

BEFORE THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of	)	
Ohio Power Company for Authority to	)	Case No. 16-1852-EL-SSO
Establish a Standard Service Offer	)	
Pursuant to §4928.143, Ohio Rev. Code,	)	
In the Form of an Electric Security Plan	)	

In the Matter of the Application of	)	
Ohio Power Company for Approval of	)	Case No. 16-1853-EL-AAM
Certain Accounting Authority	)	

**DIRECT TESTIMONY
OF
SAM SPOFFORTH
ON BEHALF OF
SIERRA CLUB, NATURAL RESOURCES DEFENSE COUNCIL AND
ENVIRONMENTAL LAW & POLICY CENTER**

Filed: May 2, 2017

1 **QUALIFICATIONS & PURPOSE OF TESTIMONY**

2 **Q. State your name and business address.**

3 A. My name is Sam Spofforth. My business address is 530 West Spring Street, Suite 250,
4 Columbus, Ohio 43215.

5 **Q. By whom are you employed and in what capacity?**

6 A. I am the Executive Director of Clean Fuels Ohio, a non-profit organization.

7 **Q. What is the purpose of your testimony?**

8 A. My testimony is limited to issues raised by Ohio Power Company's (hereinafter "AEP
9 Ohio" or "Company") proposal to initiate an electric vehicle charging program. In my
10 testimony, I review the company's proposal and recommend that the Commission act to
11 approve adoption of AEP's proposed electric vehicle infrastructure program with
12 modifications to ensure that:

- 13 • the deployment of charging infrastructure be structured to support electric vehicle
14 adoption and comprehensively serve driver needs;
15 • vehicle charging load will be well integrated with the electric grid; and
16 • utility engagement supports the development of a competitive vehicle charging
17 market.

18 I conclude my testimony with additional, specific recommendations to improve the AEP
19 Ohio's proposal, including the need for customer education and data collection and
20 reporting, clarification on electricity pricing, and other issues.

21 I believe that it is important that the Commission approve an AEP Ohio pilot program in
22 this case, but as I discuss below some additional details need to be added to the
23 Company's proposal to ensure the program provides optimal benefits to the public.

1 **Q. On whose behalf are you appearing in this case?**

2 A. I am testifying on behalf of Sierra Club, Natural Resources Defense Council, and
3 Environmental Law & Policy Center.

4 **Q. Please describe your educational and professional background.**

5 A. I have a Bachelors of Arts from Hiram College and a Master's in Public Administration
6 from University of Pennsylvania. I have directed Clean Fuels Ohio, originally Central
7 Ohio Clean Fuels Coalition, since its inception in 2002. Our work has focused on
8 strategies and best practices for market growth and consumer adoption of a wide range of
9 cleaner transportation fuels and vehicles, including electricity and electric vehicles. I was
10 recognized by the U.S. Department of Energy as the Midwest Clean Cities Coordinator of
11 the Year in 2004, the National Clean Cities Coordinator of the Year in 2017, and was an
12 original inductee to the U.S. Department of Energy Clean Cities Hall of Fame in 2012.

13 **Q. Do you have specific experience related to the development of charging
14 infrastructure and related programs for plug-in electric vehicles in Ohio?**

15 A. Yes. My experience includes, but is not limited to, the following projects:

- 16 • Administration of an \$11 million grant from the U.S. Department of Energy that
17 included deployment of over 50 of the earliest public charging stations in Ohio
18 and electric vehicle fleet projects;
- 19 • Development of the Ohio Electric Vehicle Readiness Plan in 2013;
- 20 • Development of scope of work and activities in the City of Columbus application
21 to the Paul G. Allen Foundation for Smart City;
- 22 • Creation of Drive Electric Ohio, a program focused on consumer education,
23 workplace and public charging, and policy.

1 **Q. Have you previously testified before this Commission?**

2 A. No.

3 **Q. What materials have you reviewed in preparation for your testimony?**

4 A. I reviewed AEP Ohio's application in this case and testimony related to the company's
5 proposal to initiate a vehicle charging program. In addition, there is a substantial body of
6 literature on electric vehicles and electrical vehicle charging that I have routinely
7 reviewed over the last several years as part of my work for Clean Fuels Ohio.

8

9 **AEP OHIO'S ELECTRIC VEHICLE CHARGING PROPOSAL**

10 **Q. Please summarize AEP Ohio's proposal to develop electric vehicle charging**
11 **infrastructure.**

12 A. In this case, AEP Ohio presents its request and justification for electric vehicle charging
13 infrastructure primarily through the testimony of Scott S. Osterholt.¹ The vehicle
14 charging program is one of several technologies the Company proposes to deploy as part
15 of its Distribution Technology Plan.² In his work papers, Mr. Osterholt estimates the total
16 vehicle charging program cost to be \$8.1 million over its four-year term, with total capital
17 expenditures of approximately \$6.4 million and total operation and maintenance costs of
18 \$1.7 million.³ In addition, witness David R. Gill testifies as to the cost recovery vehicle
19 for the Distribution Technology Plan (the Distribution Technology Rider), as well as the
20 accounting treatment for EV charging stations⁴

¹ *Direct Testimony of Scott S. Osterholt*, page 11, line 8 through page 21, line 7.

² *Id.* at page 2, line 22 through page 3, line 3.

³ *Workpapers for Scott S. Osterholt*, page 3. *See also Direct Testimony of Scott. S. Osterholt*, page 19, table 3.

⁴ *Direct Testimony of David R. Gill*, page 9, line 18 to page 10, line 7.

1 Mr. Osterholt explains that AEP Ohio has proposed several initiatives designed to
2 improve access to vehicle charging station infrastructure: (1) the deployment of 25 direct
3 current fast-charging stations; (2) the deployment of 250 public Level 2 alternating
4 current charging stations; and (3) a residential electric vehicle charging program, through
5 which the Company will deploy 1,000 Level 2 charging stations “at customers’
6 residences.”

7 Mr. Osterstolt represents that the DC fast-charging and public Level 2 stations will be
8 deployed pursuant to guidance from Smart Columbus and the Department of
9 Transportation, but in any event in locations that “best promote PEV adoption.” Charging
10 at these stations will be “free of charge during an initial period,” after which the company
11 will file a schedule of charges.

12 With respect to the residential program, the 1,000 chargers will be provided at no cost to
13 customers during a “demonstration period,” but AEP Ohio will require customers to
14 agree to participate in a forthcoming demand response pilot. Mr. Osterholt does not list
15 further requirements for participation, or identify the rate schedule under which
16 customers will be charged for energy use at the stations.

17 Finally, Mr. Osterholt explains that the company is “requesting the ability to deploy twice
18 the number of charging stations” in each category “during this initial phase.”

19 **Q. Can you provide additional detail on the types of charging technology that AEP**
20 **Ohio has proposed to deploy through its program?**

21 **A.** Yes. The PEV industry has developed standards and equipment for three types of
22 charging, and the Company has proposed to deploy two of those types: Alternating

Current (“AC”) Level 2 Charging, and Direct Current (“DC”) Fast Charging. In the table below I summarize each of the three types of charging technology.

Charging Type	Plug-type Standard	Power Supply	Power Rate	Range added per hour
AC Level 1	SAE J1772	120V (single phase) 12A	1.4kW	4-5 miles
AC Level 2	SAE J1772	240V (single/split phase) 40-80A	Up to 19kW (common range is 3.3-7.4 kW)	20-30 miles
DC Fast Charging	Multiple (CHAdeMO, CCS, Tesla)	200 - 500 VDC	45 kW +	100 miles

RELATION OF AEP OHIO’S PROPOSAL TO SMART COLUMBUS AND POWER FORWARD

Q. AEP Ohio refers to the PEV charging proposal as “Smart Columbus—Electric Vehicle Charging Stations.” Please briefly describe Smart Columbus and its relation to AEP Ohio’s proposal in this case.

A. The Smart Columbus Electrification Project (SCEP) is an initiative of the City of Columbus in collaboration with numerous government and private-sector partners. AEP Ohio is an important partner in this project. Smart Columbus actually comprises the seven-county region, including Franklin and the six counties contiguous to the County. SCEP is undertaken through a \$10 million grant from the Paul G. Allen (a.k.a. “Vulcan”) foundation combined with close to \$20 million in additional partner match commitments, primarily from companies working through the Columbus Partnership. SCEP is part of a much broader Smart Columbus program that also included a \$40 million grant from the U.S. Department of Transportation. The total private sector commitment was \$90 million

1 on top of the combined \$50 million award. The City of Columbus won both awards as
2 part of a national competition that included 78 original applicants and seven finalists. The
3 goal of SCEP is to “decarbonize” the transportation sector by leveraging grid renewable
4 energy and deploying electric vehicles among consumers along with businesses and local
5 governments with fleets. Deployment of PEV charging is one of five high-priority goals
6 of SCEP. As part of Smart Columbus, AEP Ohio agreed to submit a proposal for cost
7 recovery of investments in PEV charging stations.

8 **Q. How does PEV charging and this AEP Ohio filing relate to the Commission’s Power**
9 **Forward initiative?**

10 A. Power Forward examines the utility of the future in Ohio, and PEV infrastructure will be
11 part of that discussion. The AEP Ohio pilot comes at an ideal time to provide valuable
12 information and lessons learned as part of Power Forward for the Commissions, AEP and
13 other Ohio utilities. Several of my recommendations below, including the need for robust
14 data collection and reporting, as well as a more defined term and scope for the installation
15 of vehicle charging infrastructure and establishment of electricity pricing, should ensure
16 that AEP Ohio’s program fulfills that need.

17 **BENEFITS OF, AND BARRIERS TO, THE ADOPTION OF PLUG-IN ELECTRIC**
18 **VEHICLES (PEVS)**

19 **Q. In general, what are the benefits of PEVs⁵?**

20 A. Vehicle electrification can result in numerous benefits for ratepayers and Ohioans,
21 including:

⁵ The term “plug-in electric vehicle” or “PEV” refers to light-duty passenger plug-in hybrid electric vehicles and battery electric vehicles.

- 1 • EV charging can “fill valleys” in load without proportionally increasing overall
2 capacity requirements. This, in turn, can reduce the average cost of electricity for
3 all utility customers.
- 4 • PEVs produce zero tailpipe emissions while using battery power. This improves
5 local air quality and reduces the negative public health impacts from conventional
6 vehicle pollution.
- 7 • The greater efficiency and increasingly cleaner fuel of PEVs translates to lower
8 net carbon emissions compared with average conventional vehicles. For example,
9 a recent report⁶ by the Union of Concerned Scientists illustrates in the following
10 map that electric vehicles charged in AEP Ohio’s service territory produce
11 greenhouse gasses equivalent to those from a gasoline vehicle that averages 44
12 miles per gallon, which is higher than the vast majority of gasoline-powered
13 vehicles.⁷ As we transition to cleaner energy, the air quality advantage of PEVs
14 become even greater.
- 15 • Because the number and diversity of new and used PEVs at all price points is
16 growing, and PEVs are expected to become increasingly popular in car and ride-
17 sharing programs, consumers at all income levels can reap the benefits of cost
18 savings for access to increased mobility.
- 19 • PEVs contribute to economic benefits for the region and state. This is due to a
20 combination of factors, including the federal tax credits paid based on PEV and

⁶ Union of Concerned Scientists, 2015. Cleaner Cars from Cradle to Grave. Available from <http://www.ucsusa.org/clean-vehicles/electric-vehicles/life-cycle-ev-emissions#.V4vXAI-cFJ8>.

⁷ DOE also has a calculator at http://www.afdc.energy.gov/vehicles/electric_emissions.php that compares emissions from powering an electric vehicle to emissions from a comparable internal combustion vehicle. For Ohio, this calculator shows that EVs pollute about 40% less CO₂.

PHEV vehicle purchases along with less consumer spending on gasoline, which
frees up more opportunities for consumers to save or spend in other ways.

Q. How can PEVs benefit all electricity rate payers?

A. When customers charge vehicles at home during off-peak times, typically overnight, PEVs can provide additional revenue without adding significant cost, since they are utilizing idle capacity of the transmission and distribution systems. In a recent data response to the Office of the Consumers' Council, AEP Ohio provided a cost-benefit analysis of PEV adoption within its territory, performed by Energy+Environmental Economics.⁸ I have reviewed the analysis, which estimated the net benefits from PEV adoption to range from \$351M to \$278M in the base scenario.⁹ This translates to a ratepayer net benefit of \$1,470 per vehicle. These analyses assume that the overwhelming majority of charging will take place at home during off-peak hours. Consumer charging data suggest this already is happening and will continue to happen. However, achieving the maximum off-peak load shifting potential requires charging that can be controlled, when needed, by the utility. It also may require a variable time of charge rate structure currently not offered to AEP Ohio customers.

This analysis is consistent with others I have reviewed.

A nationwide analysis performed by the Pacific Northwest National Laboratory, for example, shows that large numbers of EVs charging during off-peak hours could significantly lower the marginal cost of energy. The same analysis found that there is sufficient spare generation capacity in the nation's electric grid to power nearly the entire light-duty passenger fleet through "valley filling." Thus, PEV owners plugging into the

⁸ OCC Set 3-Interrogatory 378, Attachment 1.

⁹ Energy+Environmental Economics, *Cost-Benefit Analysis of Plug-In Electric Vehicle Adoption in the AEP Ohio Service Territory* (April 2017).

1 grid provide economic benefit to utilities and can apply downward pressure on utility
2 rates to the benefit of PEV and non-PEV owners alike.

3 **Q. Can PEVs provide benefits to the electric grid?**

4 A. Yes. EVs represent load growth, but this load is flexible and manageable. Vehicles are
5 driven during only a small fraction of each day, and, assuming charging infrastructure is
6 accessible, can be otherwise plugged in and connected to the electricity grid.
7 Charging can be managed to occur during off-peak periods, increasing usage of standing
8 assets, smoothing and shifting loads, and improving reliability to the benefit of all utility
9 customers. Charging can also be shifted to facilitate the integration of variable generation
10 from renewable sources.¹⁰ The Commission should be mindful of this long-run benefit
11 but remain focused in the near-term on the rate reduction that PEVs offer through dilution
12 of fixed costs and load “valley-filling.”
13 Managed charging can also avoid placing too much demand on localized grid resources.
14 Real world experience demonstrates that significant PEV adoption can be accommodated
15 without significant adverse impacts to the distribution system; as of October 31, 2016,
16 only 387 or 0.19 percent of the more than 200,000 PEVs in investor-owned utility service
17 territory in California triggered a grid upgrade that could be attributed to PEV load.¹¹

¹⁰ Regulatory Assistance Project, *In the Drivers Seat: How Utilities and Consumers Can Benefit From the Shift to Electric Vehicles* at 5, 13 (April 2015); CAISO, *California Vehicle-Grid Integration (VGI) Roadmap: Enabling Vehicle-Based Grid Services* at 5. (2014).

¹¹ *Load Research Report Compliance Filing of Southern California Edison Company (U 338-E), on Behalf of Itself, Pacific Gas and Electric Company (U 39e), and San Diego Gas & Electric Company (U 902-M), Pursuant to Ordering Paragraph 2 of D.16-06-011*, December 30, 2016.

1 **Q. What are barriers to PEV adoption?**

2 A. A significant barrier to PEV market growth is lack of sufficient charging facilities at
3 workplaces, publicly-accessible locations, and residences, especially multi-unit
4 dwellings.

5 The National Academy of Sciences’ landmark 2013 report, *Overcoming Barriers to*
6 *Electric Vehicle Deployment*, found that access to charging at home is a “virtual
7 necessity” for all EV drivers, and that residences without access to electric vehicle
8 charging “clearly [have] challenges to overcome to make PEV ownership practical.”¹²

9 The same study also found that charging at workplaces offers an important opportunity to
10 increase EV adoption and to increase electric miles driven.¹³

11 Another barrier today is lack of sufficient awareness and understanding of PEVs by most
12 consumers. On this issue, the National Academy of Sciences found that “most potential
13 PEV customers have little knowledge of PEVs and almost no experience with them. Lack
14 of familiarity with the vehicles and their operation and maintenance creates a substantial
15 barrier to widespread PEV deployment.”¹⁴ However, even with relative lack of
16 awareness, over 400,000 people in a two-week period placed \$1,000 deposits down on
17 the moderately priced Tesla Model 3. The 238-mile range Chevy Bolt is entering the
18 market in 2017. Yet, absent a concerted investment in PEV charging, supported by
19 electric utilities, the barrier of insufficient charging infrastructure will stunt the potential
20 of the PEV market.

¹² National Research Council of the National Academies of Sciences, *Overcoming Barriers to the Deployment of Plug-in Electric Vehicles*, the National Academies Press (2015).

¹³ Id.

¹⁴ Id.

1 **THE ROLE FOR ELECTRIC UTILITIES TO ADVANCE THE MARKET FOR PEVS**
2 **AND PEV CHARGING IN OHIO**

3 **Q. Should utilities play a role in helping to overcome these barriers?**

4 A. Yes. Utilities are well situated to advance the market for PEVs and PEV charging. One,
5 they have “patient capital,” – in other words, a long term investment and planning
6 horizon – which can be used to strategically scale and equitably locate charging
7 infrastructure for the benefit of all customers. Two, they can effectively integrate that
8 equipment into their distribution system. Three, they have capacity to ensure that
9 equipment utilizes available grid resources, including base load and intermittent
10 renewables, as efficiently as possible by taking advantage of EVs as flexible loads. Four,
11 they can leverage their existing customer relations platform to engage and educate
12 consumers about PEVs.

13 **Q. Is there sufficient deployment of PEV charging resources in the market without**
14 **utility involvement or funding?**

15 A. No. First, the number of charging stations is nowhere near sufficient to address “range
16 anxiety” concerns and handle potential PEV market growth. Entities active in the PEV
17 charging space today will likely not be able to develop the infrastructure necessary to
18 achieve widespread electrification without utility coordination and investment to spur
19 growth and competition. Unfortunately, without extremely high utilization rates at
20 charging stations, it is difficult for independent firms to realize a profit in the time frame
21 required for most private enterprises. This problem may be acute for investments in DC
22 Fast Chargers, which are much more expensive per unit than AC charging stations today.
23 Next, automakers generally do not see themselves as the appropriate actor to make

1 significant charging station investments. While Tesla has successfully built and operated
2 a DC charging station network, we do not expect charging station deployment to become
3 a core business of automakers, which did not enter the service station business to sell
4 gasoline to gasoline-powered vehicles. Likewise, while state and federal programs have
5 supported some of the existing charging network nationwide, public funding alone will
6 likely not be sufficient to meet the scale of the challenge. Second, we are not seeing
7 investments needed in workplaces, multi-unit dwellings (MUDs) and needed public
8 locations to meaningfully support the growing PEV market. This can be explained by
9 indirect network effects, or the chicken-and-egg dilemma: customers may be unwilling to
10 purchase a PEV if there is not sufficient charging network development, and charging
11 station providers and site hosts may be unwilling to build out a network with insufficient
12 demand. In particular, MUDs may suffer from misaligned incentives between tenants and
13 property owners that make it difficult to arrive at an agreement over who pays for, owns,
14 and operates charging infrastructure.

15 **Q. In your experience, is there sufficient vehicle charging infrastructure in Ohio to**
16 **support growth of the PEV market?**

17 A. No. Although Ohio has stronger vehicle sales than most states, within portions of the
18 AEP Ohio territory today, we see charging stations lacking needed redundancy. Nearly
19 all locations offer only one plug, so if that plug is occupied all other drivers must wait.
20 Many stations are not located where needed. For example, some AAA Car Care Centers
21 host DC Fast Charging, but these sites lack consumer amenities and some are not close to
22 travel corridors. A few others are located at car dealers, which is a positive indication of
23 dealer engagement, but they lack redundancy and amenities. Finally, one is located at the

Ohio State University Center for Automotive Research. This is a positive show of support by the research center, but the Lennox Shopping Center, a quarter mile away off S.R. 315, would have been a better choice from a consumer PEV owner perspective.

Q. Why is the private market not sufficient to provide needed PEV charging?

A. Much of the reason is because the business model for charging does not generate sufficient revenue to cover the equipment and installation costs, especially for DC fast charging stations. Thus, there are not enough of these locations. I believe that when AEP announces this program and the building of new charging stations, it will encourage the purchase of electric vehicles and jumpstart the market.

Q. What is different about the utility business model that makes it better suited to support these needs?

A. Utilities are able to capture revenue, through utility rates, from the entire charging ecosystem. In other words, a network of public charging stations should induce more utility customers to purchase PEVs, leading not only to electricity consumption at the public chargers, but also to greater consumption of electricity at residences served by the utilities. In the long-term, net revenue growth can offset near-term investments in the charging installations needed to enable PEV market growth.

KEY DESIGN FACTORS FOR AEP OHIO TO INCORPORATE IN ITS DC FAST CHARGING AND PUBLIC LEVEL 2 CHARGING PROGRAMS

Q. What types of locations should AEP Ohio prioritize for charging infrastructure deployment?

A. AEP should prioritize the two segments where vehicles are stationary for the longest period of time (i.e., homes and workplaces) and strategic, publicly accessible locations that remove barriers to PEV adoption (e.g., DC Fast Charging along highway corridors

necessary to enable intercity travel, and high traffic volume locations in population centers to alleviate “range anxiety” and enable increasing use by a variety of transportation service providers).

Q. For residential locations including multi-unit dwellings, what type and level of charging is appropriate?

A. Within the residential segment, multi-family locations are especially appropriate for utility investment, given they represent a demonstrably underserved market. Currently, the PEV market is essentially restricted to detached single-family homes. Level 1 or 2 may be appropriate for residential locations. Level 2 offers greater flexibility for managing loads, but Level 1 offers some DR capability depending on the amount of charge needed to replenish batteries. For overnight charging, Level 1 charging may be appropriate for plug-in hybrid electric vehicles (PHEVs) which have a relatively smaller battery and gasoline engine. However, Level 2 will likely be the preferred choice for battery electric vehicles because of their larger battery and the ability of Level 2 charging to better manage and integrate EV load during off-peak periods.

Q. If the vast majority of charging can be accomplished at home, why should AEP Ohio invest in non-residential (i.e., workplace and public) charging stations?

A. While most driving needs can be accomplished with home charging overnight during hours when there is plenty of spare capacity on the electrical grid, workplace and public charging are also needed to facilitate a mainstream PEV market. For example, workplace charging is especially needed for PHEVs with limited electric range to extend miles driven on electric power in order to realize the full value of owning that PHEV in the first place. Charging at workplaces, the location where vehicles are typically parked for the

1 longest time outside of the home, also increases the availability of PEVs to support the
2 grid. Plug-in vehicles that are not plugged into the grid cannot be leveraged to integrate
3 variable renewable resources, such as wind and solar generation. Public Level 2 and DC
4 fast charging helps overcome “range anxiety” by providing charge when needed for
5 additional driving beyond the daily commute. Market research has shown that lack of
6 infrastructure to enable the occasional longer trip is a significant barrier to consumer
7 purchases of PEVs.

8 **Q. What type of charging, Level 1 or 2, should AEP help deploy at workplaces?**

9 A. Either Level 1, Level 2 or a combination of both can be appropriate at workplaces. In
10 situations where employees must park far away from the workplace or for other reasons
11 do not want to swap cords or move vehicles during the workday, Level 1 can be
12 sufficient. Level 2 provides greater capacity for managing loads through the day, thus
13 using PEVs assets as part of individual facility load management or utility demand
14 response. But Level 1 can provide some capability in this area. For example, Liberty
15 Plugin’s HYDRA HYDRA-R technology is a control system that links together up to ten
16 Level 1 charging stations and can “implement utility and building energy management
17 system (BEMS) load-control, using simple mail transfer protocol (SMTP) messages,
18 OpenADR and other communication methods”).¹⁵ The system also includes extra
19 features, such as payment collection and restriction of access, for Level 1 charging.

20 **Q. What are the characteristics of publicly-accessible locations that AEP should target?**

21 A. Locations should be regularly visited by the public, along significant travel routes, and/or
22 those that enable/extend miles driven on electricity. Good publically-accessible locations
23 include but are not limited to public parking garages, zoos, museums and other frequently

¹⁵ <http://libertyplugins.com/technical-information/>

1 visited destinations, public spots at airports, hotels/motels, hospitals, regional malls and
2 shopping districts, places along travel corridors that provide consumer amenities. It is
3 worth noting that a few of these site hosts have begun to install Level 2 charging as a
4 consumer amenity. However, collectively, these installations are too few in number,
5 sometimes lack network connectivity and consumer-friendly protocols and common
6 payment systems. While DC Fast Charging is the priority for publicly-accessible
7 charging, some investment in level 2 charging also is appropriate.

8 **Q. How should AEP identify potential public locations?**

9 A. AEP should apply the above criteria to site identification. Additionally, AEP says it will
10 rely on the analysis National Renewable Energy Laboratory and Mid-Ohio Regional
11 Planning Commission are conducting as part of the Smart Columbus Electrification
12 Project. Electric Vehicle Charging Association (EVCA) Int-1-003, That analysis is due to
13 be delivered to Smart Columbus in August 2017. This study will review regional traffic
14 flow data, including trip origin and destination, and identify heavily travelled routes.
15 Sites then need to be vetted to determine available electricity in particular areas and/or
16 needs to upgrade capacity. After gathering this data, AEP Ohio should consult with the
17 Advisory Committee, referenced elsewhere in this testimony, on site selection. The
18 Committee should have the opportunity to comment on site selection. Finally, as also
19 referenced below, prospective site hosts should have an opportunity to propose and
20 compete for location of equipment. These opportunities should be extended to sites
21 throughout AEP Ohio's territory that can demonstrate need and usage potential.

1 **Q. For publicly-accessible charging, what level of charging (Level 1, 2 or DCFC) should**
2 **AEP deploy?**

3 A. The level depends on site characteristics and needs. Level 1 is appropriate at very long
4 dwell public locations such as airports and as a portion of other installations. Level 2 is
5 appropriate for medium to long dwell such as retail settings, public garages and many
6 others. DCFC is appropriate and needed along heavily traveled corridors at locations that
7 offer consumer amenities.

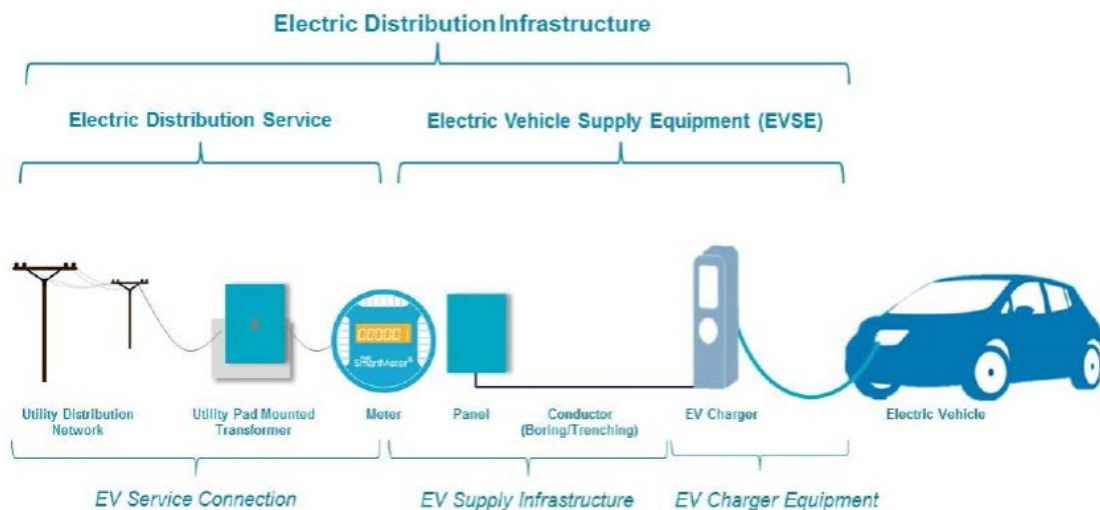
8 **Q. How should AEP ensure that PEV charging supports the grid?**

9 A. Communications and grid-integration functionality is very important, and can be housed
10 in the Electric Vehicle Supply Equipment (EVSE, colloquially, “charging station”) or in
11 the PEV itself. There are multiple technological pathways to ensure “smart charging” and
12 AEP should allow for the most cost-effective solutions to emerge, be they EVSE-based or
13 PEV-based. Many currently available commercial EVSE have load management
14 capabilities and automakers and utilities have also demonstrated the potential to use the
15 “smarts” embedded in the PEVs themselves to manage load.¹⁶ As more PEVs are
16 acquired by consumers and aggregate electrical load increases, utilities must be able to
17 manage these flexible loads to avoid the need to increase ratepayer-funded peak
18 generation capacity and to leverage the energy storage inherent in PEVs to lower the
19 costs of integrating variable resources and managing the grid. Building energy managers
20 also need this capability to manage loads through the day to avoid excessive electricity
21 costs and system upgrades that could be avoided through management.

¹⁶ See PG&E-BMW “iChargeForward” pilot (<https://www.bmwchargeforward.com/>) and Electric Power Research Institute “Open Vehicle Grid Integration Platform” (<http://www.epri.com/Press-Releases/Pages/EPRI,-Utilities,-Auto-Manufacturers-to-Create-an-Open-Grid-Integration-Platform.aspx>)

1 **Q. Please describe the relationship between PEV charging infrastructure and the**
2 **electric distribution system.**

3 A. In considering the utility role with respect to infrastructure, it is important to understand
4 in some detail the structure of costs and scope of potential competition for vehicle
5 charging. The following diagram is a useful reference for discussion.
6



7
8 In the diagram, PEV infrastructure costs are shown to consist of three groups: the “EV
9 Service Connection”; the “EV Supply Infrastructure”; and the “EV Charger Equipment.”
10 The EV Service Connection refers to the utility distribution infrastructure, including
11 transformers, utility services, and meters. The EV Supply Infrastructure is comprised of
12 panels, conduits and wiring. The EV Charger Equipment refers to the charging station
13 itself. The hardware and software that comprise the EV Charger Equipment are typically
14 supplied by third party manufacturers, and are the center of innovation activity in vehicle
15 charging technology and business models.”

1 **Q. Should AEP own the actual EVSE, or should its ownership be restricted to the**
2 **electrical equipment up-to but not including the EVSE?**

3 A. There are pros and cons of both models. Either ownership model can work effectively if
4 the program is properly designed to leverage market competition, provide opportunities
5 for site-hosts to participate, and ensure accountability of site hosts and/or utilities. Who
6 has title to the actual EVSE is only one element of program design that relates to
7 potential impacts on competition. Third-party charging equipment and service providers,
8 including Greenlots, EVGo, ChargePoint, and Smart Grid Services Siemens, have
9 supported programs in which the utility owns all the electrical equipment including the
10 EVSE *and* programs in which the utility owns the electrical equipment up-to, but not
11 including the EVSE, and provides rebates to help site-hosts purchase EVSE from a list of
12 pre-qualified equipment.

13 **Q. What are features of utility ownership programs that engage the competitive**
14 **market and are accountable to regulators and rate-payers?**

15 A. Some features of these programs include:

- 16 • Initial competitive solicitation by the utility to establish a list of qualified
17 equipment and software providers; (In the Osterholt testimony, page 16, that AEP
18 Ohio's intent is to select "one or more" qualified vendors. I would encourage AEP
19 Ohio to select multiple vendors as long as they are qualified.)
- 20 • Site selection process that provides opportunities for sites to compete to
21 demonstrate their value in providing PEV charging that will be utilized;
- 22 • Process that gives sites the ability to select equipment from a pre-qualified list
23 acceptable to the utility;

- Creation of an independent committee that receives reports from the utility and input from sites, EVSE industry, and other stakeholders, and advises both the utility and Commission; and
- Provisions to ensure load management needed to support the electric grid and provide the opportunity for drivers to realize the fuel cost savings that motivate PEV purchase decisions.

Q. What are features of a utility infrastructure program with rebates for the actual EVSE (site host ownership model) program that ensure universal network access, sustained high percentage up-time, and full integration of units into the electric grid for DR purposes?

A. Under this model the utilities would still do all of the wiring and make the site ready for the charger. Some features of these programs include:

- Utility pre-qualification of equipment and guidance on system design to ensure EVSE and software meet quality specifications and is capable of grid integration;
- Ability of utility to claw back rebate payments and/or ownership of equipment if data show it is not being maintained or it is not operational a high percentage of time;
- Standards and network protocols to ensure consistent, easy user access and experience;
- Provisions to ensure load management needed to support the electric grid and provide the opportunity for drivers to realize the fuel cost savings that motivate PEV purchase decisions.

1 **Q. In general, who should pay for the energy costs of PEV charging?**

2 A. From a resource-allocation and grid-management perspective, it is generally best for the
3 end-user (the PEV driver) to face reasonable price signals that encourage charging which
4 supports the grid and that provide an opportunity to realize significant fuel cost savings
5 relative to gasoline. At first glance, free charging would seem appealing, but it can lead to
6 PEV drivers who could charge elsewhere occupying spaces that would be better reserved
7 for PEV drivers who really need the charging stations, necessitating the deployment of
8 more charging stations than would otherwise be needed. Researchers from UC Davis
9 have documented this and other unintended consequences of free charging in a paper
10 entitled: “Charging for Charging: The Paradox of Free Charging and Its Detrimental
11 Effect on the Use of Electric Vehicles.”¹⁷ Conversely, unfettered site-host discretion over
12 end-use pricing can undermine load management and the fuel savings that remain the
13 most important motivator of PEV purchase decisions. At many public charging locations
14 today, the fees charged for charging are well in excess of equivalent gasoline prices.

15 **Q. Please discuss the issue of who should pay for the energy costs of PEV charging in**
16 **the context of a utility program.**

17 A. Utility charging infrastructure programs can be structured to bill PEV drivers or to bill
18 site-hosts or third-party charging service providers. In programs in which the site-host is
19 the customer-of-record who ultimately pays the utility bill, they should have the choice as
20 to how to recover those costs from PEV drivers, subject to reasonable provisions that
21 ensure load management and the opportunity to realize fuel cost savings.

¹⁷ Michael Nicholas and Gil Tal, [*Charging for Charging: The Paradox of Free Charging and Its Detrimental Effect on the Use of Electric Vehicles*](#), October, 2013.

1 In particular, access to DC Fast Charging will be critically important for PEV drivers
2 when needed to extend or enable distance travel. Thus, it is important to manage these
3 important assets so they are not occupied by drivers that are taking advantage of free
4 power but do not really need it to provide necessary range.

5 I submit that lessons will continue to be learned with respect to pricing, especially for
6 public charging and as longer capacity battery PEVs become the market norm. Dynamics
7 may change as people use fast charging on corridors more routinely. However, offering
8 fee-free, especially for DC Fast Charging stations, is a poor option, especially for a pilot
9 program, because nothing will be learned about how consumers respond to charging
10 needs and price signals.

11 **Q. How has AEP proposed handling the question of who pays the energy costs for PEV**
12 **charging?**

13 A. Mr. Osterholt's testimony explains that charging for non-residential Level 2 and DC Fast
14 Charging sites will be "free of charge during an initial period," after which the company
15 will file a schedule of charges. In response to EVCA INT-1-022 AEP states that it plans
16 offer free charging for a limited time, and "gather data that would support the best pricing
17 options." It is unclear exactly what AEP Ohio means by this.

18 I recommend that, at a minimum, AEP Ohio should specify the time period during which
19 charging will be free and provide a better description of exactly what metrics it plans to
20 collect and how they relate to a future schedule for rates. Any free charging should be
21 limited to a short period, while an initial pricing plan is developed and data is collected
22 from deployed stations. A reasonable approach may be for AEP Ohio to propose a
23 schedule of rates for nonresidential Level 2 and DC Fast Charging no more than three to

1 six months after one-third of the stations have been deployed. AEP needs to fully explain
2 its strategy for this critical element of the program.

3 **Q. Does AEP Ohio propose an appropriate number of charging stations/sites for this**
4 **pilot?**

5 A. Yes. The overall number proposed is appropriate for a pilot scale program, but I feel this
6 is the minimum to gain insights into best practices. As we do more work regarding site
7 location it may make sense to marginally increase the number, subject to final
8 Commission approval of the locations. Given the substantial need for charging to
9 leverage and support greater adoption, it is likely that future programs would be larger in
10 scale.

11
12 **ADDITIONAL DESIGN FACTORS FOR AEP OHIO TO INCORPORATE IN ITS DC**
13 **FAST CHARGING AND PUBLIC LEVEL 2 CHARGING PROGRAMS**

14 **Q. Do you have additional design factors to suggest for the implementation of the DC**
15 **Fast Charging and Public Level 2 Charging Programs?**

16 A. Yes, I do. While I agree fundamentally with the need for AEP Ohio to make rate-payer
17 funded investments in PEV charging infrastructure, some issues raised could be clarified.
18 I also believe that additional program elements would strengthen this pilot to create
19 greater value for ratepayers and larger public benefit generally.

20 **Q. Please explain.**

21 A. In my view, the following program design elements should be incorporated:

- 22 • **Open network protocols and common payment options.** All charging stations
23 in a network should be available for any driver with a credit card and/or smart

1 phone to access easily and without needing to join more than one charging
2 network and carry multiple authentication cards. In addition, Smart Columbus is
3 developing a method that will enable people who do not have a credit card,
4 smart phone or even a bank account to be able to access mobility services
5 through a common system. Charging stations in this network should work with
6 Smart Columbus and include protocols to allow people to access and pay for
7 charging through these means.

- 8 • **Data collection and management.** Capturing data as to utilization, load
9 management, and pricing by market segment is critical to learn about charging
10 behaviors and demands at various locations to help guide new installations,
11 management of existing ones, and to provide guidance to prospective site hosts.
12 This should include but not be limited to: stations planned and implemented;
13 station usage and load patterns; distribution system impacts; host and customer
14 satisfaction and issues; electric vehicle sales in Ohio; impacts of vehicle
15 charging on AEP Ohio's distribution system architecture.
- 16 • **Consumer education.** Lack of awareness and understanding of PEVs by
17 consumers is a significant market barrier. Utilities should conduct direct
18 education of their customers. AEP Ohio also should provide funding directly to
19 non-profit entities that have expertise on EV and relevant consumer issues that
20 demonstrate ability to provide such education through a Commission approved
21 process. The program should allocate approximately 5% of total revenues to
22 consumer education and activities.

- **Serving all customers, including the less-advantaged.** PEVs provide direct economic benefits because they are less expensive to operate than conventional vehicles. These programs and investments may take many forms. Examples include education about availability of used PEVs along with rebates and/or installation of charging equipment at single and multi-unit residences. Used PEVs are highly suited to shared mobility programs. Utility pilots can include rebates or grants for car sharing programs and transportation network providers that directly serve low-income communities. AEP should seriously consider future charging infrastructure programs that enable the electrification of transit buses, school buses, and other forms of transportation that serve disadvantaged communities.
- **Program accountability through a program advisory committee.** The Commission should create, as part of its ruling in this case, a Program Advisory Committee to work with AEP Ohio on issues of site selection, scoping and competitive bidding, charging fee structure, open protocols, D/R or grid-integration features and other areas that present opportunities for all parties to learn from results of the pilot. The Committee should be created by and report to the PUCO. AEP Ohio should provide the Committee with information on operation of the pilot, charging station use and other data, and proposals from prospective sites to host charging stations. A partial list of Committee members would include representatives from Ohio Consumers Council, Clean Fuels Ohio, a major private employer, Smart Columbus, major developer of commercial, retail and/or multi-unit dwellings, Mid-Ohio Regional Planning Commission,

1 and Ohio Department of Transportation. AEP Ohio and PUCO would be invited
2 to participate in meetings at the Committee's discretion. The Committee should
3 meet at least once per month and create sub-committees as needed to conduct its
4 business.

6 **RECOMMENDATIONS FOR THE RESIDENTIAL CHARGING PROGRAM**

7 **Q. Do you have specific comments regarding the single-family residential component of**
8 **the program?**

9 A. Yes. Rather than utility ownership of equipment in single-family homes, a better option
10 would be a partial rebate that requires the resident to contribute a percentage or fixed
11 amount. This would reduce spending on EVSE not needed because the consumer
12 purchased a PHEV, or for other reasons has a PEV for which daily home charging needs
13 can easily be accomplished by Level 1 charging using equipment that comes standard
14 with the vehicle. This also would avoid many situations in which a car dealer encourages
15 a consumer to accept a "free" charger that still requires a significant installation costs and
16 turns out to be unneeded.

17 Finally, a "time of charge" rate design for home charging should accompany the single-
18 family and multi-unit portions of the residential program. This would allow the
19 Commission and others to learn how such pricing impacted charging timing since
20 strategies to encourage load shift are an important longer-term consideration.

CONCLUSION & SUMMARY OF RECOMMENDATIONS

Q. Please summarize your preceding recommendations.

A. I want to clearly recommend that the Commission approve a pilot program for AEP Ohio in this case, in order to accelerate adoption of electric vehicles, support Smart Columbus, and inform the Commission's PowerForward proceeding. To meet these goals, some clarification and modification of AEP Ohio's proposal is necessary.

With respect to the Nonresidential Level 2 and DC Fast Charging program, I recommend that AEP Ohio make several key program design changes. AEP Ohio should explicitly target the multi-family settings, workplace charging, and public locations with longer dwell times. Overall, AEP Ohio must clarify and make available for comment the "siting studies" that are currently being completed, to provide for meaningful stakeholder engagement.

Similarly, the Company should commit to a timeline for the establishment of electricity pricing at its stations; I recommend that AEP Ohio be required to propose a schedule for rates within 3-6 months after it has deployed a significant portion of the stations. To leverage competition in the market for providers of EV charging services, AEP Ohio should conduct a competitive solicitation for equipment and services, and provide for a measure of Site Host "choice" over equipment. With respect to the EV charging equipment, I recommend the minimum requirement that it utilize open network protocols and common payment options.

With respect to the 1000 residential charging stations, I recommend that AEP structure it as a rebate program, rather than AEP owning the charging stations and that participating customers should be obliged to take service on a time-of-use rate as a program

1 beneficiary. I also suggest that additional clarification is needed to determine who
2 qualifies for the residential charging program, and for the Company's proposed demand
3 response pilot, including data collection and reporting.

4 **Q. Do you have any additional recommendations that address both the Public Level 2**
5 **and DC Fast Charging Program, as well as the Residential Charging Program?**

6 A. Yes. To address consumer unfamiliarity with EVs, and to leverage the unique position of
7 the utility with respect its customers, I recommend that a portion of program funds be set
8 aside to conduct customer education and outreach.

9 Finally, I recommend establishment of a Program Advisory Committee to provide for
10 continued stakeholder engagement, and robust data collection and reporting to ensure that
11 the program results in "learning by doing."

12 **Q. Does that complete your testimony?**

13 A. Yes.

CERTIFICATE OF SERVICE

I hereby certify that a true copy of the foregoing Direct Testimony of Sam Spofforth submitted on behalf of Sierra Club, Natural Resources Defense Council, and Environmental Law & Policy Center was served by electronic mail, upon the following Parties of Record on May 2, 2017.

/s Madeline Fleisher
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