. Currently, there are multiple EVSE providers with proprietary systems installed throughout the United States; a PEV owner may have to be a member of multiple systems to charge his/her PEV across the region. AEP ownership and operation of a portion of the EVSE infrastructure, as well as the development of functional and technical requirements for this equipment, will go a long way toward encouraging standardization.
- **Extension of opportunity to disadvantaged segments.** With adequate focus on EVSE for multi-family housing, a significant segment of the population that would otherwise be unable to consider the adoption of PEVs will have access to charging equipment. This will greatly level the playing field and improve the adoption of PEVs among that segment.
- **Identification of Best Practices for PEV Infrastructure Deployment.** The AEP EVSE Pilot Program will produce a base of valuable experience for the utility and for the industry in Ohio regarding charging behavior, demand response program parameters, EVSE installation and operation, and interactions with PEV owners.

Section 2
Microgrid Pilot

For purposes of this proposal, the term "microgrid" is defined as a collection of generation assets, connected loads, and control equipment installed across a defined geographic area that is capable of disconnecting from the surrounding electric distribution system and operating independently while maintaining uninterruptible service. The proposed AEP Microgrid Pilot Program discussed herein contemplates the deployment of public purpose microgrids, or microgrids that serve critical community assets such as such as emergency services complexes (fire, police, emergency response centers or shelters, etc.), community centers, and commercial hubs. The public purpose microgrids may serve multiple customers and multiple properties.

2.1 Program Rationale

Electric utilities are increasingly taking action to enhance the resiliency and reliability of the electric system during severe weather events, modernize the electric grid system, and reach environmental sustainability goals from government regulations.

2.1.1 Severe Weather

Severe weather events have increased in frequency and severity, and are the primary cause of power outages, attributing to 80 percent of all outages. According to the National Oceanic and Atmospheric Administration, severe weather events that possess the ability to damage the electric system are on the rise. Similarly, Climate Control, an independent organization that studies and reports on climate change, determined that weather-related power outages doubled over the period 2003-2012. As severe weather continues to grow in frequency and severity, so does resulting power outage-related costs. The President's Council of Economic Advisers and the United States Department of Energy reported that weather-related outages are to have cost an annual average of $18 billion to $33 billion over the period 2003-2013.

It is necessary to upgrade and reinforce the electric system to better withstand the impacts of severe weather and to more quickly recover from related damage. Microgrids have the potential to enhance the capability of the electric system to withstand and recover from major storms, and help ensure facilities that provide for public health and safety will maintain power during outages. By ensuring continued operation of critical electric and governmental facilities, microgrids offer a level of resiliency and reliability that cannot be achieved solely through system hardening or other similar investments.[10]

[10] PECO Microgrid Integrated Technology Pilot Application

2.1.2 Grid Modernization

The prospect of extended power outages has prompted growing concerns related to the reliability and cybersecurity of the electric system. Severe weather events and the potential for a cyberattack targeting the electric system, both having the ability to result in extended power outages, has increased interest in being part of an electric system that is more reliable, secure and can separate from grid, when necessary. There have been many governmental legislative and regulatory organizations calling for grid modernization, including microgrids in particular. For instance, the development of microgrids is supported by the reliability and infrastructure security goals that are outlined in the Energy Independence and Security Act of 2007 ("EISA 2007"). According to the EISA 2007, "it is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure…"

More recent activities pushing for grid modernization, with microgrids at the forefront include:

- **Energy Policy Modernization Act ("EPMA").** Currently passed by The House and now under review by The Senate, this bill will enhance the federal role in supporting microgrids. The EPMA promotes various strategies and policies aimed at increasing the reliability and cybersecurity of the electric system.
- **The Maryland Resiliency Through Microgrids Task Force Report**. A study completed under the Governor's Task Force, which concluded that the uninterruptible services that public purpose microgrids are able to provide to critical infrastructure are beneficial to public policy. Furthermore, it is stated that the State should pursue various avenues to thrust the deployment of public purpose microgrids, such as advocacy and incentives.
- **Demonstrating Secure, Reliable Microgrids and Grid-Linked Electric Vehicles to Build Resilient, Low-Carbon Facilities and Communities.** A $26.5 million grant offered by the California Energy Commission, in which the majority of money was allocated to microgrid development.

2.1.3 Environmental Sustainability

Environmental sustainability regulations and incentives by government organizations have been very active in recent years on the federal and state level. Many of the recent policies take aim at reducing greenhouse gas emissions by the power sector and strengthening the trend of clean energy resources. A few of these policies include renewable energy credits, renewable portfolio standards ("RPS"), and emissions restrictions.

Federal Policies

The following are federal policies associated with environmental sustainability and are supportive impact of microgrids.

- **Clean Power Plan.** Issued on August 3, 2015, and is aimed at reducing the carbon dioxide ("CO_2") emissions from the power sector. Microgrids generally use clean sources of generation, such as wind, solar and battery storage, and are a viable option to meet the Clean Power Plan goal of reduced CO_2 emissions.
- **Tax Credits.** The Business Energy Investment Tax Credit ("ITC") and the Renewable Electricity Production Tax Credit ("ITC"), are two types of federal tax credits that issue rebates for the implementation and use of renewable generation resources, such as solar and wind.

State Policies

The following are state policies in Ohio associated with environmental sustainability and have a supportive impact on microgrids.

- **RPS.** In 2008, Ohio implemented a RPS requiring 12.5 percent of electric sales to be generated from renewable energy resources by 2027. While the renewable energy ramp-up schedule was "frozen" for the years 2015 and 2016 at 2.5 percent (2014 levels), the original schedule is anticipated to resume in 2017. In order to meet the RPS requirement, not only clean energy alternatives need to be developed, but upgrades to the electric system will be necessary to interconnect these clean sources of generation.
- **Solar Easements.** Ohio law allows property owners to create binding solar easements for the purpose of protecting and maintaining proper access to sunlight.
- **Air-Quality Improvement Tax Incentives.** Provides assistance to businesses for new air quality projects such as solar, wind, and biomass generation resources. A business can receive a 100 percent exemption from the various taxes resulting from the project (i.e., property, sales).

The commercial sector has also been active in pursuing clean energy options, as many Fortune 500 companies have established clean energy goals[11].

2.1.4 Rationale for Utility Investment

There are many different reasons for a utility to develop a microgrid program.

- **Experience.** Utilities are best equipped to build, own, and operate microgrids because utilities possess immense experience and success in developing long lived assets that serve the power needs of its customers.
- **Economies of scale.** Utilities would likely be able to achieve economies of scale in both installation and operation of microgrids, due to the commonality of equipment and staff required to operate and maintain generation and interconnection equipment.

[11] PECO Energy Company's Microgrid Integrated Technology Pilot Plan. May 18, 2016.

- **Control.** Utility ownership and operation will ensure that the utility has the ability to fully control the microgrid in a manner that maximizes the overall electric system performance and is beneficial to all customers.
- **Existing infrastructure.** The utility already has established distribution infrastructure, which would avoid unnecessary redundancies and duplicative investments.
- **Ratemaking.** The existing regulatory process would apply to utility investments in microgrids, ensuring that such rate-based investments are cost-justified and can be made without undue regulatory impediments.
- **Franchise issues**. Non-utility owned microgrids that cross public rights-of-way will likely be confronted with a host of legal and regulatory hurdles, including the need to qualify its distribution infrastructure as "related facilities" within the meaning of the qualifying facility exemption, or the granting of a franchise or lesser consent from the presiding municipal authority.[12]

Acquiring the necessary awareness and knowledge is best accomplished through a pilot program. Pilot programs provide an ideal setting where the performance and impacts of new technologies can be monitored, studied and optimized. The lessons learned through pilot programs create the blueprint for the programs future, large-scale deployment, that maximize benefits and minimize unexpected challenges and complexities.

2.2 AEP Microgrid Pilot Program

AEP seeks approval from the Commission to construct, own, and operate three-five public purpose microgrids, totaling approximately 3 MW and seek cost recovery through a monthly charge billed to applicable electric customers through a new microgrid rider to AEP's Electric Service Tariff. AEP proposes to construct these initial sites in order to apply lessons learned from those projects to the design and construction of future microgrid sites.

2.2.1 Target Locations

Target locations for the pilot program are anticipated to include the following types of government facilities, community infrastructure, and commercial installations:

- Fire and police stations
- Emergency shelters
- Water delivery facilities (e.g., lift stations)
- Wastewater treatment facilities

[12] NYSERDA. Microgrids for Critical Facility Resiliency in New York State. Final Report. December 2014.

- Grocery stores
- Gas stations

2.2.2 Technical Description of Microgrid Resources

Under the proposed Microgrid Pilot Program, AEP will construct, own, and operate primarily clean generating resource technologies to power these microgrids. The following technologies are anticipated to be considered as potential microgrid generation resources:

- **Photovoltaic (PV) Systems.** Fixed plate, rooftop-mounted PV system, producing direct current (DC) power to be converted to required alternating current (AC) power through an inverter.
- **Wind Turbines.** Horizontal axis, 3-4 blade, ground-mounted wind turbine system, with turbine blades capable of being angled in response to wind conditions.
- **Cogeneration (i.e., combined heat and power).** Natural gas-fired generation (e.g., reciprocating engines, microturbines, etc.) capable of providing both electric generation and thermal energy in support of cooling loads, heating loads, and/or hot water consumption through heat recovery equipment capturing the thermal waste energy from the generator's exhaust.
- **Battery Storage.** AEP evaluated storage technologies for application as generation support for intermittent supply resources anticipated to be the primary generation technology incorporated in the microgrid. AEP anticipates that the preferred storage technology will be a lithium-ion battery system. The capacity of the battery system will need to be sufficient to serve critical facility loads for potentially long durations—at least during hours of darkness for PV-only primary generation microgrids.

The primary purpose of the microgrids is to continue to deliver energy to critical facilities to support the broader community impacted by a significant loss of electricity supply through the broader distribution system due to outages caused by significant weather or other events. In normal conditions, the microgrids will be interconnected to the electric distribution system and will operate as a part of that system, such that the critical facility will be served by some mix of microgrid energy and grid energy. The microgrid may also backfeed energy over the grid, serving other loads. On initiation of a significant outage and/or extended loss of service from the distribution system, the microgrids will island from the wider distribution system. As necessary and depending on the criticality of loads internal to the microgrids, discretionary generation resources (gas-fired generation or battery systems) will initiate operation and provide energy to the islanded loads. When service is restored to the grid, the microgrids will revert back to the standard interconnection with the distribution system, and discretionary resources will cease operations that are non-economic relative to grid resources.

AEP anticipates each individual microgrid location will require 0.5-3 megawatts (MW) of generation to support the customer load. However, sites may require more or less generation depending on the facilities to be supported. Each microgrid will be evaluated in terms of load to be served, appropriate sizing of resources, and prevailing market projections to determine the mix of resources and their operation relative to grid power to provide power supply to the host facilities, recognizing the potential need in emergency conditions to island the system and self-supply all critical loads.

AEP intends to modify the existing distribution circuit configurations and add new switching and control capability as needed to each location. Required work is anticipated to be limited to the utility distribution side of the service interconnections with the customer site and would support the connected customer or group of customers within the microgrid.

2.2.3 Capital and Operating Cost

AEP anticipates that typical microgrid generation will consist of a PV system and a battery storage system sized to meet critical load requirements. However, as discussed above, the exact specification will vary depending on the mix and criticality of loads incorporated into the microgrid. For planning and cost estimation purposes, AEP has assumed the specification summarized in Table 2-1 below.

Table 2-1
Assumed Microgrid System Capital and Operating Costs

Category	Solar PV	Lithium-Ion Battery System	Total
System Capacity	500 kW	3,000 kWh	500 kW
Capital Cost ($/kW-DC)	$3,600/kW	$700/kWh	
Total Capital Costs	$1.6 M	$2.1 M	$3.7 M
Additional Infrastructure Cost			$0.5 M
Overhead Cost			$0.4 M
Total Cost			**$4.6 M**

AEP's Microgrid Pilot contemplates installing 2-3 microgrid systems over a two-year period for a total cost of approximately $10.5 million.

2.2.4 Utility-Customer Arrangement

For customers served by the microgrid, there will be no change in how AEP delivers the service to the customer meters and AEP will maintain the same utility-customer arrangement that is currently in place.

2.2.5 Implementation Considerations

AEP will solicit parties interested in participating in the microgrid pilot. This will include meeting with various municipal bodies and target locations (identified above), in order to gauge the initial interest levels, practicality, and necessity.

The potential sites resulting from the solicitation will be assessed for suitability based on a variety of factors, including the following:

- Criticality
- Resiliency requirements
- Population served by infrastructure in question
- Location of adjacent additional critical community facilities
- Existing reliability issues
- Tractability of microgrid installation
- Ease of access

To provide a complete evaluation of the potential sites, the site evaluation will be conducted using a qualitative assessment. Each site will be scored on the attributes above and an overall score determined based on a set of weights by attribute. Selection of the site will determined by the highest overall scorers resulting from the qualitative assessment.

2.3 Program Benefits

AEP's Microgrid Pilot is designed to achieve the following benefits:

- **Improved resiliency and reliability for critical infrastructure.** The fundamental purpose of a microgrid is to improve the resiliency and reliability for critical infrastructure. A more resilient grid is better able to maintain and restore services to customers after severe weather events. A more reliable grid is able to experience shorter and fewer power outages. In the event of severe weather-related power outages, the microgrid operates in island mode, ensuring uninterruptible service to facilities that provide for public health and safety, such as hospitals and police stations. Supporting and powering these critical facilities during these types of events is extremely beneficial to providing disaster resistance and emergency services to the community.
- **Reduced system peak demands.** A reduction in peak demands across the system is a valuable outcome as it reduces the necessity for costly upgrades to power delivery infrastructure. Microgrids, particularly located in advantageous locations, are able to reduce peak demand on upstream transmission equipment, and those incorporating battery storage can be used to manage peak demands.
- **Improved integration of intermittent renewables.** Microgrids incorporating battery storage can improve the load profile served by central resources by

charging during periods of excess renewable generation or otherwise load power prices and discharging when loads and power prices are otherwise high.

- **Clean energy generation and reduced emissions.** Microgrids generally use clean sources of generation, such as natural gas, renewables, and storage. These sources of clean energy will aid in meeting the Ohio RPS, as well as the emissions reduction of CO_2 and other types of GHGs.
- **Ancillary services.** As microgrids developed under this Pilot are anticipated to incorporate battery storage devices, in isolation or in addition to other generation, the system will accrue additional benefits due to decreased system ancillary requirements (i.e., load following, spinning reserves). Battery storage systems are able to quickly increase and decrease energy output, including both charging and discharging, allowing them to compete in the ancillary services market. In fact, according to the Energy Storage Association, battery storage provides a load response that is ten times faster and more accurate to power dispatch signals compared to combustion turbine generators. Utilizing a battery storage system, microgrids can provide both demand response and, potentially, ancillary services to the PJM market.

Section 3
Smart Streetlighting Pilot

3.1 Program Rationale

Street lights are one of the utility's most significant assets, distributed evenly throughout the system on existing easements. A renewed emphasis on sustainability is increasing the value of the street lighting system, and new ways to leverage that resource are developing rapidly.

Significant advancements have been made in street lighting over the past several years, not only luminaire advancements with light-emitting diodes ("LEDs"), but also integrated controls. Simple timers, photocells and motion sensors have been replaced with controls that provide two-way communications allowing the direct control and management of lighting and monitoring lighting performance for instant problem identification and lighting change. In the near future, smart street lighting will be able to interact directly with consumer-owned devices and vehicles, providing context-sensitive lighting and increasing customer safety and satisfaction, while reducing customer costs.

A street lighting pilot will allow the testing of program elements from which prudent larger-scale investments may be made.

3.2 AEP Smart Lighting Pilot Program

AEP has been monitoring the development of controls technology in several utility applications over the past several years. AEP has already benefited significantly from its advanced metering implementation and now is ready to move forward with the next series of steps in its overall grid modernization effort. Relatively recent developments in lighting controls have resulted in significant operational and maintenance cost savings, plus additional benefits which are discussed in more detail below.

In addition, the City of Columbus, Ohio was recently selected as the winner of the Department of Transportation's Smart City Challenge and recipient of a $50 million grant. As a result, consumer interest in smart technology is expected to rise, and AEP intends to prudently meet that expectation by undertaking a Pilot Study to review Smart Lighting implementation strategies.

3.2.1 Program Design

AEP has identified a Pilot Study scope wherein 9,000 controls will be added to existing AEP Ohio street and area lighting. The smart control will still make use of the existing luminaire.

The Pilot Study will target both roadway street lighting and area lighting in the northeast part of central Ohio within the Columbus metro area, focusing on areas with specific demographics as denoted below. At this time, AEP has not decided to convert the luminaires to light-emitting diodes (LEDs), but to add the control module allowing two-way communications between the street and area lighting and the control system.

AEP plans to fund the Smart Lighting conversion through a $3 million capital investment and recover such investment through its Grid Modernization Rider.

Initial Financial Analysis

AEP has undertaken an initial financial analysis to estimate the reach of the initial Pilot Study. Specific cost data on the control modules and wireless control system is changing, but the estimates below are representative.

AEP plans to install Smart Lighting equally over a two-year period, as shown below.

Table 3-1
Proposed Smart Lighting Pilot

Description	Year 1	Year 2	Total
Smart Lighting Control Units Installed	4,500	4,500	9,000

Estimated expenditures over a five year Pilot horizon, segmented between capital and operation and maintenance (O&M) costs, are shown in Table 3-2. Capital costs include the controls and their installation, system integration and management systems. Operating and maintenance costs include servicing of the Smart Lighting system.

Table 3-2
Proposed Smart Lighting Pilot Program Expenditures -

Cost Characterization	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Capital Cost	$1,136,400	$836,400	-	-	-	$1,972,800
O&M Cost	281,400	281,400	$155,040	$155,040	$155,040	$1,027,200
Total Pilot Cost	$1,239,600	$939,600	$155,040	$155,040	$155,040	$3,000,000

3.2.2 Target locations

AEP plans to install Smart Lighting controls for both street lighting and area lighting in the region currently served by gridSMART Phase 1. In this way, AEP will leverage existing grid modernization elements, adding in the additional functionality of the Smart Lighting system.

AEP will identify areas within the gridSMART Phase 1 network representing a wide customer demographic in order to test economic viability, customer satisfaction, safety impact, commercial and business development, and broader community-oriented objectives.

Initial discussions have resulted in the selection of the following target areas:

- **Single-family residential.** Smart Lighting installations in single-family moderate income neighborhoods will serve to test engagement with the young urban customer. Young urbans tend to be sensitive to issues of sustainability and motivated by technology. Smart Lighting delivered to multi-family may prove useful for further smart controls testing.
- **Low income.** Smart Lighting installations in low income neighborhoods will serve to test values of safety and reduction of day-burners. Low income neighborhoods tend to exhibit higher potential for crime and have a greater proportion of pedestrian traffic than other residential areas. The increase in pedestrian traffic may sometimes contribute to higher accident rates which may be reduced through more consistent lighting.
- **Multi-family residential.** Smart Lighting installations to multi-family residential communities will serve to test values of customer satisfaction and utility engagement. Multi-family residential areas will likely have more area lighting under control than in some of the other demographics.
- **Commercial Retail.** Smart Lighting installations in commercial retail areas will serve to initially test customer satisfaction for reasons of customer satisfaction and reduced call center activity. Similar to multi-family, commercial retail typically has a significant amount of area lighting as well as street lighting. Later advancements in controls may provide opportunity to test other smart lighting features such as context-sensitive lighting wherein lighting is automatically changed when weather changes or customers/vehicles approach.
- **Commercial Business.** Smart Lighting installations in commercial business areas will serve to initially test customer satisfaction for reasons similar to commercial retail. Later advancements in controls may provide opportunity to test other smart street and area lighting features such as context-sensitive lighting wherein lighting is automatically changed when weather changes or customers/vehicles approach. Also, there is downstream potential for Smart Lighting in the business context to integrate further with building systems.

3.2.3 Implementation

AEP's initial Smart Lighting implementation will not initially involve LED lighting or dimming capability. These features may provide significant quantitative and qualitative benefits in the future, however, at this time the IES has not released standards that specify the required performance and lighting intensity for the various applications within this proposed Pilot. AEP has decided to delay its implementation of LED until such standards are released.

In later implementations, Smart Lighting may involve context-sensitive lighting, either allowing the lamp to be dimmed for certain weather conditions (e.g., snow on the ground) to reduce energy consumption or increase lighting when the control detects the presence of a smartphone or approaching car.

3.3 Program Benefits

Benefits of the proposed Smart Lighting Pilot include three categories: operational, customer satisfaction and safety.

3.3.1 Operational Benefits

AEP's implementation of Smart Lighting will yield significant operational benefits through reduced maintenance costs, reduced power consumption, reduced call center activity, and reduced inventory costs.

Reduced Operations and Maintenance Costs

Current street and area lighting is primarily controlled by simple photocells which simply monitor ambient light levels. Once the ambient light level drops below a certain defined level indicating the onset of evening, or rain, the street and area lighting powers on. When the lamp or photocell fails, there is no communication, so the streetlight will remain inoperative or "day-burning" until a work order is generated by either a customer or utility representative. The work order is routed to the maintenance department through the utility call center. The work order is then placed in a queue and service is scheduled. Maintenance crews are dispatched to repair streetlights, but do not know what the problem is until onsite investigation. Maintenance crews may not carry a full complement of parts necessary for such repairs.

The Smart Lighting control mounts on top of the fixture and integrates a photocell with communications and monitoring capabilities. The controls monitor the status and performance of the luminaire and also provide communications to a wireless gateway in real-time. If the lamp fails or is day, the system provides an immediate alert, generating an appropriate work order for the maintenance crew. Street or area light repair may be scheduled and completed more efficiently thereby reducing maintenance costs.

Reduced Call Center Volume

Direct utility control over the street and area lighting reduces the call load for the utility call center by constantly monitoring the performance of the streetlights. In addition to saving on call volume, operators will be relieved of the additional responsibility of issuing a maintenance ticket for the streetlight or area light repair. The smart functionality can communicate with AEP's OMS to provide data for a maintenance ticket.

3.3.2 Customer Satisfaction

AEP's implementation of Smart Lighting will increase customer satisfaction by reducing the time to lighting restoration. The control module constantly monitors the condition and operation of the luminaire and provides data to the data management system. When the streetlight fails the system notifies the outage management system preparing a maintenance ticket for resolution. The ability of the system to communicate failure and initiate a maintenance ticket might further be leveraged to provide affected customers with an outage notification. Data analytics will eventually enable luminaire failure detection allowing for even more coordinated and efficient replacement and minimized interruption of service.

3.3.3 Safety and Security

There is a known correlation between properly designed street and area lighting and:

- Reduction in daytime and nighttime crime;
- Reduction in fear; and
- Increase in pedestrian traffic

In Painter and Farrington's research on the relationship between street and area lighting and crime, they note:

> "As a highly visible sign of positive investment, improved street lighting might reduce crime if it physically improves the environment and signals to residents that efforts are being made to invest in and restore their neighborhood. In turn, this may lead them to have a more positive image of their area and increased community pride, optimism and cohesion. It should be noted that this theoretical perspective predicts a reduction in both day-time and night-time crime…. In addition to leading to a positive change in resident opinions and physically creating a brighter and safer environment, street lighting might also send a non-verbal message to offenders that the reputation of the area is improving, that there is more social control, order and surveillance and hence that crime at that location is riskier than elsewhere."

AEP's Smart Lighting Pilot will enhance existing street and area lighting by making street and area lighting more consistent and less problematic. It will reduce the effort necessary to manage the operation and maintenance of the street and area lighting system. The capability of the Smart Lighting system to provide added downstream benefits due to its location and distribution is significant.

Avista Corp.
1411 East Mission P.O. Box 3727
Spokane. Washington 99220-0500
Telephone 509-489-0500
Toll Free 800-727-9170

January 14, 2016

Washington Utilities and Transportation Commission
1300 S. Evergreen Park Drive S. W.
P.O. Box 47250
Olympia, Washington 98504-7250

Attention: Mr. Steven King, Executive Director & Secretary

RE: Tariff WN U-28 (New Tariff Schedule 77)

Dear Mr. King,

Attached for electronic filing with the Commission is the Company's proposed tariff WN-U28, Schedule 77, Electric Vehicle Supply Equipment (EVSE) Pilot Program. The purpose of this tariff filing is to establish a new tariff for the Company's proposed EVSE Pilot Program.

I. SUMMARY OF EVSE PILOT PROGRAM

An Avista EVSE program is key to enabling greater Electric Vehicle (EV) adoption that results in benefits to all customers. A comprehensive EVSE program aligns with State policy goals to achieve societal benefits, is responsive to customers, and addresses critical adoption barriers. It also provides important channels for learning and paves the way for cost-effective off-peak charging, improved system planning, and ultimately lower total life-cycle costs of grid infrastructure. Additionally, as noted in the recently adopted resolution of the NW Energy Coalition, which reflects the broad consensus in support of utility involvement in accelerating the EV market, "the electrification of the transportation sector provides an opportunity to use the electric grid more efficiently and cost-effectively, to the benefit of all utility customers."[1]

Avista proposes a two-year pilot program to install up to the following number of AC Level 2 EVSE[2] at the following locations: 120 residential single-family homes (SFH), 100 at workplaces, fleet and multi-unit dwelling (MUD) locations, and at 45 public locations. In addition to the

[1] NW Energy Coalition Resolution on the Electrification of Transportation, adopted December 4, 2016: http://www.nwenergy.org/data/EV-Resolution-Adopted-12_4_15.pdf
[2] AC Level 2 EVSE charges at 208/240 volts AC and typically recharges a vehicle at 3.3 kW to 6.6 kW.

Level 2 EVSE installations, Avista is proposing to install DC Fast Charging EVSE[3] at seven locations as part of the pilot program. The following table provides a summary of the targeted EVSE installations over the two year pilot program.

Charging Type	Year 1	Year 2	Total
Residential SFH Level 2	40	80	120
Workplace/Fleet/MUD Level 2	30	70	100
Public Level 2	20	25	45
Public DC Fast Charging	2	5	7

All Level 2 installations will be completed at sites that are customers of Avista. Of the Level 2 EVSE installations, "smartchargers" will be planned for installation in 100 residential and 90 other locations. Smartchargers provide enhanced capabilities that allow for data acquisition, network communication, and demand response, which is essential to determine baseline charging profiles, enable demand response experiments, and ultimately help shape the long term impact of EV charging for the greatest benefit of all customers.

Cost estimates for the various types of Level 2 and DC Fast Charging EVSE installations in the Company's service territory are as follows:

Charging Type	EVSE equipment	EVSE installation	Site property & Premises wiring	Utility distribution	Total cost per EVSE port connection
Residential SFH L2	$500	$150	$675	$50	**$1,375**
Workplace/Fleet/MUD L2	$700	$350	$1,700	$750	**$3,500**
Public L2	$2,500	$500	$3,000	$2,000	**$8,000**
Public DC Fast Charging	$35,000	$55,000	$10,000	$25,000	**$125,000**

The Company will pay for the upfront cost of the EVSE equipment, installation, and any required utility distribution upgrade. These costs are the basis for the estimated Capital and costs further described below. In addition, the Company will provide a reimbursement for the site property premises wiring for Level 2 EVSE up to $1,000 for residential installations and $2,000 per port connection for all other installations as proposed in the pilot program. The premises wiring reimbursement costs are included in the Operation and Maintenance costs described below.

If the Company reaches its targeted installation rates during the two-year pilot program, the estimated Capital and Operation and Maintenance costs are as follows:

[3] DC Fast Charging EVSE provides DC Electricity at high voltage, usually delivering power at 50 kW or more.

	Year 1	**Year 2**	**Year 3**	**Totals**
Capital	$704,500	$1,610,750	$0	$2,315,250
O&M	$271,135	$329,833	$179,458	$780,425
Totals	**$975,635**	**$1,940,583**	**$179,458**	**$3,095,675**

The Company proposes to fund the pilot-program through its normal capital funding program, with no request for an accounting deferral or tariff rider to collect funds for the program. Instead, the Company will seek recovery of Capital and Operations and Maintenance (O&M) costs through the normal General Rate Case process. O&M costs include credits paid to automobile dealers for data acquisition, administrative expenses, premises wiring reimbursement, data analytics, and reporting. The majority of the O&M costs during the course of the pilot program represent one-time expenses. The expected annual O&M cost beginning at the conclusion of the two-year pilot program is approximately $179,458 per year. The estimated annual revenue requirement after the equipment is installed (Year 3 and beyond) is $686,194 (see workpapers for calculation), which equates to an approximate 0.14% bill impact to customers (prior to any offset from the increased sales of electricity from additional EVs).

II. BACKGROUND

A. <u>Factors Driving Adoption of Electric Vehicles</u>

A number of factors are driving increased adoption of electric passenger vehicles both regionally and globally. These factors include:

1. <u>Environmental Benefits</u>

Customers using a conventional vehicle powered by an internal combustion engine (ICE) emit over 5 tons of CO^2 per year, per vehicle, and the transportation sector represents close to 50% of all CO^2 emissions in Washington State.[4] Avista customers who drive a plug-in electric vehicle (EV) use electricity that is generated by a variety of sources, emitting 1.06 tons of CO^2 per EV each year, a reduction of 79%.[5] Surveys show that environmental benefits are one of the top three reasons why customers purchase an EV.[6] Increasingly, State and Federal governments recognize the opportunity to realize environmental benefits through electrified transportation. As stated in House Bill 1853, passed in the 2015 WA legislative session, “The legislature finds that state policy can achieve the greatest return on investment in reducing greenhouse gas emissions and improving air quality by expediting the transition to alternative fuel vehicles, including electric vehicles.” In addition to the near-term benefits of improved air quality, over the long-

[4] Washington State Department of Transportation. *Washington State Electric Vehicle Action Plan.* December, 2014.
[5] Avista Corp (2015). *Electric Integrated Resource Plan.* August 31, 2015. 0.27 metric tons of CO^2 per MWh * 3,555 annual kWh/EV *1.1 tons/metric ton = 1.06 tons of CO^2 per EV each year
[6] California Center for Sustainable Energy (2013). *California Plug-in Electric Vehicle Driver Survey Results.* May, 2013.

term the electrification of the transportation sector will likely play a key role in the larger effort to reduce climate change risk.[7]

2. <u>Improving Battery Technology and Manufacturing Costs</u>

Over the last few years, the manufacturing cost of a lithium-ion battery pack for an EV has been reduced from over $600 per kWh installed capacity to under $400 per kWh.[8] By 2020 if not earlier, researchers predict costs will lower to about $200 per kWh, which would then make the total ownership costs of battery electric vehicles competitive with internal combustion engine (ICE) vehicles without federal tax incentives, when gasoline prices are at or above $2.60 per gallon. By 2025, battery costs are projected to decrease to about $160 per kWh.[9]

3. <u>Significant Fuel and Maintenance Cost Savings</u>

At $3.00 per gallon of gasoline, the average household spends over $2,800 in gasoline costs each year to drive its ICE vehicles. Driving EVs the same number of miles at current electricity prices would cost under $500 per year – a savings of over $2,300 per year, per household. This translates to a fuel cost of $0.53 per gasoline gallon equivalent for electric vehicles, compared to the average ICE vehicle on the road. In addition, maintenance costs are reduced by $3,100 over the life of a battery electric vehicle, compared to a generic conventional ICE vehicle.[10] This keeps more discretionary dollars in the hands of customers which benefits the EV owner, as well as the local economy.[11,12] Electricity prices are also much more stable than gasoline, which has shown volatile price swings between $1.73 and $4.33 per gallon over the last 10 years.[13]

4. <u>Vehicle Performance and Owner Satisfaction</u>

EV drivers consistently report very high satisfaction with their EVs.[14] A superior driving experience is afforded by the electric motor that provides a quiet ride and instant torque, with no tailpipe emissions. In addition, the electric driving range of most EVs is adequate to meet the needs of the majority of drivers for their daily driving needs, as the average person drives 29

[7] Ryan, Nancy. (2015). *Engaging Utilities and Regulators on Transportation Electrification*. Energy and Environmental Economics. March 1, 2015.
[8] Kamath, H. (2014). *Batteries and Electrification*. Presentation to the Edison Electric Institute. Electric Power Research Institute. August 19, 2014.
[9] Hensley, R., Newman, J., and Rogers, M. (2012). *Battery Technology Charges Ahead*. McKinsey Quarterly. July 2012.
[10] Electric Power Research Institute (2014). *Total Cost of Ownership for Current Plug-in Electric Vehicles*. Publication No. 3002004054.
[11] Energy and Environmental Economics, Inc. (2014). *California Transportation Electrification Assessment, Phase 2: Grid Impacts.* October 23, 2014.
[12] Drive Oregon (2015). *The Returns to Vehicle Electrification.* This study estimates that 4,500 current EVs in Oregon contribute between $1.8 million and $10.2 million additionally each year to the economy, as well as $191,600 to $676,700 in local and state tax revenues.
[13] Gas Buddy (2015). *120 Month Average Retail Price chart (Washington).* http://www.washingtongasprices.com/Retail_Price_Chart.aspx, accessed September 17, 2015.
[14] California Center for Sustainable Energy (2013). *California Plug-in Electric Vehicle Driver Survey Results.* May, 2013.

miles per day.[15] Many customers purchase or lease an EV to do something good for the environment, but then are pleasantly surprised by the convenience, enjoyable driving experience, and operating cost savings of their EV.[16]

5. Policy Support

Mounting support from Washington State's government is apparent from the recent publication of the Washington State Electric Vehicle Action Plan[17], and several bills introduced in the recent Washington legislative session. This includes House Bill 1853 which provides "a clear policy directive and financial incentive to utilities for electric vehicle infrastructure build-out." [18] Ongoing federal tax credits of up to $7,500 per EV purchase are expected to remain available until phase-outs beginning in 2020, and the U.S. Department of Energy continues to fund large programs supporting the adoption of electric vehicles. In addition to short- and long-term economic and environmental benefits, energy independence is a strategic motivation for supporting transportation electrification, in order to reduce reliance on foreign oil sources and thereby strengthen national security.[19]

B. Barriers to EV Adoption

Although many factors are driving the adoption of EVs, a number of significant barriers also exist which must be overcome to enable entry in the mass market and full-scale EV adoption. These barriers include:

1. Upfront Purchase Cost

Due to the cost of the battery, electric motor and related control systems, and low economies of scale, EVs currently have a higher upfront purchase cost than a similarly sized and equipped ICE vehicle. For example, the purchase of a new 2015 Nissan LEAF (an EV) is approximately $30,000, while the 2015 Nissan Versa (an ICE vehicle) is $18,000. After the federal tax credit of $7,500, the Nissan LEAF net purchase price is $22,500. This represents an effective purchase premium of 25% for a Nissan LEAF compared to the Nissan Versa. Although the Nissan LEAF provides a better driving experience and lower total lifecycle costs[20], this higher upfront cost takes precedence for many individuals who forego an EV purchase as a result. Lower purchase costs will occur with improved battery technology, reduced production costs, and the

[15] U.S. Department of Transportation (2009). *2009 National Household Travel Survey.*
[16] The Register-Guard (2015). *"EV drivers love their cars and wouldn't go back"*. Guest Viewpoint by Rep. Phil Barnhart (D-OR). September 9, 2015.
[17] Washington State Department of Transportation (2015). *Washington State Electric Vehicle Action Plan, 2015-2020.* February, 2015.
[18] House Bill 1853, Section 1, Paragraph (3).
[19] U.S. Department of Energy (2014). *EV Everywhere Grand Challenge: Road to Success.* January, 2014.
[20] Electric Power Research Institute (2014). *Total Cost of Ownership for Current Plug-in Electric Vehicles.* Publication No. 3002004054.

development of the EV used car market. For example, a 2013 Nissan LEAF lease return in new condition with less than 9,000 odometer miles, may be purchased today for under $15,000.[21]

2. Battery Degradation Concerns

Many potential consumers worry about the possibility of battery degradation, large battery replacement expenses, and rapid market value depreciation of an EV. The strong fear of battery degradation and replacement costs persists despite lab testing data that show batteries may perform satisfactorily for the life of the vehicle, and substantial Original Equipment Manufacturers' (OEM) guarantees such as Chevy's battery warranty for 100,000 miles. This barrier will be lessened over time as EVs with high mileage capabilities demonstrate satisfactory performance. Alternatively, creative business models that lease the batteries to the EV owner may help overcome this barrier.[22]

3. Low Customer Awareness and EV Promotion

Most consumers are not aware of the current opportunities and benefits afforded by EVs. Much of this may be attributable to OEMs such as Ford, GM, and Nissan which have limited marketing and promotion.[23] Furthermore, most dealerships have demonstrated a lack of knowledge and interest in selling EVs, do not adequately inform customers, and in some cases steer them away from an EV purchase.[24,25] This barrier may be overcome with more active promotion and marketing by the OEMs, incentives to dealers, and other public education and outreach programs that help raise consumer awareness and interest.

4. Low Electric Driving Range and Limited Charging Availability

There are two main types of EVs: battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).[26] BEVs rely exclusively on an external source of electricity to power the vehicle, as they do not have a secondary propulsion system powered by an ICE. Other than Tesla models, the typical BEV has a driving range of under 100 miles between battery charges. This is sufficient to handle customer driving needs on most days, but is not practical for the

[21] This example came from the experience of an Avista employee who recently purchased a used Nissan LEAF in the Seattle marketplace from Paramount Motors.
http://www.paramountmotorsnw.com/inventory.asp?showOnly=Nissan

[22] Lim, Michael K., Mak, Ho-Yin and and Rong, Ying (2014). *Toward Mass Adoption of Electric Vehicles: Impacts of the Range and Resale Anxieties*. August 29, 2014.

[23] Morris, Charles (2015). *"New Study: Lack of coherent sales concepts is responsible for weak EV sales."* Charged Electric Vehicles Magazine. September 18, 2015.

[24] Morris, Charles (2014). *"Are auto dealers the EV's worst enemy?"* Charged Electric Vehicles Magazine. September 9, 2015.

[25] Consumer Reports (2014) *"Dealers not always plugged in about electric cars, Consumer Reports' study reveals."* ConsumerReports.org. April 22, 2014.

[26] Vehicles commonly known as "hybrids" or "Hybrid Electric Vehicles" (HEVs) rely entirely on gasoline as an energy source, as the onboard ICE is used to turn a generator which supplies electric energy to the battery. HEVs cannot receive electricity from an external source, and therefore are not relevant to filing.

occasional longer trip, or for those who regularly commute longer distances. PHEVs use both gasoline and electricity supplied by an external source. PHEVs are not limited by driving range between battery charges as they have a secondary propulsion system powered by gasoline, which takes over once the battery is depleted. However, PHEVs have smaller battery packs with lower electric driving ranges, usually between 11 and 40 miles depending on the model. If the driver of a PHEV wishes to drive on electric power and avoid gas-driven miles, they must recharge more frequently than BEV drivers. The barrier of limited electric range for both BEVs and PHEVs will be mitigated by improvement in battery technology that enables larger battery packs with longer electric range at lower cost, and the availability of charging equipment, as detailed in subsequent sections.

C. Types of Charging Equipment and Costs

Charging equipment, also known as Electric Vehicle Supply Equipment (EVSE) is available in three different categories.

1. AC Level 1 EVSE

Level 1 EVSE connects the vehicle to AC electricity at 110 volts, usually providing power to the vehicle at 1.4 kW. This results in 3 to 5 miles of driving range gained per hour of charging, taking between two to ninety hours[27] to charge an empty battery depending on battery size.[28] This is sufficient to recharge the battery overnight for the average daily driving distance of 29 miles, in about 6.4 hours of continuous charging. However, for many vehicles with larger battery packs, Level 1 may not be sufficient to recharge the battery in a reasonable amount of time, e.g. after longer trips or on those days when several smaller trips may be needed. Level 1 EVSE is provided as standard equipment with the purchase of an EV, such that this level of charging is available to households with a standard 110 volt receptacle near the EV's parked location. For those households residing in multiple unit dwellings (MUDs), off-street parking with 110 volt receptacles are often not available, which makes charging overnight impractical.

2. AC Level 2 EVSE

At 220 volts AC, Level 2 EVSE typically recharges the vehicle at 3.3 kW to 6.6 kW, corresponding to a 20 amp or 40 amp protected circuit, taking between 1.3 to 2.7 hours to recharge the average driving distance of 29 miles.[29] Some vehicles like the Tesla Model S are equipped to charge at 10 kW to 20 kW, requiring a 50 amp to 100 amp protected AC circuit. Other than residential installations in single family homes (SFH), Level 2 EVSE is also

[27] For example, a Nissan LEAF has a range of 84 miles, requiring 17 to 28 hours to recharge at Level 1. A Tesla vehicle at 230 or more miles electric range, would require 90 hours of continuous charging at Level 1 to fully recharge from a near empty battery state.
[28] A Chevy Volt PHEV with 38 miles electric range could take between 8 to 13 hours to recharge from empty to full at Level 1. A Toyota Prius PHEV has an electric range of only 11 miles and even if the battery is fully depleted, would recharge within 2 to 4 hours at Level 1.
[29] Assuming an average energy consumption of 3.3kWh per mile, 29 miles requires 8.8 kWh of energy; this corresponds to 1.3 and 2.7 hours charging time, for 3.3 kW and 6.6 kW charging, respectively.

commonly found in MUDs, workplace, fleet and public locations. However, in these applications the Level 2 EVSE usually includes more robust housings and mounting hardware, and in some cases added software functionality. Also, the installation usually involves more extensive trenching, conduit lengths, supply panel and utility distribution upgrades, which adds considerable cost compared to residential EVSE installs in single family homes. Both Level 1 and Level 2 EVSE use a standard conductive coupler known as a J1772 connector to attach to the vehicle and supply electricity to the vehicle's rectifiers.[30]

3. DC Fast Charging EVSE

DC Fast Charging EVSE provides DC electricity at high voltage, usually delivering power at 50 kW or more. For vehicles equipped to connect with DC Fast Charging EVSE, the onboard rectifiers are bypassed and DC electricity is provided directly to the battery, gaining 165 miles driving range per charging hour or more. DC Fast Charging EVSE is relatively expensive and usually found only in commercial fleet or public locations. However, as opposed to public Level 2 EVSE, the charging time of the vehicle is greatly reduced to as low as 15 minutes to significantly recharge the battery. For this reason, DC Fast Charging EVSE is a critical enabler of practical, longer distance EV driving. As battery technology advances and manufacturing costs are reduced, more vehicles are expected to have larger battery packs similar to today's Tesla vehicles. Therefore, it is reasonable to expect that the need for residential and dedicated workplace Level 2, as well as public DC Fast Charging EVSE will increase over time.[31] Unfortunately, DC Fast Charging EVSE has not been standardized under one type of connector that works for all vehicles. Three different types of DC Fast Charging connectors are utilitized: Tesla, CHAdeMO, and SAE Combo. Generally, Tesla connectors only work for Tesla models, CHAdeMO for Nissan, Kia and Mitsubishi, and SAE Combo for the remainder of EVs equipped with a DC fast charging connection. For this reason, new DC Fast Charging EVSE installations (non-Tesla) should incorporate a dual-connector with both CHAdeMO and SAE Combo connections.

D. EVSE Installation Costs

Avista's experience with EVSE installations is limited. Based on review of various literature and discussion with subject matter experts,[32,33,34] cost estimates for the various types of Level 2 and DC Fast Charging EVSE installations in our service territory are as follows:

[30] A rectifier is an electrical device that converts an alternating current into direct current by allowing a current to flow through it in one direction only.
[31] Comments by Dan Bowermaster, Electric Transportation Program Manager, Electric Power Research Institute
[32] Electric Power Research Institute (2014). *Assessment of Compressed Natural Gas and Electricity as Transportation Fuels for Utility Fleets and Utility Customers.* Report No. 3002000295.
[33] Comments by Dan Bowermaster, Electric Transportation Program Manager, Electric Power Research Institute
[34] Electric Power Research Institute (2013). *Electric Vehicle Supply Equipment Installed Cost Analysis.* Report No. 3002000577.

Charging Type	EVSE equipment	EVSE installation	Site property & Premises wiring	Utility distribution	Total cost per EVSE port connection
Residential SFH L2	$500	$150	$675	$50	**$1,375**
Workplace/Fleet/MUD L2	$700	$350	$1,700	$750	**$3,500**
Public L2	$2,500	$500	$3,000	$2,000	**$8,000**
Public DC Fast Charging	$35,000	$55,000	$10,000	$25,000	**$125,000**

Installation of Level 2 EVSE in a single-family residential garage usually involves installing premises wiring for a dedicated 220 volt circuit from the electric supply panel to the charging equipment. In our service territory, this cost is estimated at $675 including permit and inspection. The cost of the Level 2 EVSE equipment is approximately $500, plus approximately $150 for EVSE installation and testing. In some cases, utility distribution upgrades such as higher capacity transformers may be needed. This results in a total cost estimate of $1,375 for a typical residential installation.

Level 2 EVSE installations for MUDs, workplaces and commercial fleets are more expensive than most residential applications, with greater cost variability due to a number of variables, such as the location of where the EVSE must be located in relation to the power source, additional trenching, protection or barriers to protect the EVSE from damage. These types of EVSE installations are estimated at $3,500 per port connection. Public Level 2 EVSE are usually more expensive still, for a total cost of about $8,000 per port connection. These costs reflect the common need for significant ground trenching work with extended conduit lengths, repaving, panel upgrades, and occasionally utility distribution equipment upgrades. DC Fast Charging installations are the most expensive, estimated at a total cost of $125,000 each. Very careful selection of DC Fast Charging EVSE site locations is necessary to maximize utilization and limit costs by avoiding areas requiring extensive utility distribution feeder supply and trenching work.

In addition to these costs, the use of EVSE “smartchargers” which have communications, data collection, and in some cases meter-grade sensing and demand response capabilities, add approximately $2,000 per port connection. Lastly, there are recurring operations costs involving network communications, data management and analysis.

E. <u>Charging Infrastructure Assessment</u>

About 80% of charging is expected to occur at home, 10% to 15% at the workplace, and 5% to 10% percent at public charging locations.[35] As mentioned earlier, residential charging at Level 1 and Level 2 is adequate to meet the daily driving needs of many EV drivers. However, the availability of workplace charging is of major importance as a catalyst for adoption, as it allows

[35] Halliwell, John (2013). *Plug-in 2013 Infrastructure 101 Presentation.* Electric Power Research Institute. September 30, 2013.

many PHEV owners to drive to and from work using electricity in both directions, and to extend the commuting range of BEV owners. In fact, the availability of workplace charging can "make or break" the decision to drive an EV. For example, the U.S. DOE showed that twenty times as many employees drove EVs when charging was made available at the workplace, compared to the average worker.[36] Public Level 2 EVSE is needed to enable local driving needs beyond the normal daily commute, and public DC Fast Charging EVSE is necessary to enable longer distance EV travel. Although public Level 2 and DC Fast Charging EVSE in many cases are not highly utilized, their visibility and availability help build awareness and confidence in the ability to find a charging station if the battery gets low, or as a convenient way to take the occasional longer trip. This greatly helps overcome consumer "range anxiety" and enable EV purchase decisions.[37] It's also essential to recognize the importance of site location. For example, public Level 2 EVSE located at a car dealership may be useful in rare emergencies, but most likely would lack public visibility or convenience as a place to park the vehicle for an extended period of time in normal circumstances.

The following number of EVSE port connections for each type are deemed adequate to serve 1,000 EV drivers, compared to the number available in our service territory today.[38,39]

Charging Type	**Number of EVSE port connections needed per 1,000 EVs**	**Current Number of EVSE port connections in Avista WA service territory**
Residential Level 2	500	unknown
Workplace Level 2	270	unknown
Public Level 2	67	17
Public DC Fast Charging	5	1

Note that due to location, of the seventeen public Level 2 EVSE currently available, most are unsuitable for convenient or routine use by EV drivers as only four are available to the general public located near shopping or other attractions where a driver might realistically want to spend two hours or more time.

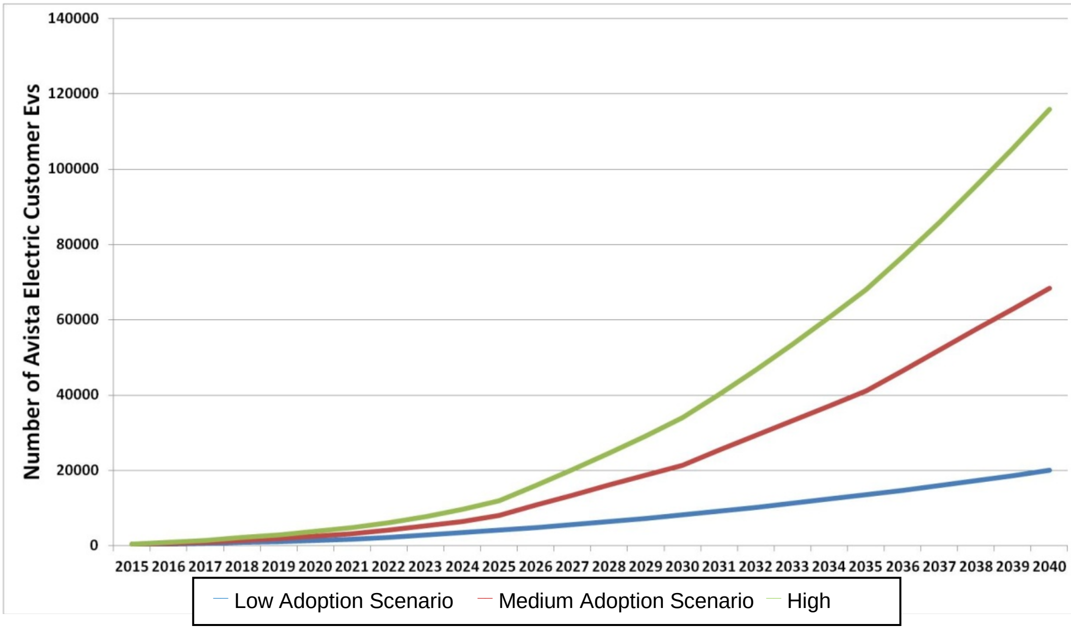
Based on vehicle registrations and RL Polk research data, as of June 30, 2015 an estimated 250 to 300 Avista customers drive EVs in Washington.[40] This is segmented by approximately 45%

[36] U.S. Department of Energy (2014). *Workplace Charging Challenge Progress Update 2014: Employees Take Charge*. November, 2014.
[37] Nick Nigro, Jason Ye, and Matt Frades (2014). *Assessing the Electric Vehicle Charging Network in Washington State.* September, 2014.
[38] Electric Power Research Institute (2014). *Guidelines for Infrastructure Planning: An Explanation of the EPRI Red Line/Blue Line Model.* Publication No. 3002004096.
[39] www.plugshare.com. Accessed September 18, 2014.
[40] Washington State Department of Transportation (2015). *Plug in Electric Vehicles Registered in Washington as of June 30, 2015.*

PHEVs and 55% BEVs, the great majority of which are registered in Spokane County. The relatively low adoption rate per capita in our service territory compared to the Puget Sound region is due at least in part to the low level of accessible charging infrastructure.[41] For example, the absence of DC Fast Charging EVSE in nearby towns and cities around Spokane and along I-90 means EV drivers cannot practically use their vehicles to take longer trips between neighboring cities and towns, such as Spokane, Pullman, Chewelah, and Clarkston, let alone between Spokane and Seattle or Portland, Oregon. This situation undoubtedly dampens EV adoption in our service territory.[42]

The chart below illustrates the projected growth of EV's on Avista's system, given reasonable low, medium and high adoption scenarios over the next 25 years.[43,44,45] This represents EV penetration of 3%, 12%, and 20% of all vehicles on the road by 2040 for the low, medium and high scenarios, respectively. The low scenario is simply a regression of the low adoption rate seen thus far, projected forward with an assumption of small population growth. Avista believes the low scenario is very conservative as EV adoption has been hampered in its service territory due to the lack of EVSE. As a benchmark comparison, in the 10 years since the introduction of HEV's, the penetration is already greater than 3%. Even greater EV adoption than the high scenario shown below may be needed to achieve emerging policy goals to mitigate climate change risks.[46] However, this would most likely require significant political and cultural influence beyond that considered here.

[41] Of the approximately 300,000 EVs registered in the United States, about 46% are located on the west coast, with 120,000 in California, 5,600 in Oregon, and 12,000 in Washington.
[42] Nick Nigro, Jason Ye, and Matt Frades (2014). *Assessing the Electric Vehicle Charging Network in Washington State.* September, 2014.
[43] Electric Power Research Institute (2012). *The Plug-In Electric Vehicle Market: Current Status and Long-Term Outlook.* Publication No. 1024103.
[44] Shields, Craig (2011). *Predicting the Electric Vehicle Adoption Curve.* Presented at the 2011 Electric Vehicle Summit.
[45] Santa-Eulalia, Luis Antonio de; Neumann, Donald; Klasen, Jorg (2011). *A Simulation-Based Innovation Forecasting Approach Combining the Bass Diffusion Model, the Discrete Choice Model and System Dynamics.* Presented at SIMUL 2011: The Third International Conference on Advances in System Simulation.
[46] Ryan, Nancy. (2015). *Engaging Utilities and Regulators on Transportation Electrification*. Energy and Environmental Economics. March 1, 2015.



In the near term, through 2020 the medium and high adoption scenarios translate to between 2,500 and 3,800 Avista customers with EVs, respectively. Adequate charging infrastructure is a key enabler to accelerate and achieve these higher rates of EV adoption in the near term, which in turn has a major effect on the trajectory of longer-term adoption. As it stands, currently available charging infrastructure is inadequate to support the number of EV drivers in our service territory today, and grossly inadequate to encourage higher EV adoption rates in the future.

F. Benefits of EV Adoption and the Need for an Avista EVSE Program

Greater numbers of EVs benefit all utility customers when the billed revenue from EV customers exceeds the costs of serving them. [47] For example, the California Transportation Electrification Assessment showed that each EV provides billed revenue of over $2,500 net present value above utility costs over its lifetime. [48] In the long term, much of this may depend on the flexibility of EV charging to occur during system off-peak times, such that the utilization of grid infrastructure is maximized. For example, "smartcharging" techniques to encourage off-peak charging could result in the avoidance of grid upgrades for up to 50% of residential households with an EV,[49] as well as substantial reductions in major capacity investments.

A preliminary Avista study indicates that net present value contributions of $500 to $2,000 per PEV may be possible in a medium adoption scenario, resulting in negative rate pressure. However, sensitivity analysis shows that depending on different assumptions for EV adoption scenarios, base charging profiles, shifting of on- to off-peak charging times, and the level of

[47] Ryan, Nancy. (2015). *Engaging Utilities and Regulators on Transportation Electrification*. Energy and Environmental Economics. March 1, 2015.
[48] Energy and Environment Economics (2014). *California Transportation Electrification Assessmen – Phase 2: Grid Impacts*. October 23, 2014.
[49] Vermont Energy Investment Corporation (2015). *In the Driver's Seat: How Utilities and Consumers Can Benefit from the Shift to Electric Vehicles*. April 30, 2015.

EVSE investment by the utility, a range from slightly negative to slightly positive rate pressure could occur.[50] Empirical data acquired from a statistically significant number of customers is necessary to establish base charging profiles and model system impacts with greater certainty.

In addition to all customers benefiting from EV billed revenue exceeding costs, EVs result in other benefits including improved air quality and lower greenhouse gas emissions, energy security, macro-economic benefits resulting from reduced transportation fuel costs, and overall energy conservation. As an example, using a total resource cost test (TRC), the California Transportation Electrification Assessment showed a net benefit of $5,000 per EV, and using a societal cost test (SCT) showed a net benefit of over $6,100 per EV. [51] In light of the many benefits of EVs and in order to achieve greenhouse gas emission reductions, the Washington Governor's office has set a Results Washington Clean Transportation Goal of 50,000 EVs registered in the state by 2020.[52]

In the near term, the number of EVs in Avista's service territory will have a negligible effect on revenues and rates, in terms of added electric load and costs to serve that load. Continued energy efficiency improvements such as reduced lighting energy usage with the switch to LEDs, is expected to result in negative to flat electrical use per customer through 2035. [53] Over time, greater adoption of EVs may act to offset these reductions, possibly resulting in slightly positive overall usage per customer. Regardless of average loads, however, it is possible that on-peak EV charging could result in the need for increased peak capacity. Utility assets can be better utilized if electricity for EVs is consumed during off-peak periods, thereby delaying investments in generation and distribution infrastructure.[54] As part of an EVSE program, deliberate demand response experiments may enable an assessment of the feasibility, costs and benefits associated with getting customers to charge their EVs off-peak, and help inform improved long-term infrastructure planning that ultimately optimizes system lifecycle costs.

An Avista EVSE program can also serve participating customers by alleviating informational and first-cost barriers. EV owners and organizations desiring Level 2 EVSE at home, at work or at public locations are faced with significant effort to gain reliable information, evaluate charging needs, product vendors, installation contractors, and municipal code requirements. Many opt to forego purchase and installation of a Level 2 EVSE, due to information uncertainty, inconvenience, and up-front purchase and installation costs. A program sponsored by Avista would provide assistance to these customers and value in the form of reliable information and effective EVSE products and services.

[50] Avista Corporation (2015). *Electric Vehicle Impact Study*. July 22, 2015.
[51] Energy and Environment Economics (2014). *California Transportation Electrification Assessmen – Phase 2: Grid Impacts*. October 23, 2014.
[52] Results Washington, http://www.results.wa.gov/what-we-do/measure-results/sustainable-energy-clean-environment/goal-map
[53] Avista 2015 Electric Integrated Resource Plan, Figure 3.15
[54] Driving an average of 11,400 miles per year in an EV at 3.3 miles per kWh, results in 3455 kWh electric consumption per year. This represents a 29% increase over the current 11,664 kWh average used by Avista's retail customers.

In addition, the use of Level 2 EVSE at home and at work results in lower electrical resistance losses than Level 1 EVSE, for an equivalent amount of energy delivered. This can provide efficiency gains of 2.3% to 12.8%, depending on a variety of factors.[55] Over the course of time and with growing numbers of EVs on the system, the efficiency gains from charging at higher voltage levels effectively reduces the total lifecycle cost of charging at Level 2.

Finally, an effective EVSE program can address the lack of EVSE in our service territory and greatly increase the availability of workplace charging. This is necessary to facilitate regional EV travel, build range confidence, and achieve higher EV adoption rates. As public EVSE are expensive, a more limited quantity and careful selection of site locations is imperative to minimize costs and maximize benefits.

In summary, an Avista EVSE program is key to enabling greater EV adoption that benefits all customers. A comprehensive EVSE program aligns with State policy goals to achieve societal benefits, is responsive to customers, and addresses critical adoption barriers. It also provides important channels for learning and paves the way for cost effective off-peak charging, improved system planning, and ultimately lower total lifecycle costs.

III. EVSE PILOT PROGRAM DETAILS

The factors driving EV adoption, the need to overcome barriers, and the potential for short-term benefits as well as substantial long-term utility customer and societal benefits, have led Avista to propose a two-year EVSE pilot program that accomplishes two primary objectives:

1. install a moderate number of different EVSE types in beneficial locations, in order to immediately support EV adoption and develop the capability to deploy an effective EVSE program on a larger scale.
2. Determine EV residence locations and base charging profiles for residential, workplace and public charging locations, in order to better estimate system impacts, facilitate long-range planning, and design useful demand response experiments.

Specifically, the pilot's targeted number of EVSE port installations are listed below:

Charging Type	**Year 2**	**Year 2**	**Total**
Residential SFH Level 2	40	80	120
Workplace/Fleet/MUD Level 2	30	70	100
Public Level 2	20	25	45
Public DC Fast Charging	2	5	7

Included in the installation figures above are proposed "smartcharger" installations for 100 residential (out of the total 120) and 90 combined workplace and public Level 2 EVSE port

[55] Vermont Energy Investment Corporation, Transportation Efficiency Group (2013). *An Assessment of Level 1 and Level 2 Electric Vehicle Charging Efficiency*. March 20, 2013.

connections (out of the total 145). Statistically significant sample sizes of BEV, PHEV, commuting and non-commuting subsets are targeted in these “smartcharger” installations, with data acquisition, network communications, and demand response capabilities. Cost estimates for the pilot program are as follows:

	Year 1	**Year 2**	**Year 3**	**Totals**
Capital	$704,500	$1,610,750	$0	$2,315,250
O&M	$271,135	$329,833	$179,458	$780,425
Totals	**$975,635**	**$1,940,583**	**$179,458**	**$3,095,675**

The Company proposes to fund the pilot-program through its normal capital funding program, with no request for an accounting deferral or tariff rider to collect funds for the program. Instead, the Company will seek recovery of Capital and O&M costs through the normal General Rate Case process. O&M costs include credits paid to automobile dealers for data acquisition, administrative expenses, premises wiring reimbursement, data analytics, and reporting. The majority of the O&M costs during the course of the pilot program represent one-time expenses. The expected annual O&M cost beginning at the conclusion of the pilot program is approximately $179,458 per year. The estimated annual revenue requirement after the equipment is installed (2018 and beyond) is $686,194 (see workpapers for calculation), which equates to an approximate 0.14% bill impact to customers.

Attached tariff Schedule 77 explains the following elements of the program:

i. Availability – the pilot program will be available to electric customers in the Company’s Washington service territory.
ii. Eligibility requirements – participants of the program must be a customer of Avista, and for residential customers must own or lease an EV.
iii. Site selection – all residential, workplace, and MUD site locations shall qualify if the customer meets all eligibility criteria of the program. Level 2 public installations shall qualify if the EVSE is at a site location where users are likely to reside for more than two hours. DC Fast Charging EVSE site locations will be determined by the Company, based on locations that minimize costs and will be utilized by the greatest number of EV drivers.
iv. Ownership of EVSE – all equipment installed will be owned and maintained by the Company.
v. Premises wiring reimbursement – described below.
vi. Customer obligations – described below.
vii. EVSE Site Agreement – described below.

Participants of the pilot program will include existing EV drivers, new EV drivers during the course of the pilot, and public and private organizations, all of which are Avista customers. Regular reviews and reporting of results, adaptive management, and adjustments during the two-year period are expected. Further details are provided below.

A. EVSE

EVSE will be purchased and owned by Avista, with an expected depreciable life of ten years. One or more vendors will be selected for the pilot following requests for proposals. Standard Level 2 EVSE will be capable of charging at a minimum of 3kW output power. In addition, "smartcharger" Level 2 EVSE will be capable of data collection, network communications, and demand response. Data collection will include amperage, voltage, date, time, and battery state. A limited number of public Level 2 EVSE may be capable of user payment. DC Fast Charging EVSE will generally be capable of 50kW output power and user payment.

Installation of some standard (non-networked) EVSE allows Avista to understand costs and operational implications for this category of EVSE, and forms a stronger relationship with the customer whereby a smartcharging EVSE could be more readily installed in the future. We anticipate that following the 2-year pilot program installation period, if a longer term installation program is proposed and launched, it will involve a much higher proportion of standard chargers until such time as the market makes available smartchargers at reduced costs, such that overall benefits outweigh costs in a shorter time horizon. As stated in the petition, a transition from petroleum to electric vehicle transportation results in net benefits to all customers and society in general. For these reasons it is important for Avista to utilize and become familiar with some standard EVSE as part of the pilot program.

B. Installation

Coordination, installation and inspection of EVSE will be designed to streamline the process and provide a satisfying Customer experience, while ensuring required safety and permitting is performed. Installations will be performed by Avista contractors selected through a request for qualifications process.[56] Contractors will deliver, install and test EVSE, following verification that electrical supply service meets all code and legal requirements.

C. EVSE Site Agreement

For purposes of the pilot program, the EVSE Site Agreement will include the obligation of the Customer to participate in regular feedback surveys and future demand response experiments until such time as the EVSE is removed or the agreement is terminated.

The Customer must also agree to be responsible for routine inspection, maintenance and troubleshooting not requiring technicians (e.g., resetting the circuit breaker). Operation and maintenance (O&M) activities requiring field technicians will be accomplished by qualified contractors, selected through a request for qualifications process. Customers will be responsible to pay Avista for electricity delivered to EVSE, and by law may not resell this electricity to EV drivers using EVSE. In many workplace and public locations the cost of electricity is relatively small, such that the total cost to enable and transact payments may be more than simply

[56] Contractor selection is critical to the success of this pilot so as to install EVSE in accordance with all code requirements, provide prompt follow-up services where needed, and ensure high customer satisfaction.

providing charging services free of payments. [57] However, in some public Level 2 EVSE locations, the EVSE may need to be managed for optimal use, possibly including port availability control and a reasonable payment by the EV driver.[58] In limited cases such as these, the terms of payments by EV drivers will be determined by the Customer who is hosting the EVSE and paying for the electricity.

In contrast, DC Fast Charging EVSE will require payment by the EV driver. This helps ensure availability for drivers that depend on it to make a longer trip, rather than others using it for "free" local driving needs that can be met by charging at home or at work. In the case of DC Fast Charging EVSE, Avista will own and maintain all equipment from the transformer to the EVSE, and transact EV driver payment for electricity use at the EVSE. In these cases, Avista will seek a property easement from a site host if it does not own the property, and request that the site host notify Avista's maintenance contractors in the event of any problems with the DC Fast Charging EVSE.

For all AC Level 2 EVSE the term of the Site Agreement will be ten years or until such time that either the Customer or the Company terminates the agreement and removes the EVSE from the Customer's location. At the end of the term of the EVSE Site Agreement the Company will work with the Customer on potentially replacing or upgrading the EVSE and signing a new EVSE Site Agreement, removing the EVSE, or provide the Customer the option to purchase the EVSE from the Company.

D. <u>Premises Construction and Wiring</u>

A strong incentive is needed to gain adequate participation levels and ensure a successful pilot program. This is accomplished in part through reimbursement of installation costs, up to a reasonable limit. Under the pilot program, Level 2 EVSE installations will be contracted between the Customer and the assigned installation Contractor. Upon receipt of documentation that demonstrates satisfactory operation and the completion of legal inspection(s), costs will be reimbursed to the Customer up to a maximum of $1,000 per port connection for single-family residential installations, and $2,000 per port connection for workplace and public installations. The Customer retains full responsibility and ownership of all premises wiring downstream from the utility meter, and any premises construction work performed in the course of the installation.
In the event that a participating customer terminates his or her agreement prior to the end of the term, the charging units from early terminations will be reclaimed, with no compensation requirements, and redeployed at other customer sites.

In the case of DC Fast Charging EVSE installations, the Company will pay for all installation costs, retain ownership and maintain equipment from the transformer to the EVSE.

[57] At a commercial rate of $0.11 per kWh and a charging rate of 3.3 kW delivered to the vehicle, the Customer would be responsible for $0.36 per hour of actual charging, and $2.90 for 8 hours of continuous charging. In a workplace setting dedicated to employee use, the average commuting distance of 29 miles range per day would require 8.8 kWh, or 2.7 hours of charging for a cost of $0.96.
[58] For example, at a pay-for-use parking lot near a downtown core or shopping mall, or in a hotel owner's parking lot where the EVSE is available for non-guests at certain times.

E. Data Acquisition through Signed Customer Releases

EV sales volume, residence location, and contact information are critical to effective system planning and successful pilot participation. Avista is proposing that automobile dealers who sell EVs be paid $100 per Avista customer that purchases an EV, up to the first 250 customers, if they collect this data and submit it to the Company. This credit will act as an incentive for dealers to obtain information from the customer, at the customer's written consent of information disclosure, and then provide it back to the Company. The incentive will be paid regardless of whether the customer elects to install a Level 2 EVSE.

F. Evaluation and Adjustment

The pilot program will be continuously evaluated for improvement and adaptive management adjustments, including two annual reports. Customer feedback and performance metrics will be reviewed on a quarterly basis, including:

- Number, type and location of PEV purchases and charger locations
- Charging data quantity and quality
- Customer satisfaction
- Installation costs
- Dealer response rate
- Installation and service lead time
- Budget spending and cash flows

All aspects of the pilot project and improvement adjustments will be evaluated including:

- Metering integration
- Customer outreach and education
- EVSE performance
- Contractor installation and service performance
- Residential apartment and commercial/public installations
- Consideration of future program revisions

G. Demand Response and Controlled Charging

As described in the customer Site Agreements, customers will allow the Company to control charging in instances where the installed EVSE has smartcharging capabilities. Avista plans to collect data uninfluenced by demand response for a minimum of one year after the installation of the EVSE, and possibly longer depending on participation levels, until such time that the Company is able to establish baseline charging profiles. Analysis of this data will help determine customer behaviors and system impacts, as well as the specifics of potential demand response experiments, i.e., exactly when and for how long the Company should attempt to modify the charge time from one day to the next, given the charging behavior that is demonstrated.

Demand response experiments will continue well beyond the initial 2-year period of the pilot program installations, for those customers electing to continue participating in the program. Four basic categories of EV drivers are of interest for establishing baseline charging profiles as well as participation in controlled charging: BEVs, PHEVs, commuters, and non-commuters. The Company would like to install smartchargers for 20+ Customers in each group for the residential installations in order to form a reasonable statistical sample. Demand response will generally be done for residential and workplace Level 2 installations where the vehicles are parked for many hours, but not for public installations where the EVs are parked for just a few hours. Each day, charging is curtailed when demand is at its peak, but with the goal of fully charging the EV by the time the customer needs to use the vehicle. Customer notifications and right to opt-out will be available, via email and/or smartphone communication. This is all designed with the primary goal to convincingly demonstrate how much on-peak load can be shifted to off-peak, and with important details such as what percentage of demand response events are opted-out of, and if customer satisfaction can remain high compared to uninfluenced charging. Future demand response experiments with other parameters may be devised, in which case the Company will submit a proposal to the Commission for approval.

H. Post-Pilot

Ongoing data acquisition and demand response experiments will continue for several years following EVSE installations. This will entail O&M expenses including project management, data management fees, return service visits, and miscellaneous administrative costs at an estimated $179,458 per year.

Following the conclusion of the pilot program the Company will re-evaluate the costs, benefits, and need for continued investment in EVSE. The Company will use this evaluation to inform the framework of a future long-term program.

Avista requests the tariff revisions become effective March 14, 2016. If you have any questions regarding this filing please contact Shawn Bonfield at 509-495-2782 or myself at 509-495-8620.

Sincerely,

Shawn Bonfield

Sr. Regulatory Policy Analyst
Avista Utilities
shawn.bonfield@avistacorp.com
509-495-2782

Enclosures

N

SCHEDULE 77

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)
PILOT PROGRAM

PURPOSE & OBJECTIVES
This Schedule outlines the parameters of the Company's two-year pilot program for installation of EVSE in residential, workplace, multi-unit dwelling, and public locations. The objectives of the program are to (1) enable installation of a moderate number of different EVSE types in order to immediately support Electric Vehicle adoption and develop the capability to deploy an effective EVSE program on a larger scale, and (2) determine Electric Vehicle residence locations and base charging profiles for residential single family homes, workplace, and public charging locations, in order to better estimate system impacts, facilitate long-range planning, and design useful demand response programs.

As described below, Avista will provide and install EVSE at participating customer locations. Customers will be responsible for providing adequate electric service at the point of installation. Avista will reimburse customers incurred wiring costs, up to the levels specified in this Schedule. The pilot's targeted number of EVSE port installations is listed in the following table:

Charging Type	**Year 1**	**Year 2**	**Total**
Residential Single Family Home Level 2	40	80	120
Workplace/Fleet/MUD Level 2	30	70	100
Public Level 2	20	25	45
Public DC Fast Charging	2	5	7

AVAILABLE:
To Customers in the State of Washington where Avista has electric service, up to the number of units in the table above.

APPLICABLE:
To all customers receiving electric service who contract with Avista to own and install EVSE behind the existing Avista electric service meter that provides service to customer premises.

ELIGIBILITY:
The EVSE and associated Premises Wiring Reimbursement is available to Customers who agree to the terms and conditions of this Schedule, sign an Avista EVSE Site Agreement, and for residential customers, provide proof of Electric Vehicle ownership or lease.

TERM
The term of the pilot program shall be two years, beginning May 1, 2016 and ending May 1, 2018.

N

AVISTA CORPORATION
d/b/a Avista Utilities

N

SCHEDULE 77 - Continued

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)
PILOT PROGAM

DEFINITIONS:
Electric Vehicle means a vehicle that uses at least one method of propulsion that is capable of being reenergized by an external source of electricity, is designed to have the capability to drive at a speed of more than 35 miles per hour, and is licensed to drive on state and federal highways.

Electric Vehicle Supply Equipment means the installed device used to deliver electricity from the Premises Wiring to the electric vehicle, meeting Standard J1772 of the Society of Automotive Engineers International and listed under applicable UL Standards and requirements or equivalent listing by a nationally recognized testing laboratory. This device includes the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets or apparatuses associated with the installed device, but does not include Premises Wiring.

Premises Wiring means a dedicated 208/240VAC, 40 ampere or lower circuit that supplies electricity directly to the installed Electric Vehicle Supply Equipment. This includes the protective breaker at the supply panel, wiring, final junction box, receptacle and all attachments and connections. The Customer retains ownership and is wholly responsible for the Premises Wiring, including that it meets all industry workmanship standards and applicable requirements in the National Electric Code, Washington Administrative Code, and local municipal codes.

An Avista EVSE Site Agreement is an Avista document stating the terms and conditions of participation in the Program, including but not limited to the installation of Premises Wiring and EVSE, ongoing maintenance, and effect of termination.

SITE SELECTION:
All locations in residential single-family homes, multiple-unit dwellings, and at businesses or workplaces for employees shall qualify if the Customer meets all eligibility criteria of the Program. Each single family residence will be limited to the installation of one EVSE. Multi-unit dwelling and businesses or workplace installations will be limited as reasonable to match the need at the location with the demand of the Program.

Public AC Level 2 (208/240V) EVSE installations shall qualify if the EVSE is at a site location where users are likely to dwell for more than two hours. DC fast charging EVSE site locations will be determined by the Company, based on locations that minimize costs and provide the greatest value and utilization to EV drivers.

N

Issued January 14, 2016 Effective March 14, 2016

Issued by Avista Corporation
By Kelly Norwood, Vice President State and Federal Regulation

Kelly Norwood

AVISTA CORPORATION
d/b/a Avista Utilities

N

SCHEDULE 77 - Continued

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)
PILOT PROGAM

PREMISES WIRING REIMBURSEMENT
Avista will reimburse Customers a maximum amount of $1,000 per EVSE to residential single family home installations to cover the cost of the installation and associated Premises Wiring, and $2,000 per EVSE port connection for multi-unit dwelling and business or work place installations, provided the Customer meets the requirements, terms and conditions of this Schedule and the EVSE Site Agreement. The customer will retain ownership of the Premises Wiring and is wholly responsible for the premises wiring at all times.

TERMINATION:
Customers may terminate participation from the Program at anytime, subject to the termination provisions in the EVSE Site Agreement, at which time the Company will remove the EVSE installed at their location. The Company may terminate the EVSE Site Agreement upon 30 days notice to the Customer and allow the Customer to have the EVSE removed or elect to retain the EVSE as described in the EVSE Site Agreement. In the event the customer relocates within Avista's service territory, Avista will give the Customer the option to install an EVSE at the new location, at the Customer's expense.

OWNERSHIP OF EVSE:
All EVSE installed will be owned and maintained by the Company until the EVSE is removed or the EVSE Site Agreement has been terminated by either party. At the end of the term of the EVSE Site Agreement the Company will work with the Customer on replacing or upgrading the EVSE and signing a new EVSE Site Agreement, removing the EVSE, or providing the Customer the option to purchase the EVSE from the Company.

CUSTOMER OBLIGATIONS
Customers who participate in the Program must notify the Company or its contractors in the event of any problems with the EVSE. Customers whose locations have a smartcharger installed as part of the EVSE must participate in ongoing surveys, data acquisition and demand response initiatives as described in the EVSE Site Agreement.

DATA ACQUISTION FROM AUTOMOBILE DEALERS
Automobile dealers who sell Electric Vehicles will be paid a $100 incentive per Avista customer that purchases an EV if the dealer collects certain data from those purchasers at their consent and returns the information to Avista. Such information shall include an option for Customer to indicate whether he/she would like to be contacted about the Program. The incentive will be paid regardless of whether the Customer elects to participate in the Program. A maximum of $25,000 will be spent on dealer incentives during the Program.

SPECIAL TERMS AND CONDITIONS:
Service under this schedule is subject to the Rules and Regulations contained in this tariff.

N

Issued January 14, 2016 Effective March 14, 2016

Issued by Avista Corporation
By Kelly Norwood, Vice President State and Federal Regulation

Kelly Norwood

ELECTRIC POWER
RESEARCH INSTITUTE

Total Cost of Ownership for Current Plug-in Electric Vehicles

Update to Model 2013 and 2014 Model Year Vehicles

3002004054

Total Cost of Ownership for Current Plug-in Electric Vehicles

Update to Model 2013 and 2014 Model Year Vehicles

3002004054

Technical Update, May 2014

EPRI Project Manager

M. Davis

ELECTRIC POWER RESEARCH INSTITUTE
3420 Hillview Avenue, Palo Alto, California 94304-1338 ▪ PO Box 10412, Palo Alto, California 94303-0813 ▪ USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

THE FOLLOWING ORGANIZATION PREPARED THIS REPORT:

Electric Power Research Institute (EPRI)

This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.

NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

ACKNOWLEDGMENTS

The following organization prepared this report:

Electric Power Research Institute (EPRI)
3420 Hillview Avenue
Palo Alto, CA 94304

Principal Investigator
M. Davis

This report describes research sponsored by EPRI.

This publication is a corporate document that should be cited in the literature in the following manner:

Total Cost of Ownership for Current Plug-in Electric Vehicles: Update to Model 2013 and 2014 Model Year Vehicles. EPRI, Palo Alto, CA: 2014. 3002004054.

ABSTRACT

As of April 2014, there are over 200,000 Plug-in Electric Vehicles (PEVs) on the roads in the United States. From 2011 to the present, sales growth has been steady and strong—approximately double historical hybrid sales during the same period. This sales performance is attributable to increasing consumer acceptance, recent decreases in price, and the introduction of very competitive leasing deals on vehicles. In June 2013, EPRI released the public report, *Total Cost of Ownership for Current Plug-in Electric Vehicles* (3002001728) to address whether or not PEVs are cost competitive over a 150,000-mile lifetime in comparison to closely matched Generic Conventional and Generic Hybrid vehicles. The 2013 report analyzed the total cost of ownership (TCO) of the 2013 Chevrolet Volt and Nissan LEAF. Since then, both companies have announced significant price reductions on these vehicles—including a price drop of $5,000 on the Volt. This Technical Update incorporates the new prices and provides TCO and payback-period analyses of two additional vehicles: the Toyota Prius Plug-in and the Ford C-Max Energi. The methods used in this study are generally the same as those used in the 2013 report. For the Prius Plug-in and the C-Max Energi, this update also compares these PEVS to their non–plug-in hybrid counterparts. The TCO pricing analyses for all vehicles includes the Manufacturer's Suggested Retail Price (MSRP), purchase price (including incentives, sales tax, and delivery charges), fuel economies, electric driving range, and powertrain description. This study reaffirms the findings of the 2013 report that the Volt and LEAF are cost-competitive for many customers relative to similar conventional and hybrid vehicles. The cost reductions for the Volt have reinforced this positive conclusion. The Plug-in Prius and C-Max Energi also have a lower TCO than generic conventional and hybrid vehicles. At present, the LEAF is more expensive than its own non–plug-in hybrid counterpart, but the 2014 Prius Plug-in has a significantly lower TCO than the non–plug-in Prius. Payback periods for all four analyzed PEVs are rapid (less than five years) relative to Generic Hybrid vehicles, but they are more variable relative to Generic Conventional vehicles.

Keywords
Plug-in Electric Vehicle (PEV)
Plug-in Hybrid Electric Vehicle (PHEV)
Battery Electric Vehicle (BEV)
Extended-Range Electric Vehicle (EREV)
Total cost of ownership (TCO)
Payback period for electric vehicles

EXECUTIVE SUMMARY

In April of 2014 the total number of Plug-in Electric Vehicles (PEVs) on the roads in the U.S. surpassed 200,000 units. As Figure 1 shows, sales growth has been steady and strong – third quarter sales in 2013 were up 32% over Q4 2012, up 319% over Q4 2011, and have generally been about double historical hybrid sales at the same time on the market.

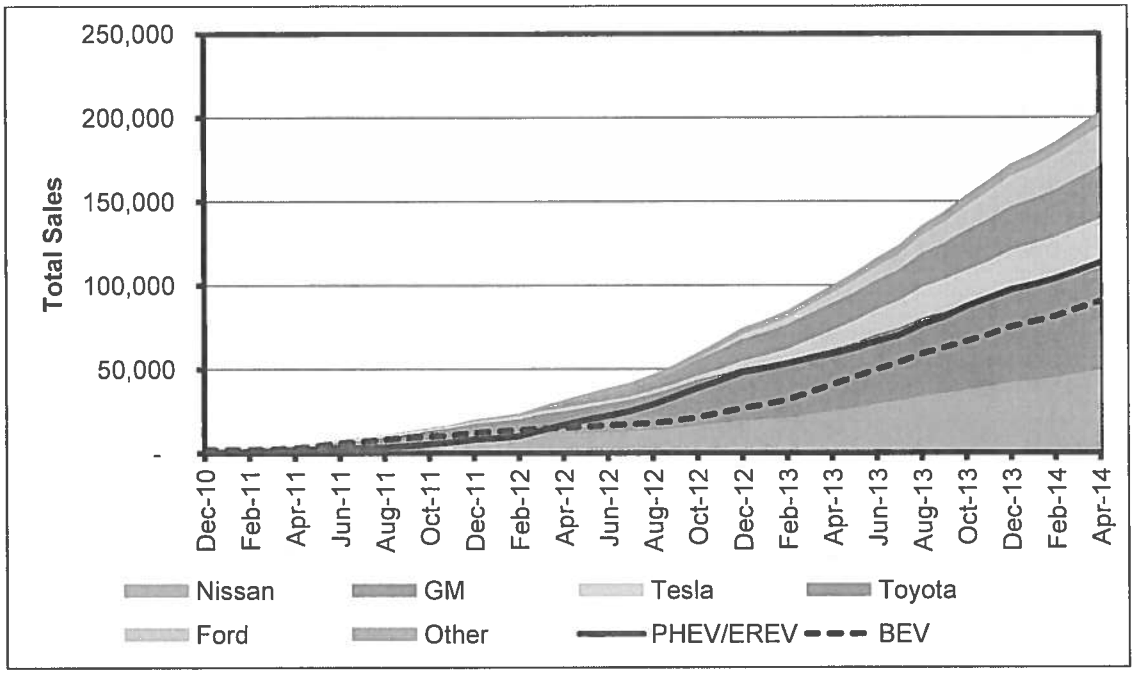


Figure 1
Cumulative plug-in electric vehicle sales for the U.S. through April 2014

This sales performance is likely attributable to both increasing consumer acceptance and recent decreases in the price of the vehicles. In the last year, there have been significant reductions in the Manufacturer's Suggested Retail Price (MSRP) reductions of some key PEVs and the introduction of very competitive leasing deals on vehicles. However, there is still some discourse on whether or not the vehicles are cost competitive over their lifetime. This study aims to provide a more comprehensive and up-to-date analysis of PEVs on the market. The June 2013 "Total Cost of Ownership Study for Current Plug-in Electric Vehicles" [1] included just two PEVs, one of which has had reduced pricing in the last 6 months. This Technical Update incorporates the new price and provides analyses of two additional vehicles.

Importance of Study & Revisiting TCO

In June 2013, EPRI released a public Total Cost of Ownership (TCO) study that presented a new way of analyzing driving data for the purpose of calculating TCO. The study used a full year's worth of driving data to calculate the TCO of vehicles over a 150,000 mile lifetime and compared PEVs to Generic Conventional and Generic Hybrid vehicles that were constructed from a set of closely feature-matched and comparably-sized vehicles. The study also included maintenance cost calculations based on OEM recommendations. These features all led toward a more accurate depiction of the true cost-to-own for PEVs than provided by previous studies.

In the June study, the TCO of the 2013 Nissan LEAF and 2013 Chevrolet Volt was presented, but the public report omitted both the Prius Plug-in and the Ford C-Max Energi. The analysis for these vehicles is presented here. Additionally, since the release of the original report the price of the Chevrolet Volt has dropped, which has had a significant impact on the vehicle's lifetime costs.

Update to Model

The model uses the same driving data as the previous TCO report, from the National Renewable Energy Laboratory's Puget Sound database [2]. The data consists of over 400 vehicles' driving data sampled for extended time periods, in most cases around one year. This data has been normalized to cover 365 days and filtered to ensure that the samples are representative of likely PEV drivers. For this update, the maintenance schedule and input assumptions were kept the same as the June 2013 study (Table 1). Gasoline costs have decreased since the previous study, but the prices have been maintained at the same level to allow the results to be compared. The vehicle options and vehicle prices have been updated as described in the next section.

Table 1
Constants for Model Input Values

Constant	Value used
Inflation rate	3%
Real interest rate	2%
Real discount rate (t <= 5 years)	2%
Real discount rate (t > 5 years)	5%
Cost of standard gasoline	$3.62 gallon^{-1}
Cost of electricity	$0.12 kWh^{-1}
Loan period	60 months/5 years
Replacement vehicle fuel economy[1]	24 miles*gallon^{-1}
Electric Vehicle Supply Equipment cost (LEAF only)[2]	$1,500
Sales tax[3]	7.2%
Vehicle lifetime	150,000 miles

[1] For BEVs, there may be days where the vehicle cannot complete the daily driving needs. These are considered to be "replacement days," which are described in more detail below
[2] Installed EVSE can vary between $500 and $6,000. The decision to use $1,500 for the EVSE installed cost is based on advertised costs from both Toyota and Ford of $1,500 for a typical installed EVSE [3].
[3] Based on a weighted average of state sales tax rates [4].

Key Results

The June 2013 Technical Update found that Volt and LEAF were cost competitive for many customers relative to similarly-equipped conventional and hybrid vehicles. This study finds that the cost reductions to the Volt have reinforced this positive conclusion, and that the Plug-in Prius and C-Max Energi have a lower total cost of ownership than the Generic Conventional and Generic Hybrid vehicles, although they are still more expensive than the hybrid vehicles which they share platforms with. In particular:

- **Chevrolet Volt:** The 2014 Volt has a significantly lower total cost of ownership than comparable conventional and hybrid vehicles. Payback is rapid relative to the Generic Hybrid, and occurs over about 7 years relative to the Generic Conventional for most customers.
- **Nissan LEAF:** The 2013 LEAF has a much lower cost of ownership than comparable conventional and hybrid vehicles, and payback is rapid compared to both the Generic Conventional and Generic Hybrid. There are some customers with driving patterns that would not be favorable for the LEAF due to its range limitations, but most customers would experience much lower expenditures over the vehicle life. The June 2013 report has a more extended discussion of the limitations for these customers; this is unchanged from the previous analysis.
- **Ford C-Max Energi:** The 2013 C-Max Energi has a significantly lower total cost of ownership than comparable conventional and hybrid vehicles, but it does have higher ownership costs that the C-Max Hybrid. Payback for the C-Max Energi occurs rapidly relative to the Generic Hybrid, but occurs over an extended timeframe relative to the Generic Conventional, and doesn't occur at all for some customers.
- **Toyota Prius Plug-in:** The 2014 Prius Plug-in has a much lower total cost of ownership than comparable conventional and hybrid vehicles, including significantly lower costs than the non-plug-in Prius. Payback is rapid relative to the Generic Hybrid, but due to relatively high up-front costs payback relative to the Generic Conventional vehicle happens over an extended timeframe.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1
METHODS

In general, the methods used in this analysis are the same as the June report. This report is meant to update the total cost of ownership model with more accurate pricing and the latest release of vehicles.

Vehicle Comparison

Similar to the previous report, we compare the selected PEVs to similarly feature-matched vehicles which are consolidated into a Generic Conventional and Generic Hybrid. For both the Prius Plug-in and C-Max Energi non-plug-in hybrid version of the cars are available, so we compare these vehicles to their hybrid counterparts. The pricing of all of the vehicles is shown below in Table 1-1, including the MSRP, purchase price including incentives, sales tax, and delivery charges, fuel economies, electric driving range and powertrain description.

Table 1-1
Vehicle comparison assumptions

	MSRP	Purchase Price	Combined Charge Sustaining Fuel Economy (mi/gallon)	Combined Electricity Consumption (AC Wh/mile)	Rated electric range (miles)	Vehicle Powertrain*
Generic Conventional	$25,000	$26,800	29	N/A	N/A	CV
Generic Hybrid	$30,658	$32,866	43	N/A	N/A	HEV
2013 Chevrolet Volt	$39,995	$35,664	37	360	38	EREV
2014 Chevrolet Volt	$34,148	$30,864	37	360	38	EREV
2012 Nissan LEAF	$35,200	$32,868	N/A	340	73	BEV
2013 Nissan LEAF	$31,730	$29,022	N/A	290	84	BEV
2013 C-Max Hybrid	$25,000	$27,014	43	N/A	N/A	HEV
2013 C-Max Energi	$32,950	$32,424	43	340	21	PHEV
2013 Prius	$27,598	$30,400	50	N/A	N/A	HEV
2014 Prius Plug-in	$29,990	$30,517	50	290	11	PHEV

* PHEV: plug-in hybrid electric vehicle; HEV: hybrid electric vehicle; CV: conventional vehicle; EREV: extended range electric vehicle; BEV: battery electric vehicle

The C-Max Energi and Prius Plug-in were not discussed in the first study because limited information on the real-world operation of these vehicles is available. These vehicles operate in a 'blended' hybrid configuration during charge depleting operation so they do not necessarily use the battery at a consistent rate per distance driven. This can have a significant effect on the fuel economy and electric range of the vehicles depending on the specifics of each individual driving pattern. For this analysis these vehicles are modeled assuming they operate similarly to an

Extended Range Electric Vehicle (EREV), driving purely on electricity during their EPA-rated charge depletion range and then switch to hybrid operation afterwards. This will be optimistic for some driving patterns and pessimistic for other driving patterns. More data and analysis is required to understand these vehicles in greater detail.

A number of assumptions were made about the purchase, charging, and use of the vehicles. The pricing does not include any state or local incentives, although these can significantly improve the TCO in some locations. All of the vehicles are assumed to charge at home at Level 1 for all vehicles except for the LEAF, which is assumed to charge at home at Level 2 with a high-power charge adaptor that requires an additional $1,500 investment. Since the LEAF is a Battery Electric Vehicle (BEV) it is assumed that on driving days which cover more distance than the electric range of the vehicle a replacement vehicle is used instead. This is called a 'Replacement Day', and assumes that the replacement vehicle gets 24 miles per gallon, the average for the national vehicle fleet. In the June 2013 report, additional replacement strategies were modeled as sensitivity cases, but this is the only scenario presented in this Update.

The maintenance model used in this study is the same as the one used in the June report for the Volt, LEAF, Generic Conventional, and Generic Hybrid. The C-Max Energi was given the same maintenance schedule as the Chevrolet Volt, and the C-Max Hybrid was given the same schedule as the Generic Hybrid. The Prius and Prius Plug-in were given a Prius-specific maintenance schedule.

2
MODEL RESULTS

The TCO model used in this study calculates the total lifetime cost of ownership for vehicles over a 150,000 mile lifetime. This section provides comparisons of the TCO and payback period for each PEV relative to the generic conventional and generic hybrid options. Vehicles that share a nameplate with another vehicle (C-Max and Prius) are also compared to their non-plug-in counterpart. Because both Nissan and Chevrolet reduced the price of their vehicles in 2013, we present the previous model prices as well for comparison.

Chevrolet Volt

In the summer of 2013 Chevrolet lowered the price of the Volt by $5,000. Previously, the total cost of ownership of the vehicle was slightly lower, on average, than the conventional or hybrid vehicle used in the study, but not every consumer benefited over the life of the vehicle. With the significant cost decrease, the Volt now is much less expensive for all drivers analyzed in this study than the comparison vehicles. The model year change did not affect the fuel economy nor were there any efficiency improvements, so fueling and maintenance costs remained the same. The results of the TCO analysis are shown below in Figure 2-1.

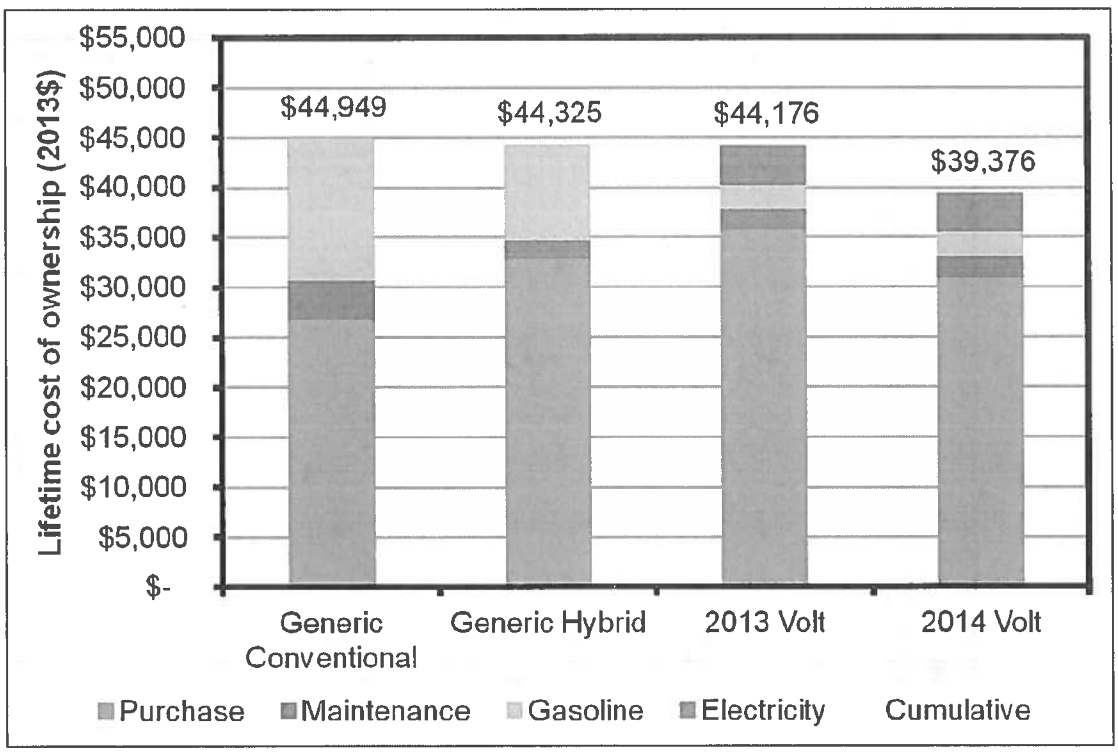


Figure 2-1
Total cost of ownership for the 2014 Chevrolet Volt

Table 2-1 shows the breakdown of the cost of the vehicles, maintenance, and fueling. Compared to either the Generic Conventional or Generic Hybrid, the largest benefit for consumers selecting the Volt comes from fuel savings. There are also significant maintenance savings relative to the Generic Conventional vehicle.

Table 2-1
Breakdown of the TCO for the 2014 Chevrolet Volt

	Generic Conventional	Generic Hybrid	2013 Chevrolet Volt	2014 Chevrolet Volt
Purchase	$26,800	$32,866	$35,664	$30,864
Maintenance	$3,909	$1,827	$2,151	$2,151
Gasoline	$14,239	$9,632	$2,444	$2,444
Electricity	-	-	$3,917	$3,917
Replacement	-	-	-	-
Cumulative Costs	$44,949	$44,325	$44,176	$39,376

Figure 2-2 shows the payback period for the 2014 Chevrolet Volt for a financed vehicle purchase using a loan period of 5 years. For 100% of drivers, the Volt pays back in less than 5 years when compared to the Generic Hybrid. The payback is less certain for drivers when compared to the Generic Conventional since a much higher fraction of this vehicle's total costs are operating costs that are incurred over an extended timeframe. This may change as increased charging is available or reduced electricity prices are used. From the 2013 to 2014 model year price changes, the payback time over the life of the vehicle drastically improved – in the previous iteration, no vehicles had less than a 12 year payback [1].

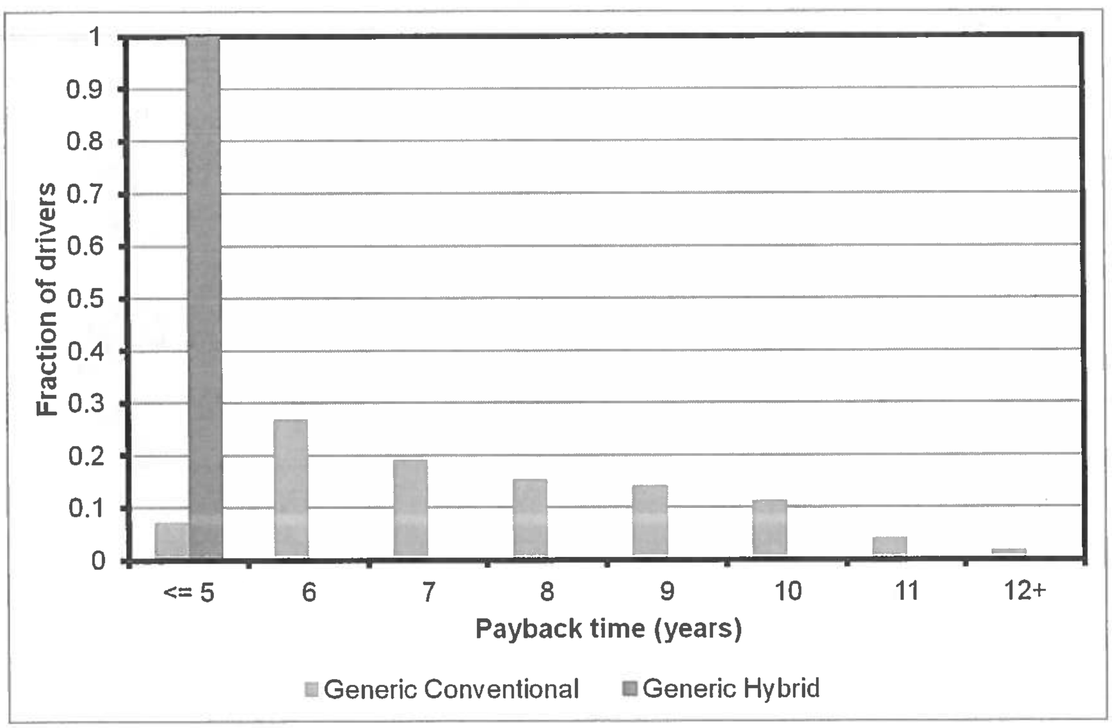


Figure 2-2
Payback period for the 2014 Chevrolet Volt

Nissan LEAF

Similar to the Chevrolet Volt, Nissan dropped the price at the beginning of 2013. While the 2012 LEAF was still less expensive over the life of the vehicle, the price drop made the vehicle even more financially attractive. However, dissimilar to Chevrolet, the LEAF also had an increase in EPA-rated MPGe from 99 in the 2012 model to 115 in the 2013 model – or a 15% improvement in the vehicle's fuel economy. The EPRI model uses the mid-range LEAF SV, to create an equivalent equipment level to the comparison vehicles. The results are shown in Figure 2-3 and Table 2-2.

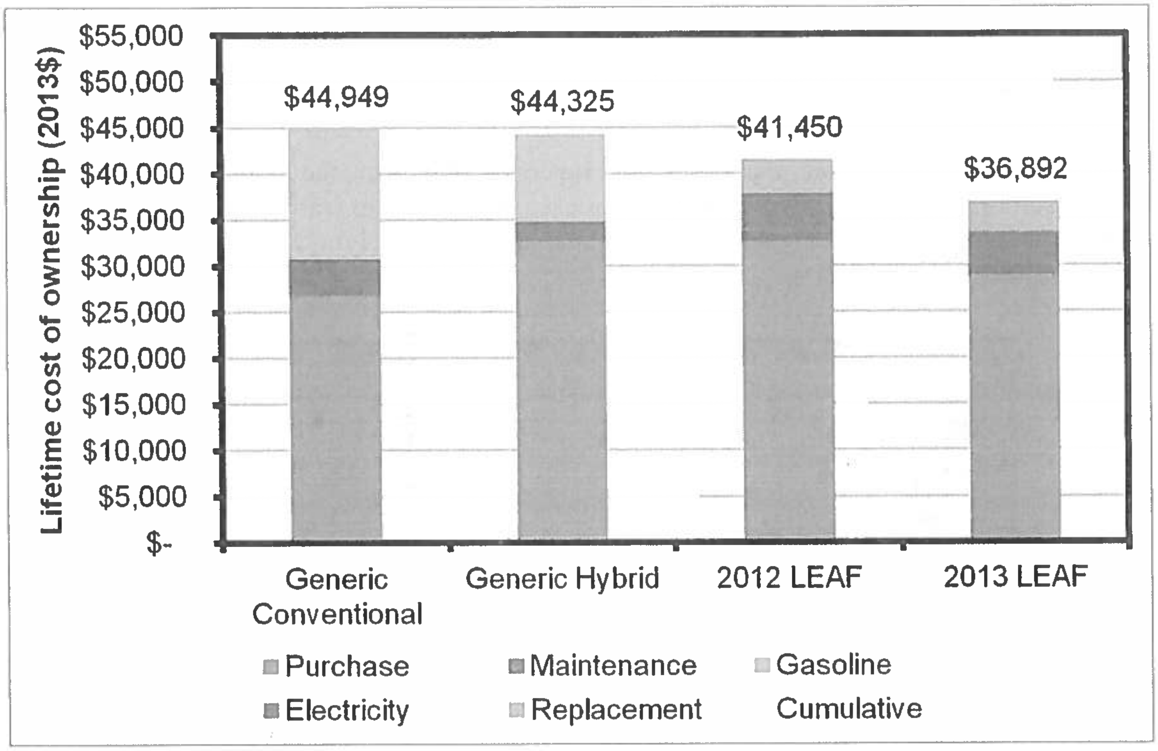


Figure 2-3
Total cost of ownership for the 2013 Nissan LEAF

The 2013 LEAF has a significantly lower total cost of ownership than the comparable options, including even the 2012 LEAF. In addition to a lower purchase cost, the improved efficiency of the 2013 LEAF decreased electricity use by about 15% relative to the 2012 LEAF. The full-charge range of the 2013 model also increased from 73 miles to 84 miles so the total replacement costs decreased slightly.

Table 2-2
Breakdown of the TCO for the 2013 Nissan LEAF

	Generic Conventional	Generic Hybrid	2012 Nissan LEAF	2013 Nissan LEAF SV
Purchase	$26,800	$32,866	$32,646	$29,022
Maintenance	$3,909	$1,827	$793	$793
Gasoline	$14,239	$9,632	-	-
Electricity	-	-	$4,361	$3,750
Replacement	-	-	$3,651	$3,320
Cumulative	$44,949	$44,325	$41,450	$36,892

Due to the low purchase price, incentives, and low operating costs, the payback period for the 2013 Nissan LEAF is quite low. For most vehicles analyzed, there was a payback of less than 5 years when compared to the Generic Conventional and Generic Hybrid vehicles. These results are shown below in Figure 2-4.

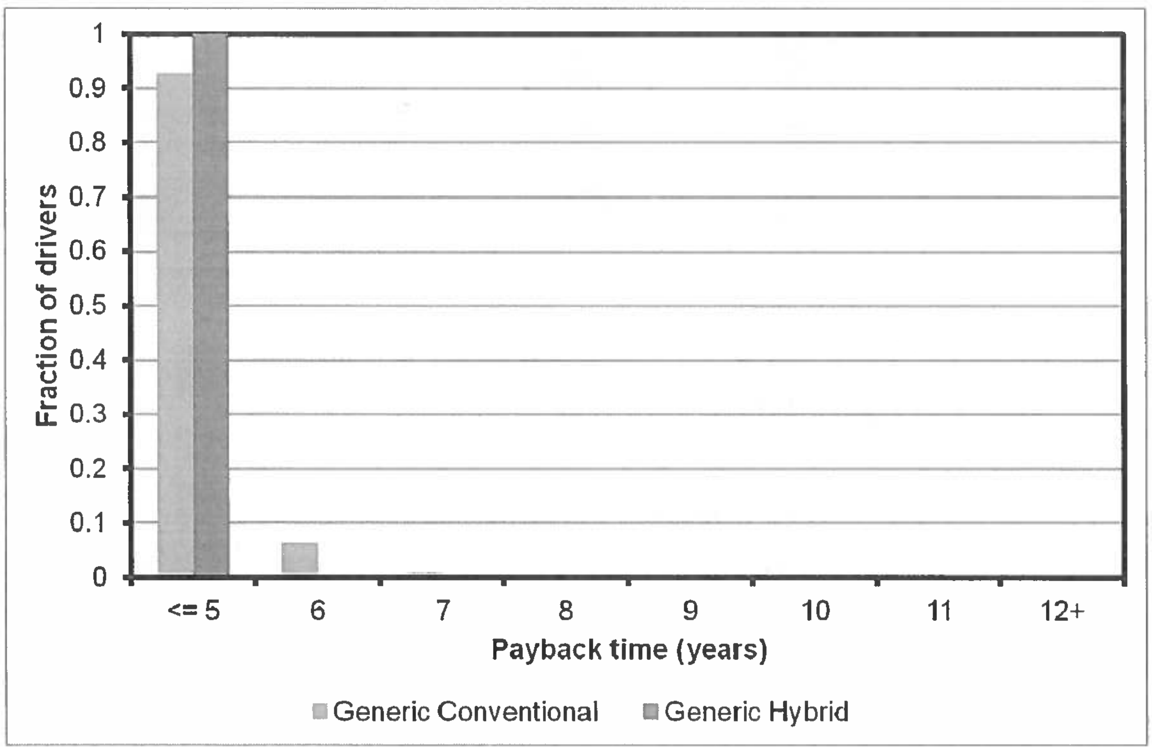


Figure 2-4
Payback period for the 2013 Nissan LEAF

While on average consumers save over $7,000, there are still some consumers who do not see a cost savings from driving the LEAF. This topic was explored in depth in the June study, but in short some owners' driving and charging behavior would not be conducive to a vehicle of this range. As a default, this study does not include DC Fast charging or workplace charging, though both are included as sensitivies in the June report.

Ford C-Max Energi

The Ford C-Max Energi entered the market in 2012. The C-Max is new to the Ford line, available as either a hybrid or PHEV with 21 miles of electric range. The list price on the C-Max Hybrid is quite low for a hybrid, at $25,000. Similar to other PEVs and HEVs, the base model for both the Hybrid and the Energi are well equipped so they are equivalent to the comparison vehicles. The results of the TCO are shown below in Figure 2-5 and Table 2-3.

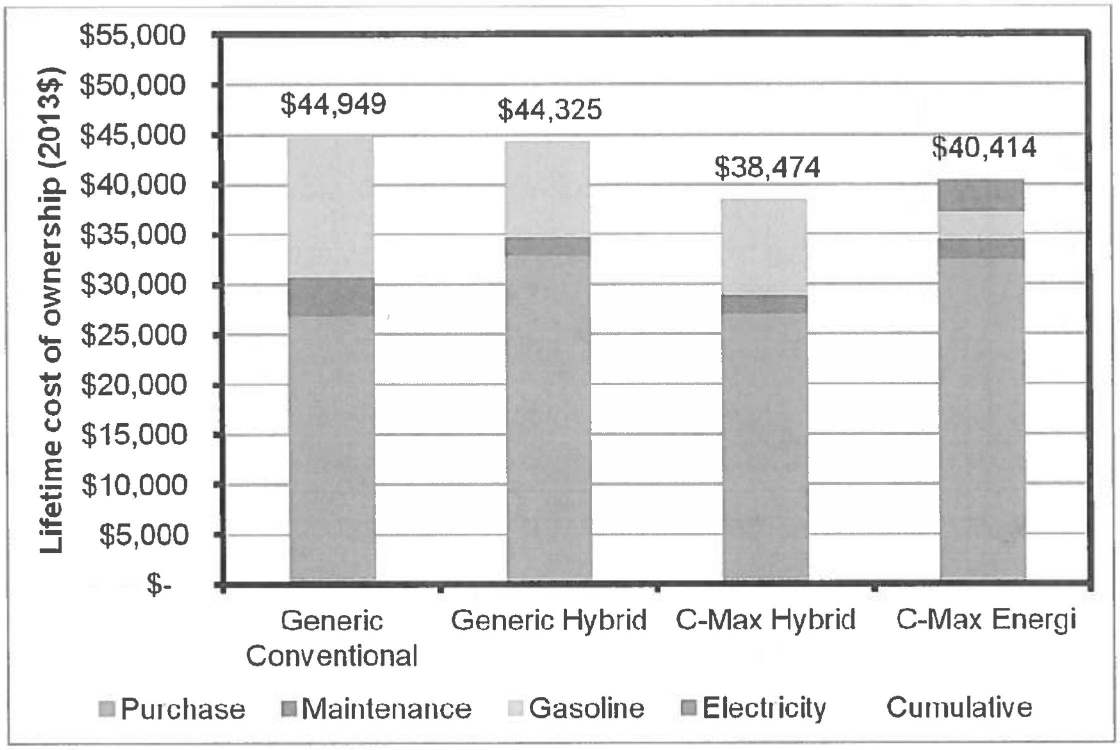


Figure 2-5
Total cost of ownership for the C-Max Energi

The Ford C-Max Energi is about $2,000 more expensive over the lifetime than its hybrid counterpart. However, the vehicle is less expensive over its lifetime than the Generic Conventional and Generic Hybrid vehicles. This is in large part due to the immense savings in fuel costs over the 150,000 mile lifetime.

Table 2-3
Breakdown of the TCO for the C-Max Energi

	Generic Conventional	Generic Hybrid	2013 C-Max Hybrid	2013 C-Max Energi
Purchase	$26,800	$32,866	$27,014	$32,424
Maintenance	$3,909	$1,827	$1,827	$2,053
Gasoline	$14,239	$9,632	$9,632	$2,754
Electricity	-	-		$3,184
Replacement	-	-	-	-
Cumulative	$44,949	$44,325	$38,474	$40,414

The payback period of the C-Max Energi is shown below in Figure 2-6. Similar to the other PEVs, the payback time as compared to the Generic Hybrid is quite compelling: 100% of vehicles have a payback period of less than 5 years. If the vehicle is compared to the Generic Conventional, the payback period is not as compelling for most drivers with 45% of the studied drivers having a payback of greater than 12 years.

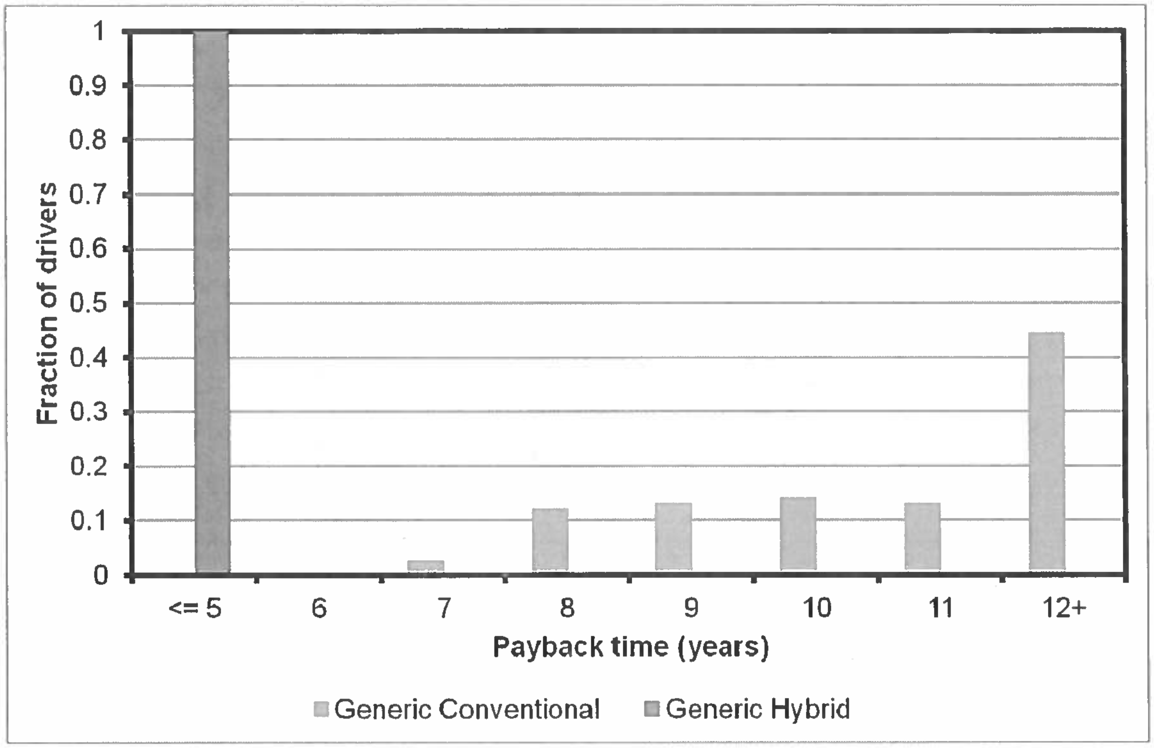


Figure 2-6
Payback period for the C-Max Energi

Prius Plug-In

Toyota introduced the Plug-in Prius in 2012 and it has gone on to become the third best-selling PEV overall and highest-selling PEV for October 2013, the latest sales month. The Prius Plug-in has an EPA-rated range of 11 miles and a combined fuel economy of 50 MPG. The entry-level Plug-in Prius is equipped similarly to a mid-level Prius (III or IV) and is comparable to the Generic Hybrid and Generic Conventional vehicle. The breakdown of the TCO for the Prius Plug-in is shown below in Figure 2-7 and Table 2-4.

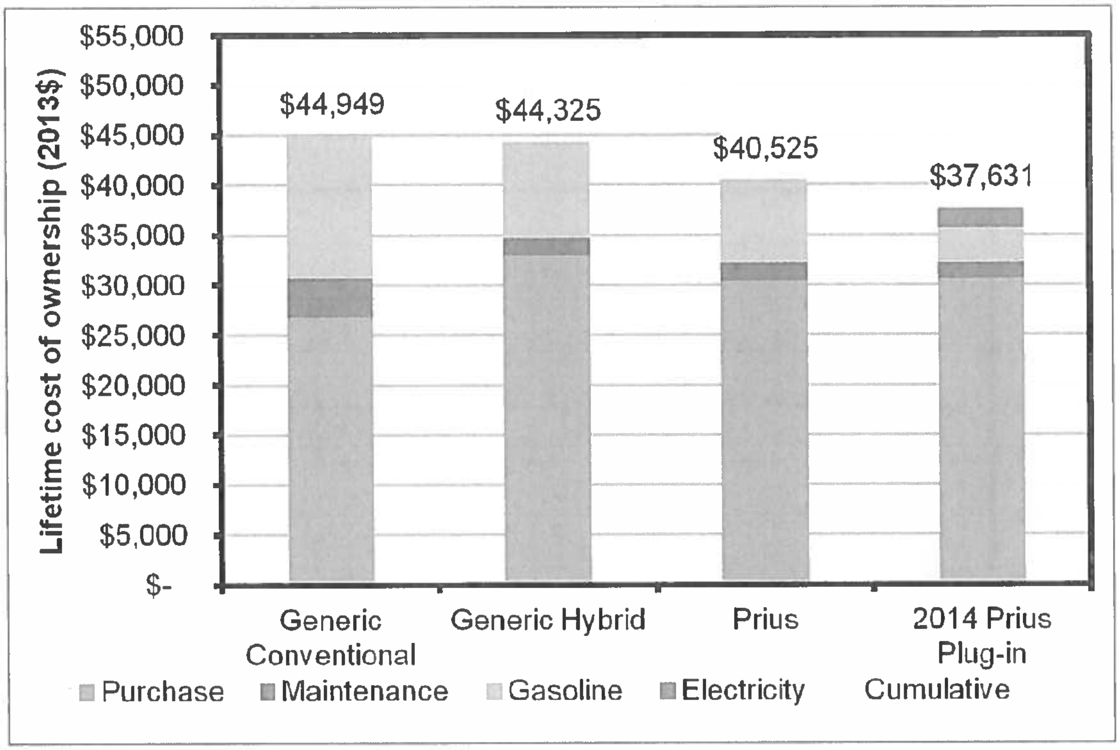


Figure 2-7
Total cost of ownership for the Prius Plug-in

The Prius Plug-in is about $3000 less expensive than the hybrid Prius over the vehicle lifetime and both vehicles are significantly less expensive overall than the Generic Hybrid or Generic Conventional vehicles. Maintenance costs are similar for both Prius options, but the charge-depletion capabilities of the Plug-in Prius reduce gasoline usage in this vehicle by 40% and total fuel expenditures by 20%.

Table 2-4
Breakdown of the TCO for the Prius Plug-in

	Generic Conventional	Generic Hybrid	2013 Prius	2013 Prius Plug-in
Purchase	$26,800	$32,866	$30,400	$30,517
Maintenance	$3,909	$1,827	$1,827	$1,827
Gasoline	$14,239	$9,632	$8,298	$4,855
Electricity	-	-	-	$1,670
Replacement	-	-	-	-
Cumulative	$44,949	$44,325	$40,525	$37,631

The payback period for the Prius Plug-in is shown below in Figure 2-8. The results show a quick payback on the Prius Plug-in relative to the Generic Hybrid and a more dispersed payback compared to the Generic Conventional. This is very similar to the distribution from the Chevrolet Volt.

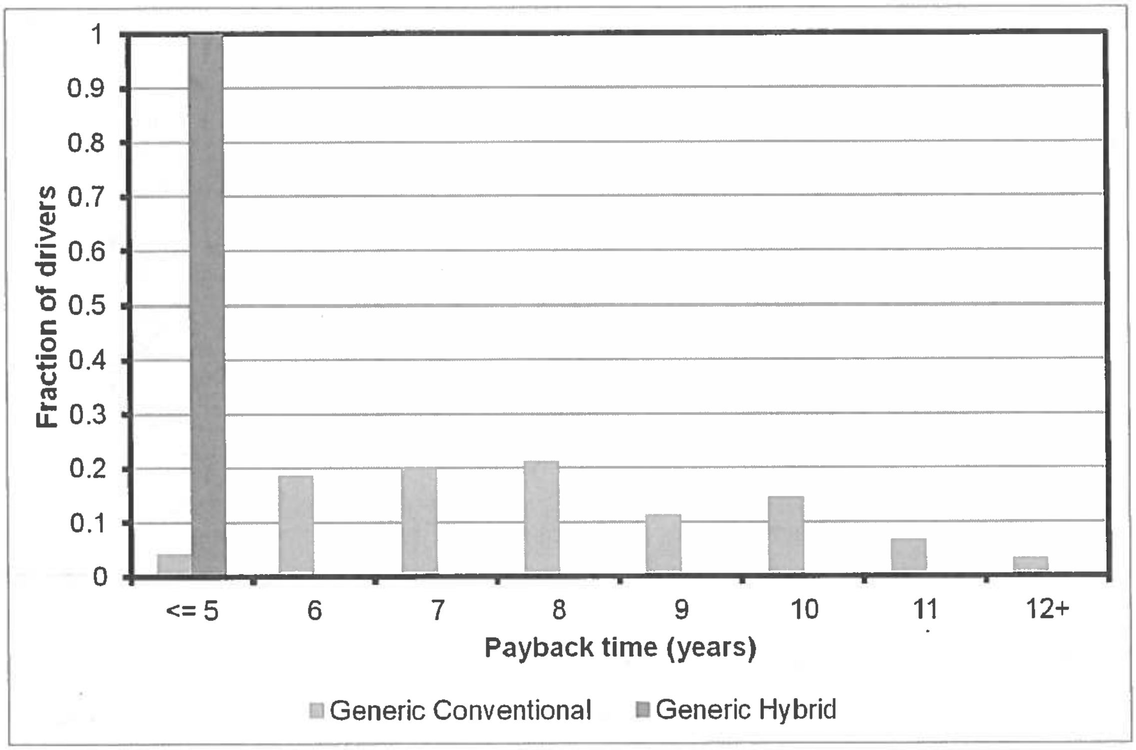


Figure 2-8
Payback period for the Prius Plug-in

3
EFFECTS OF PRICE REDUCTIONS

In 2013, both the Nissan LEAF and the Chevrolet Volt announced significant price reductions. The payback time of the Nissan LEAF is now such that every driver analyzed achieved a payback of less than 5 years. For the Chevrolet Volt this is not as certain due to a higher up-front cost, despite the fact that the price was reduced by almost $5000 from the 2013 model year to the 2014 model year. In this section we analyze the effects of dropping the price by $1,000 increments to test the effects of incremental pricing on total cost of ownership. Figure 3-1 shows the payback from the previous study on the 2013 Chevrolet Volt pricing for comparison purposes.

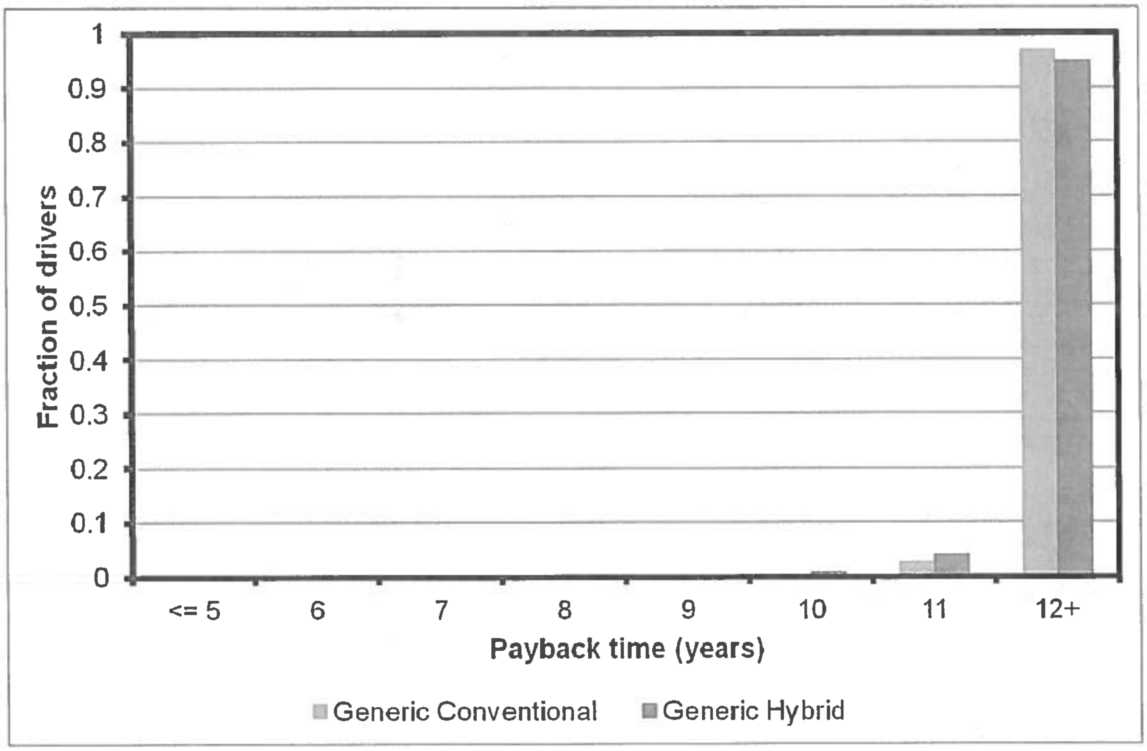


Figure 3-1
Payback period of 2013 Chevrolet Volt

This is a significant difference from the 2014 pricing shown in Figure 3-2, where 100% of drivers had a payback of less than 5 years compared to the Generic Hybrid, and a distribution of payback period compared to the Generic Conventional with an average of about 7 years. To understand this transition better, the payback was calculated in $1000 increments from the 2013 price to the full $5000 price reduction for the 2014 model year. The comparisons are shown in the below in Figure 3-2 for the comparison with the Generic Conventional and in Figure 3-3 for the comparison with the Generic Hybrid.

Compared to the Generic Conventional, payback for the Volt decreases gradually as the up-front cost of the Volt is decreased. This is due to the fact that most of the cost difference between these vehicles comes from fuel costs, which represent around 30% of the cost of the Generic Conventional vehicle and 15% of the cost of the Volt. Since fuel costs are incurred over an extended time period, up-front differences are paid back relatively slowly. The comparison with the Generic Hybrid vehicle shows a different trend. Since both the Generic Hybrid and the Volt are very fuel efficient, changes in the up-front cost of the Volt have a more immediate effect on the payback period. After about $3000 of price reduction, the Volt payback is less than 5 years for all vehicle owners, so it is less expensive on a monthly basis during the loan period.

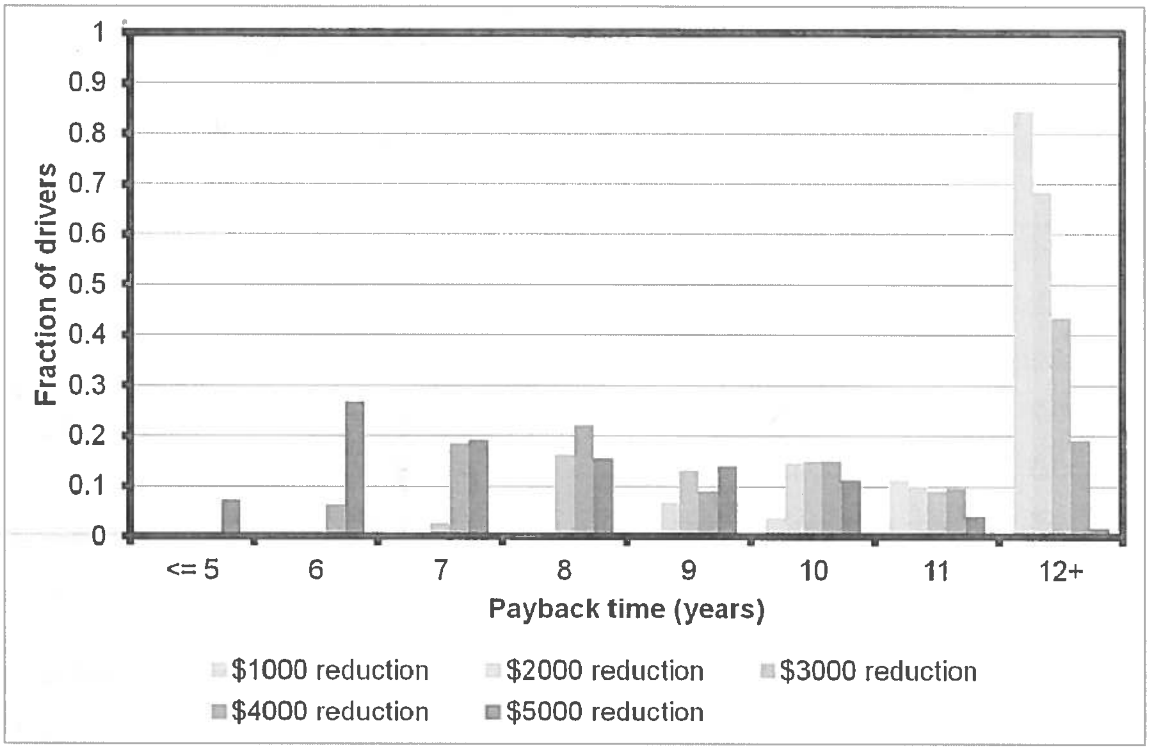


Figure 3-2
Comparison of TCO of 2013 Volt to Generic Conventional for different price reductions

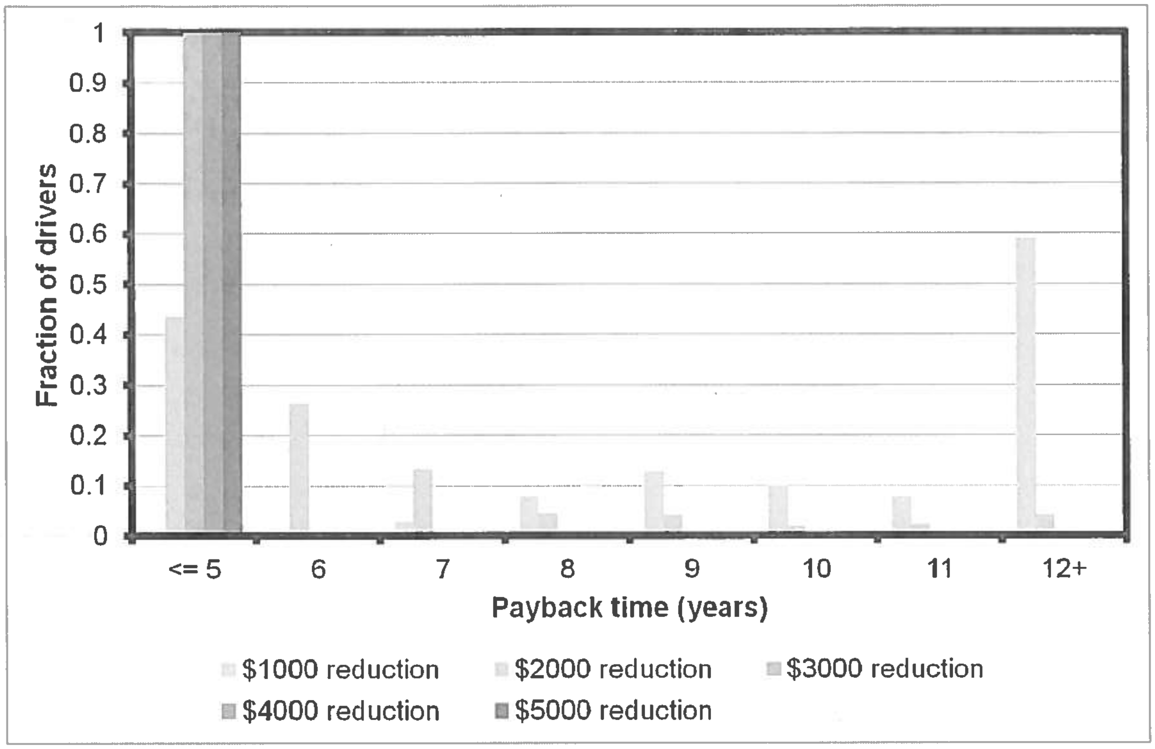


Figure 3-3
Comparison of TCO of 2013 Volt to Generic Hybrid for different price reductions

These results indicate that the price reduction for the Volt significantly improved its lifetime cost relative to the competing options. The price reductions were relatively recent, so it will take some time to see what effect they have on sales.

A
REFERENCES

1. *Total Cost of Ownership for Current Plug-in Electric Vehicles*. EPRI, Palo Alto, CA: 2013. 3002001728.
2. "Traffic Choices Study by the Puget Sound Regional Council." Transportation Secure Data Center. National Renewable Energy Laboratory. Accessed May 23, 2012.
3. PluginCars.com, 2012, http://www.plugincars.com/best-buy-provide-ford-focus-electric-charging-stations-lower-prices-competition-106640.html
4. Taxfoundation.com, 2012, http://taxfoundation.org/news/show/27967.html

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent approximately 90 percent of the electricity generated and delivered in the United States, and international participation extends to more than 30 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together...Shaping the Future of Electricity

3002004054

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-359 Provide the evaluation plan, performance metrics, and criteria that will be used to evaluate the proposed street lighting investments for the Smart Columbus project.

RESPONSE

AEP Ohio is currently working to define preliminary factors to use for the selection of which 202,000 street and area lights to be selected to be equipped with the smart street lighting modules. We have hired a consultant to assist in the development of this initial selection criteria.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-360 Referring to the Osterholt Testimony at page 32, Table 5, provide the basis and documentation to support the cost estimates in Table 5 concerning the street lighting program.

RESPONSE

The estimates are high level estimates based on a vendor proposal as well as Company and industry experience with similar technology deployments.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-274 From the testimony of Andrea E. Moore Page 12, lines 15 – 17: "The Company will file before the Commission in a separate docket the cost based information and the proposed tariff language of the LED Lighting tariff for Commission approval."

a. When is this tariff expected to be filed?
b. Do current lighting tariffs include LED lighting?
c. Could LED lighting options be added to current lighting tariffs?

RESPONSE

a. The Company has not determined a date to file an LED tariff option

b. No

c. Once approved through the separate filing, the LED options will be added to the current street lighting tariffs.

Prepared by: Andrea E. Moore

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-311 Does AEP Ohio or Mr. Osterholt consider "smart lighting control technologies" appropriate for its entire distribution system? If not, why not? If so, please describe how AEP Ohio intends to pursue "smart lighting control technologies" in areas outside the Smart Columbus initiative served by the utility and when.

RESPONSE

As stated in testimony on page 31, line 6, "AEP Ohio plans to deploy smart lighting controls across its entire gridSMART Phase 1 and Phase 2 footprint." In addition, in testimony on page 30, lines 21-22, deployment is expected to take four years. The Company is optimistic that deploying the smart lighting control technologies in conjunction with AMI meters could result in very low costs for a communication system for the smart lighting deployment. The Company is testing this assumption in the lab at this time.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-361 Referring to the Osterholt Testimony at page 33, line 5, provide an estimate of the "dramatically" reduced consumption associated with the move to LED technology that will occur with the proposed street lighting project for Smart Columbus.

RESPONSE

Smart lighting controls provide several functions that can increase the energy efficiency of company-owned street and area lighting. When combined with the benefits and complimentary functionality of LED light fixtures, energy savings of up to 75% can be achieved in certain use case scenarios.[1]

LED lighting technology inherently has a lower power consumption than that of the current high-pressure sodium vapor (HPS) lighting fixtures. LED light fixtures also typically provide brighter light than current HPS fixtures. Accordingly, LED fixtures can be dimmed to further reduce energy consumption, while still maintaining the same level of lighting coverage.

When LED lighting technology is combined with smart lighting controls, this reduced power consumption is further amplified. Existing street light controls cannot alert when there is a malfunctioning light fixture that remains on during the day. These 'day burners' lead to increased costs for all lighting customers by wasting energy and contributing to peak demand. Smart lighting controls can automatically send an alert for these types of malfunctions. While AEP Ohio will not immediately use some of the smart lighting control functionality, these control also enable dimming and seasonal timing, such that company-owned street and area lights can be dimmed or turned on/off based on ambient moon lighting, vehicle/bike/pedestrian activity, and other environmental factors.

[1] This is based on a comparison of fixtures performed in 2014. At that time, examples include the 100W HPS roadway fixture using approx. 248W of energy, while the comparable LED fixture used 60W; and the 400W HPS roadway fixture using approx. 1060W of energy, while the comparable LED fixture used 257W.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-313 Describe any potential kWh or kW usage profile or impact on the customer bills for the current street lighting system as a result of installation of "smart lighting control technologies."

RESPONSE

A potential kWh or kW usage reduction enabled from faster response to repairing lights would be "day burners", which are lights that fail in such a way that they produce light 24 hours a day. Another potential kWh or kW usage reduction from smart lighting control technologies is associated with future dimming. Since the Illuminating Engineering Society (IES) establishes standards for the amount of light and uniformity ratio for lighting on roadways and they haven't yet established the roadway lighting dimming standards, the quantification of this specific kWh or kW usage reduction from smart lighting control technologies is impossible to calculate. New street and area lights are rated at a specific amount of lighting output. This rating represents the amount of light produced over a span of time more consistent with expected in-service period of the light and is less than the initial lighting output due to the aging process of the light. The Company also plans to evaluate the impact of dimming new lights in the earlier years of a new light going into service which would yield a kWh or kW usage reduction from smart lighting control technologies. This is another aspect that will be likely standardized by the IES.
An analysis related to an impact on customers bills related to the installation of smart lighting control technologies is not available at this time. However, as shown in the testimony for Company witness Osterholt's Exhibit SSO 1, avoided energy costs from the smart lighting control technologies would manifest in a customer bill or rate in the future.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-312 Define "smart lighting control technologies" in terms of the additional equipment and technologies required; compare and contrast that equipment and technologies to those installed in the current street lighting system.

RESPONSE

The current street and area lights owned by AEP Ohio are typically controlled by a simple photocell that turns the light on at dusk and off at dawn. Smart lighting controls, comprised of a two-way communication controller for each light and centralized lighting management software, enable considerable functionality enhancements and energy-efficiency advantages, including more granular lighting-level control based on a wider variety of scenarios.
By upgrading the smart lighting controls on company-owned street and area lights, AEP Ohio will be able to realize additional operational and energy efficiencies, while providing increased safety and security to the public and its employees.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-358 Please explain the potential operational efficiencies identified as likely to occur with the street lighting investments for the Smart Columbus project and compare those efficiencies and cost savings on a system wide basis with the costs for these investments.

RESPONSE

The Company objects to the form of the question as this request is vague, overbroad and/or unduly burdensome. Without waiving the foregoing objections or any general objection the Company may have, the Company states as follows. The Company has not performed a separate or distinct scientific study to compare the efficiencies and cost savings on a system wide basis with the costs for these investments. AEP Ohio plans to deploy smart street and area lighting controls to 202,000 of its lights throughout the entire AEP Ohio system. The Company envisions the same deployment plan and technologies within the Smart Columbus area as outside it.

Prepared by: Counsel
Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-357 Is it AEP Ohio's position that none of the proposed street lighting investments proposed for the Smart Columbus project would be considered or installed in the normal course of upgrading and investing in the distribution system? Please explain why proposed street lighting controls and investments would not be considered in the normal course of upgrading the distribution system.

RESPONSE

The benefits of the smart street lighting controls as outlined in the testimony filed by Mr. Osterholt starting on page 28, line 4 would not be realized by installing them as maintenance of the lights needed over the next fifteen to twenty years (or longer). This is due to the benefits of an expected four-year deployment, which includes: improved safety and security through rapid light repair; energy savings through repair of day burners; operational savings and customer satisfaction through reduced call center volume; additional operational savings through streamlined repairs; potential for dimming and other advanced functionality; and faster response to lighting restoration requests.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-296 Referring to the Osterholt Testimony on page 9, lines 20-23, it states that "Microgrids are integrated batteries, smart controls, and (in some cases) small-scale generation that are capable of isolating – or "islanding" – small sections of the distribution grid and keeping power flowing when there are outages on other parts of the grid." Please address each of the following:

a. Please describe the types of small scale generation that may be installed "in some cases."
b. Please describe the MVA amount of small scale generation that may be installed "in some cases," relative to the peak load of the microgrid.
c. Please describe the expected size range and ideal size range of proposed microgrids in terms of peak load in MVA, and what makes this size ideal.
d. Please describe the type of batteries envisioned for proposed microgrids.
e. Please describe the amount of battery capacity, in terms of peak MVA and MWH capacity per MVA of peak microgrid load that is envisioned for proposed microgrids.
f. Please describe i) the amount of existing back-up generation relative to load at critical infrastructure installations that is expected for proposed microgrid candidates, ii) how such generation would be operated under various operating conditions, and iii) how the cost of such operation would be paid for under the microgrid proposal .

RESPONSE

a. The general industry definition of a microgrid is referenced on page 9 and more details of microgrids are listed on page 22, lines 7-14 of Mr. Osterholt's testimony. The types of small scale generation being considered include solar PV, wind, and generators fueled by natural gas or diesel. Other types will be considered as their availability becomes known. Additionally, as stated in Osterholt testimony on page 22, line 15; "The Company envisions the proposed microgrid deployment as a demonstration project designed to prove the benefits of microgrids and help the Company gain experience with microgrid planning, installation, and operations."
b. The amount of MVA small scale generation will be sized to assure that adequate capacity is available to serve the peak load of the microgrid during a multi-day outage of the normal source from the distribution circuit.
c. An ideal size for the proposed microgrids will be determined at a future time. The microgrids will be sized to serve the critical loads selected. Through collaboration with the customer and or

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-340 Has AEP Ohio designed the microgrids that it is proposing to install for the Smart Columbus project? If so, provide those designs. If not, when will the specific 8-10 microgrids be designed?

RESPONSE

AEP Ohio has not developed specific designs for the microgrids that it is proposing to install for the Smart Columbus project. The microgrids will be designed once the microgrid areas are selected and the specific needs are defined.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-341 Is it AEP Ohio's intent to use all of these technologies (e.g., smart controls, battery storage, small-scale photovoltaic or solar generation for all of the 8-10 proposed microgrids? In other words, will the microgrid projects be similar or different in design and capabilities?

RESPONSE

As referenced in OCC-INT-2-340, each microgrid will be designed to meet the needs identified for that particular microgrid. Each microgrid could contain, but is not limited to, technologies such as smart controls, battery storage, and solar generation.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-308 Has AEP Ohio ever designed, constructed, or connected a microgrid to its distribution system? If so, please provide the location, design, size, and cost (if known) of such microgrid, including any report or other document that describes the operation of the microgrid and impact on reliability, energy usage, demand response, and environmental benefits.

RESPONSE

AEP Ohio has not designed, constructed, or connected a microgrid to its distribution system to serve customer load. However, the AEP Service Corporation has conducted research on a microgrid located within the AEP Ohio region. This microgrid location is a test site allowing AEP and the AEP Operating Companies to gain knowledge on this type of technology.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-309 Referring to the Osterholt Testimony at page 9, lines 19-20, describe specifically how AEP Ohio would locate or design microgrids to include "consideration for facilities that serve lower income communities." In your response, identify any microgrid projects known to AEP or Mr. Osterholt that reflect such criteria in Ohio or elsewhere.

RESPONSE

AEP Ohio intends to collaborate with customers and communities in the selection of areas where microgrids will be installed. Low income communities can be considered as a part of that process.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NO. 16-1852-EL-SSO et al. SECOND SET

INTERROGATORY

OCC-INT-2-343 Referring to the Osterholt Testimony at page 23, lines 6-11, provide the "qualitative assessment" that the Company will use to evaluate the suitability of potential sites, showing how the selection factors will be weighted or otherwise considered in making a decision among potential site selections.

RESPONSE

As stated in the testimony factors such as criticality of the loads in a potential microgrid, reliability of the distribution system serving potential microgrid area will be considered. While the Company intends to use a qualitative assessment, it wants to keep that assessment criteria flexible enough to allow innovative approaches to improving customer and community resiliency due to extended outages of the normal distribution sources and to facilitate the use of distributed renewable energy resources during normal and emergency conditions.

Prepared by: Scott S. Osterholt

**OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET**

INTERROGATORY

OCC-INT-2-342 Referring to the Osterholt Testimony at page 22, lines 15-16, please provide the evaluation plan, performance metrics, or other criteria that the Company will use to "prove the benefits of microgrids….".

RESPONSE

The metrics and evaluation plan for each proposed microgrid project will be based on objectives relating to the design, siting, and customer impact along with the technology employed. These plans are under development at this time. However, the Company plans to develop a way to measure the benefits of the microgrids, which could include measures such as assuring reliability, resiliency and facilitating more renewable generation on the grid.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-347 Referring to the Osterholt Testimony at page 23, lines 20-23, does AEP Ohio intend to operate the microgrids to achieve demand response results? If so, provide the demand response program that will be used to operate these facilities for this purpose. If such program has not yet been designed or developed, please provide the information on when this program will be developed and filed with the Commission for review and approval.

RESPONSE

The current plan for microgrids does not involve Demand Response (DR) from the traditional perspective. In Osterholt testimony on page 23, lines 20-23, the Company is referring to using stored energy in microgrid batteries and small-scale generation to place energy onto the grid during peak hours. This would reduce the peak system demand and could lead to cost-saving system benefits.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-307 Has AEP Ohio or Mr. Osterholt considered the potential for bidding out any microgrid proposal to third parties for design and construction? If not, why not?

RESPONSE

There are a range of options AEP Ohio could seek to design and construct micro-grids, including the possibility of bidding out part or all of this work to third parties.

Prepared by: Scott S. Osterholt

OHIO POWER COMPANY'S RESPONSE TO
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S
DISCOVERY REQUEST
PUCO CASE NO. 16-1852-EL-SSO et al.
SECOND SET

INTERROGATORY

OCC-INT-2-353 Referring to the Osterholt Testimony at page 26, Table 4, provide the basis and support for your estimates of costs as reflected in Table 4 and provide the background documentation associated with these cost estimates.

RESPONSE

The estimates are high level estimates based on Company and industry experience with technology deployments. Refined estimates will be created once the scope of each microgrid being considered is developed.

Prepared by: Scott S. Osterholt