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BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union	)	
Electric Company d/b/a Ameren Missouri for	)	**File No. ET-2016-0246**
Approval of a Tariff Setting a Rate for	)	
Electric Vehicle Charging Stations	)	

SURREBUTTAL TESTIMONY OF
NOAH GARCIA
ON BEHALF OF

NATURAL RESOURCES DEFENSE COUNCIL

December 16, 2016

NRDC Exhibit No. 550
Date 1/12/17 Reporter NR
File No. ET-2016-0246

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Introduction and Qualifications

Q. Please state your name and address.

A. My name is Noah Garcia and my business address is 20 North Wacker Drive, Chicago, Illinois 60606.

Q. What organization are you employed at and what is your position?

A. I work at the Natural Resources Defense Council (NRDC) as a Schneider Fellow. NRDC is a non-profit environmental organization with more than two million members and online activists. NRDC uses law, science, and the support of its members to ensure the rights of all people to clean air, clean water, and healthy communities. One of NRDC's top priorities is to reduce transportation sector air pollutants.

Q. Please describe your educational background and work experience.

A. My educational experience includes a Bachelor of Arts in International Relations with a concentration in economics from Stanford University and a Master of Arts in Public Policy from Stanford University with a concentration in energy and environmental policy.

During my time at Stanford, I was a research assistant at the Steyer-Taylor Center for Energy Policy and Finance and analyzed the role of policy and market drivers behind clean energy development. At NRDC, I have advocated and provided support for state-based clean energy policies in various legislative and regulatory environments in Illinois. I have also advocated for and collaborated with partners on utility-driven transportation electrification programs in several jurisdictions in the Midwest. In Missouri, I participated in the *Working Case Regarding Electric Vehicle Charging Facilities* (File No. EW-2016-0123), providing substantive comments and materials on the necessity of charging stations to the development of the plug-in electric vehicle (PEV) market and how utilities could beneficially engage in this space. As part of the docketed proceeding, I presented at the Missouri Public Service Commission's EV workshop on May 25, 2016; along with Sierra Club and the Electric Power Research Institute, we expanded on the

environmental benefits of vehicle electrification and the need for strategic deployment of charging infrastructure to realize these benefits.

Purpose of Surrebuttal Testimony

Q. What is the purpose of your direct testimony in this proceeding?

A. The purpose of this testimony is to respond to rebuttal testimony offered by the parties in this case by expanding on the following topics:

1) The relationship between electric vehicles and electric vehicle charging stations;
2) The current status of electric vehicle charging infrastructure in Missouri;
3) The public policy rationale for utility deployment of electric vehicle charging stations;
4) Ameren Missouri's charging station procurement for its pilot proposal;
5) Ameren Missouri's tariff proposal.

For the reasons described in the following testimony, I recommend the Commission approve the revised tariff Ameren Missouri filed on October 7, 2016.[1]

Relationship between Electric Vehicles and Electric Vehicle Charging Stations

Q. Please describe the current status of national transportation sector greenhouse gas and criteria pollutant emissions.

A. In the summer of 2016, the US Energy Information Administration found that for the first time since 1979, carbon emissions from the transportation sector surpassed those from the power sector in the US and increased to 1,876 million metric tons (MMt).[2] Light-duty vehicles (LDVs) are responsible for over half of the carbon emissions associated with the

[1] Tariff Revision (YE-2017-0052), File No. ET-2016-0246, Filed October 7, 2016
[2] Doug Vine, "Transportation Emissions Roll Over Power Sector Emissions," Center for Climate and Energy Solutions, http://www.c2es.org/blog/vined/transportation-emissions-roll-over-power-sector-emissions (accessed November 22, 2016)

transportation sector.[3] Moreover, these LDVs are responsible for elevated levels of harmful criteria pollutants in many urban areas. It is estimated over 50,000 Americans in the lower 48 states die prematurely from traffic pollution every year, which is over one-and-a-half times as many as die in traffic accidents.[4] Any comprehensive effort to beneficially reduce carbon emissions and criteria pollutant emissions pursuant to the Clean Air Act must consider how to effectively decarbonize the domestic vehicle fleet.

Q. Does transportation electrification play a significant role in achieving carbon dioxide reductions?

A. Numerous independent studies have come to the same conclusion: reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050 will require a dramatic shift to electric-drive vehicles powered by zero-emitting energy sources.[5] Because just 15 to 17 million passenger vehicles are sold each year in the U.S., it will take decades to transform the existing U.S. stock of 250 million vehicles. To meet long-term global warming pollution reduction targets, studies have estimated that PEVs will need to account for 40 percent or more of new vehicle sales by 2030.[6]

Regrettably, the transportation policy space rivals the traditional utility policy world in its use of acronyms. **Error! Reference source not found.** harmonizes the categories of vehicle technology described in sources used in these comments.

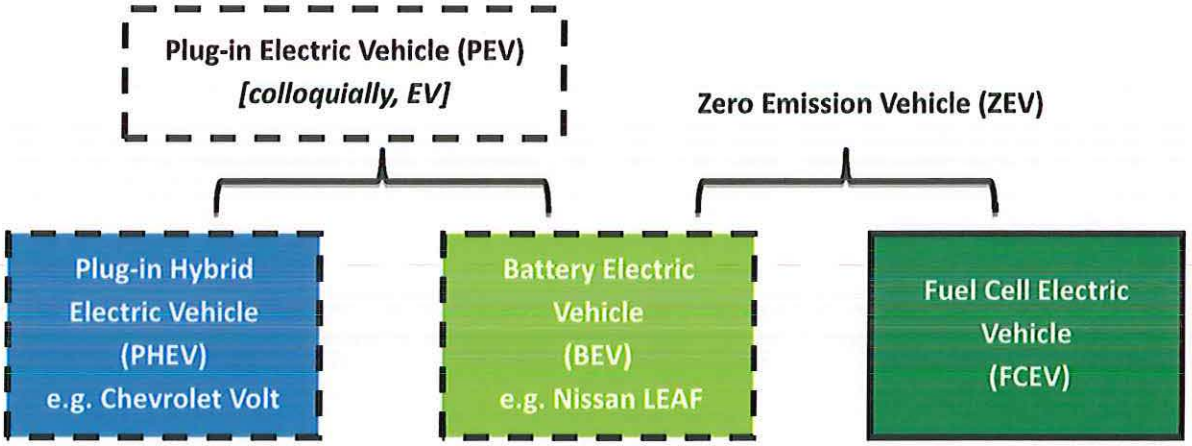
[3] "Sources of Carbon Dioxide Emissions," U.S. Environmental Protection Agency (EPA), https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#transportation

[4] Fabio Caiazzo et al., *Air pollution and early deaths in the United States*, Atmospheric Environment, 2013; National Highway Traffic Safety Administration, Fatality Analysis Reporting System (FARS) Encyclopedia.

[5] California Council on Science and Technology, *California's Energy Future*, May 2011; Williams et al., *The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity, Science*, January, 2012; Joshua Cunningham (Air Resources Board), *Achieving an 80% GHG Reduction by 2050 in California's Passenger Vehicle Fleet*, SAE International Journal of Passenger Cars, December, 2010; Max Wei et al., *Deep carbon reduction in California require electrification and integration across economic sectors*,. Environ. Res. Lett. 8, 2013; Melaina and Webster, *Role of fuel carbon intensity in achieving 2050 greenhouse gas reductions within the light-duty vehicle sector*, Environ. Sci. Technol. 45, 3865–3871, 2011; International Energy Agency, *Transport, Energy, and CO2: Moving Towards Sustainability*, OECD/IEA, 2009; National Research Council, *Transitions to Alternative Vehicles and Fuels*, The National Academies Press, 2013.

[6] California Air Resources Board, *Vision for Clean Air: A Framework for Air Quality and Climate Planning*, Public Review Draft, June 27, 2012; and National Research Council, *Transitions to Alternative Vehicles and Fuels*, National Academies of Science, 2013.

Figure 1 Vehicle Types



The Pilot Program proposed by Ameren Missouri appropriately focuses on plug-in electric vehicles (PEVs), commonly referred to as "electric vehicles" or "EVs," which can be charged with electricity from the electric grid. This includes both Battery Electric Vehicles (BEVs) that rely entirely upon electricity and Plug-in Hybrid Electric Vehicles (PHEVs) that rely upon electricity for daily driving needs, but use gasoline for longer trips. While PHEVs can be driven primarily on electricity, because they have tailpipe emissions when operating on gasoline, they are not referred to as Zero Emission Vehicles (ZEVs).

Q. Is a lack of charging infrastructure a barrier to the acceleration of EV adoption?

A. Yes, a dearth of strategically located charging infrastructure presents a significant barrier to transportation electrification and this phenomenon is recognized and well-documented by the National Academies of Science.[7] Achieving significant PEV penetration levels requires the development of an extensive, well-planned charging station network that provides value to drivers.

[7] Kassakian, John G., David Bodde, and Jeff Doyle. "Overcoming Barriers to Deployment of Plug-in Electric Vehicles." The National Academies Press. 2015.

Status of Electric Vehicle Charging Infrastructure in Missouri

Q. What is the purpose of Ameren's proposed EV charging station pilot?

A. As stated in Mark Nealon's testimony, the purpose of the pilot is to enable access to highway corridor charging that facilitates long-distance electric vehicle travel to the public and to support electric vehicle charging in communities along I-70.

Each of the proposed charging sites, or "charging islands," would be available for use by the general public to charge electric vehicles used for both long-distance driving and driving within communities situated along the I-70 corridor.[8]

Q. What does the Office of the Public Counsel (OPC) claim about the market for charging services in Missouri?

A. In his testimony, Geoff Marke makes the following statement:

Both ratepayers and drivers are best served by a competitive market for charging services rather than a regulated monopoly. There is no reason why Missouri cannot have a competitive market in EV charging and Ameren Missouri (and other investor-owned utilities "IOUs") non-regulated services should be allowed to participate in that market. [9]

Throughout the section on competition in his testimony, Dr. Marke is generally of the view that EV charging services constitute a competitive market in Ameren Missouri's service area, and that Ameren Missouri's regulated services should not be permitted to enter this market.

Q. Does an assessment of the EV charging services market in Ameren Missouri's service area require a more nuanced examination?

[8] Direct Testimony of Mark Nealon, File No. ET-2016-0246 Filed August 15, 2016
[9] Rebuttal Testimony of Geoff Marke, File No. ET-2016-0246 Filed November 29, 2016

A. Yes. The use, value, and ease of access to charging stations to both EV drivers (i.e. demand side of the market) and charging station owners and operators (i.e. the supply side) will vary depending on the type of site host, the site host location, and the type of charging station.[10] For this reason, it is useful to stratify the general EV charging services market that Dr. Marke describes into more distinct, location-based charging service markets. For the purpose of the proposal under consideration, Ameren Missouri is specifically addressing inter-city, highway corridor charging. Other conceivable markets may include the home, workplace, and intra-city locations. These categories are referenced and discussed in Sierra Club's testimony:

In particular, AC charging at home is a "virtual necessity" and must potentially be available before a potential electric vehicle driver will make an electric vehicle purchase. Employers with employees who commute any significant distance will need workplace charging. For extended range travel using battery electric vehicles, fast charging must be available along enough routes to effectively connect most trip origin-destination combinations.[11]

Q. What is the current state of the highway corridor charging services market in Ameren Missouri's territory?

A. Currently, Missouri has few AC charging stations and even fewer DC Fast Chargers located along its highway corridors. According to Plugshare – an accessible, comprehensive charging station locator application – only a couple of locations have non-Tesla DC Fast Chargers in Missouri outside of St. Louis and Kansas City metropolitan areas.[12] Dr. Marke confirms in his testimony that the vast majority of charging stations in Ameren Missouri's service area are concentrated in St. Louis and neighboring St. Charles

[10] See footnote 7

[11] Rebuttal Testimony of Douglas Jester, File No. ET-2016-0246, Filed November 29, 2016

[12] *See* https://www.plugshare.com/ I focus on non-Tesla DC Fast Charging stations because Tesla employs proprietary charging technology that is only accessible to owners of Tesla vehicles. In order to assuage range anxiety and meaningfully accelerate the PEV market, access to fast and reliable highway corridor charging is a necessity for all PEV models.

counties.[13] Aside from one Tesla Supercharger location in Columbia, there are currently no locations outside of the St. Louis area that offer DC fast charging along I-70 in Ameren Missouri's service territory.

Q. Are there private companies currently providing electric vehicle charging services to site hosts in Missouri?

A. Yes. This is clearly stated in ChargePoint's testimony. Ms. Smart explains that companies like ChargePoint, EVgo, and others provide charging stations in the state.[14] However, it is evident that for a set of reasons related to the charging services market described below, there has been very little charging infrastructure developed along Missouri's highway corridors – even the most trafficked ones.

Q. Does Ameren's EV charging station proposal address a market segment that will be critical for accelerating vehicle electrification in Missouri?

A. Yes. A robust network of charging stations along highway corridors is needed to accelerate the electric vehicle market. In particular, the development of direct current (DC) Fast Charging stations – which charge at a significantly faster rate than traditional AC charging stations and come closer to replicating the gas station experience – will be critical for this particular segment.[15] They enable long-distance, all-electric travel without significantly altering the time it takes to reach a particular destination. Electric Power Research Institute's analysis reveals that one in ten weekdays a vehicle is driven, it is driven in excess of 70 miles, which approaches the point at which most drivers of typical pure battery electric vehicles would begin to suffer from range anxiety.[16] The fear of being stranded is not just a source of anxiety for those who have already purchased BEVs, but a significant barrier to a mass market for BEVs. Although most PEV charging will occur at home, consumer research shows the lack of "robust DC fast charging

[13] See footnote 9
[14] Rebuttal Testimony of Anne Smart, File No. ET-2016-0246, Filed November 29, 2016
[15] While AC Level 2 charging is able to deliver 10-20 miles of range per hour of charging, DC fast charging can deliver 150-210 miles of range per hour of charging. See Alterrative Fuels Data Center, "Developing Infrastructure to Charge Plug-In Electric Vehicles," U.S. Department of Energy available at: http://www.afdc.energy.gov/fuels/electricity_infrastructure.html
[16] Marcus Alexander, *Transportation Statistics Analysis for Electric Transportation*, Electric Power Research Institute, December, 2011.

infrastructure is seriously inhibiting the value, utility and sales potential" of BEVs.[17] Advances in battery technology that enable affordable longer range all-electric vehicles, such as the forthcoming Chevrolet Bolt, will not reduce but increase the need for DC fast charging stations. As more automakers introduce vehicles that can complete the occasional longer trip while re-fueling during stops that would likely be made regardless to eat meals or use restrooms, demand for DC fast charging stations will increase significantly. Other critical market segments for PEV charging stations are outlined in Appendix 1.

Would-be EV drivers need to know that they can drive from St. Louis to Columbia or Kansas City when they need to and have access to reliable and affordable fuel along the way. The I-70 corridor is a critical and underserved market that needs to be addressed to unlock consumer demand in Missouri for vehicles that do not depend on gasoline or diesel refined outside of the state. Overall, developing the highway corridor fast charging market will be critical for the acceleration of the electric vehicle market.

Q. What challenges do current charging station providers – such as private charging station companies, automakers, and governments – face in the deployment of charging services along highway corridors?

A. Although OPC is quick to dismiss utility development of highway corridor EV charging infrastructure on the grounds that a competitive market exists for such products, OPC fails to consider the challenges that have hindered current market participants from deploying adequate infrastructure. Entities active in the PEV charging space today will likely not be able to develop the infrastructure necessary to achieve widespread electrification. Unfortunately, without extremely high utilization rates, it is difficult for independent firms to realize a profit in the time frame required for most private enterprises.[18] This problem may be acute for investments in DC Fast Chargers, which are much more expensive per unit than AC charging stations today. Next, automakers generally do not see themselves as the appropriate actor to make significant charging

[17] Norman Hajjar, *New Survey Data: BEV Drivers and the Desire for DC Fast Charging*, California Plug-in Electric Vehicle Collaborative, March 11, 2014.

18 The EV Project, *Lessons Learned on the EV Project and DC Fast Charging*, April, 2013.

station investments. While Tesla has successfully built and operated a DC charging station network, NRDC does not expect charging station deployment to become a core business of automakers, which did not enter the service station business to sell gasoline to gasoline-powered vehicles. Likewise, while state and federal programs have supported some of the existing charging network nationwide, public funding alone will likely not be sufficient to meet the scale of the challenge.

Automakers, governments, charging station companies, and other entities that deploy charging stations also currently face a market coordination problem that hampers the development of charging networks necessary to sustain the growing EV market. This market coordination problem – otherwise known as the "chicken and egg" dilemma – arises when the underdevelopment of one complementary or "networked" good leads to underdevelopment of the other networked good. [19] In this specific case, low penetration of charging stations inhibits the growth of the PEV market, and vice versa: customers may be unwilling to purchase a PEV if there is not sufficient charging network development, and charging station providers may be unable to build out a network with insufficient demand. As a result, there is an under-provision of charging stations in this scenario. However, as charging stations are built out, the value of owning an electric vehicle increases and the EV market grows. This in turn may attract the deployment of additional charging stations by private entities. These trends are supported by researchers at Cornell University who analyzed network effects associated with quarterly PEV sales in 353 metro areas and found, "the increased availability of public charging stations has a statistically and economically significant impact on EV adoption decisions."[20] [21]

[19] Ryan, Nancy E., and Luke Lavin. "Engaging Utilities and Regulators on Transportation Electrification." Energy+Environmental Economics. March 1, 2015.

[20] Li et al., *The Market for Electric Vehicles: Indirect Network Effects and Policy Design*, Cornell University, May, 2016. The authors of this research concluded that "a 10% increase in the number of public charging stations would increase EV sales by about 8% while a 10% growth in EV stock would lead to a 6% increase in charging station deployment." These results are not meant to predict or forecast network effects for any particular geographic area.

[21] Springel, *Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives,* University of California, Berkeley, November 1, 2016. Katalin Springel at the University of California, Berkeley has also found that in Norway, subsidies for electric vehicle charging stations were more than twice as effective at spurring EV purchases as equivalent subsidies for EVs themselves between 2010 and 2015.

Q. Are electric utilities capable of overcoming this market coordination problem and deploying widespread, strategic charging infrastructure needed to accelerate vehicle electrification?

A. Yes. For several reasons, electric utilities are uniquely positioned to accelerate the vehicle electrification process. Several utilities are already actively developing their own PEV infrastructure programs in the Midwest.[22]

First, utilities have extensive knowledge of the grid and would be able to deploy infrastructure in a way that minimizes risk to the electrical system and maintains reliability. Utilities can also leverage established customer relations to effectively communicate the public benefits of vehicle electrification. These characteristics not only could allow electric utilities to reliably jump start charging station deployment at large, but also target and educate market segments that are underserved by the existing market. Utilities are uniquely situated to capture the system-wide benefits of a comprehensive charging network. As noted in a recent National Academies of Science study, utilities can capture the "incremental revenue from additional electricity that EV drivers consume at home, where roughly 80 percent of the charging takes place" and use that revenue to reduce rates and bills for all customers.[23].

Public Policy Rationale for Utility Deployment of EV Charging Stations

Q. What is the public policy rationale for utility investment in the strategic, widespread deployment of PEV charging infrastructure?

A. As described above, the prudent development of charging station networks increases EV adoption. This not only benefits utility customers who drive electric vehicles or who are considering purchasing one; it delivers important benefits to utility customers as a whole.

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[22] Andy Balaskovitz, "Michigan utility plans statewide electric vehicle charging network," July 27, 2016 available at: http://midwestenergynews.com/2016/07/27/michigan-utility-plans-statewide-electric-vehicle-charging-network/ ; Dan Gearino, "AEP increases proposed rates to add tech features, like charging stations," November 28, 2016 available at: http://www.dispatch.com/content/stories/business/2016/11/28/aep-ups-cost-of-proposed-rates-to-add-tech-features-like-charging-stations.html

[23] Committee on Overcoming Barriers to Electric-Vehicle Deployment et al., *Overcoming Barriers to Deployment of Plug-in Electric Vehicles.*

First, widespread and intelligently integrated vehicle charging could lower electric rates for all utility customers. As described in Natural Resources Defense Council's *Driving Out Pollution*: *How Utilities Can Accelerate the Market for Electric Vehicles:*

Charging electric vehicles predominantly during off-peak electricity hours (when the electric grid is underutilized and there is plenty of spare capacity in the generation, transmission, and distribution system) allows utilities to avoid new capital investments while capturing additional revenues, lowering the average electricity cost for all their customers. This effect is the opposite of the utility "death spiral," whereby increasing costs borne by a decreasing pool of customers causes rate increases that drive away more customers, leaving those who cannot afford distributed generation or home energy storage to pay for an aging grid.[24]

This increased electric load from PEVs exerts downward pressure on rates by spreading the utility's fixed costs over a greater amount of kilowatt-hour (kWh) sales. As described above, utility customers and the utility have the potential to benefit from increased load without commensurate increases in costs to serve that incremental load.

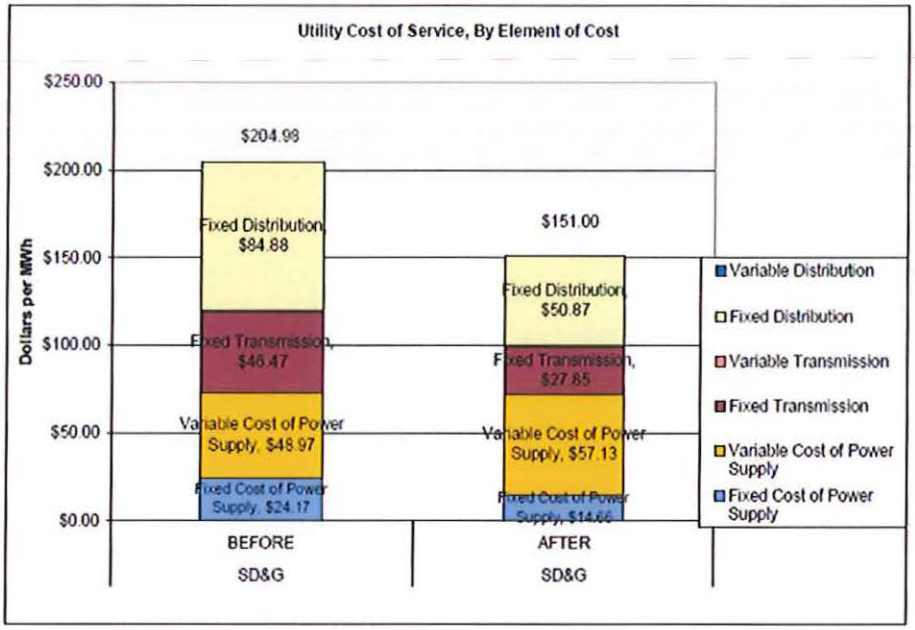
This downward pressure on rates as a result of increased electric vehicle load is consistent with the findings of researchers at the Pacific Northwest National Laboratory. They conclude there is sufficient spare generation capacity in the nation's electric grid to power virtually the entire light-duty passenger vehicle fleet without necessitating the construction of any new power plants, if vehicle charging load is integrated during off-peak hours and at lower power levels.[25] The same researchers also modelled impacts on the marginal price of electricity associated with transformative transportation electrification on two utilities, Cincinnati Gas & Electric and San Diego Gas & Electric

[24] Max Baumhefner, Roland Hwang, Pierre Bull, *Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles*, Natural Resources Defense Council, June 2016.

[25] Michael Kintner-Meyer Kevin Schneider Robert Pratt, *IMPACTS ASSESSMENT OF PLUG-IN HYBRID VEHICLES ON ELECTRIC UTILITIES AND REGIONAL U.S. POWER GRIDS: PART 2: ECONOMIC ASSESSMENT*, November, 2007. p. 11 available at: https://www.ferc.gov/about/com-mem/5-24-07-technical-analy-wellinghoff.pdf

(SDG&E). The results of a 100 percent PEV penetration scenario (1.1 million plug-in electric vehicles) in SDG&E territory are illustrated in Figure 2.[26]

Figure 2: Short Run Impact of Electric Vehicle Off-Peak Charging on Components of System Cost for San Diego Gas & Electric



Source: *Pacific Northwest National Laboratory*

These results should not be construed as a forecast, but the directional shift (approximately 25 percent reduction in the cost of electricity) is significant. Non-PEV customers would benefit from such efficient transportation electrification in the form of lower electricity bills. Ameren Missouri's pilot alone will certainly not be sufficient to facilitate this level of PEV adoption, but it could play a critical role in accelerating adoption early in the market. In sum, greater electric vehicle load can help flatten load curves, improve the efficiency and utilization of fixed distribution assets, and achieve cost savings for the body of utility customers.

[26] It is important to note that the analysis assumes that charging occurs during the "valley-filling" period between 10 pm and 6 am. Establishing residential rate structures that generally encourage off-peak charging are crucial to ensuring widespread vehicle electrification delivers system-wide net benefits in the long run.

Q. What other public policy arguments can be made in support of Ameren Missouri's EV pilot proposal and vehicle electrification more generally?

A. There is a public benefit associated with the reduction of greenhouse gas emissions from electric vehicles relative to gasoline-powered vehicles. In an attempt to refute this point, Dr. Marke carefully makes the claim that increased adoption of EVs will not reduce *Ameren Missouri's* carbon emissions.

Q. Will increased use of EVs reduce Ameren Missouri's carbon emissions?
A. No. Ameren Missouri is largely dependent on coal and natural gas/oil fossil fuel mix to supply its generation needs. This means that electric vehicles will require Ameren Missouri to continue burning carbon intense fossil fuels.

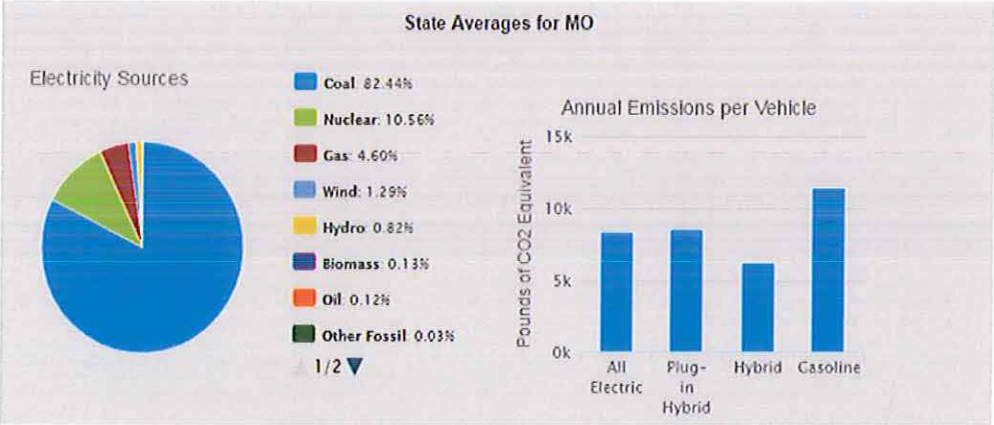
Q. What is your response to OPC's assertion regarding the environmental impacts of EVs in this case?

A. If one is to look narrowly at how Ameren Missouri's emissions profile changes as EV adoption increases, then Ameren Missouri's emissions would increase as a result of increased generation from its fossil-fuel power plants. This would be the case for virtually every other vertically-integrated regulated utility in the United States. In answering the question above, OPC ignores how the total fuel emissions from electric vehicles compare to gasoline-powered vehicles. However, in Figure 3 of Dr. Marke's testimony, OPC appears to not have a problem comparing electric vehicle and gasoline vehicle emissions when making the claim that vehicle electrification makes more environmental sense in Vermont relative to Missouri.[27] If the goal is to assess the environmental impacts of PEVs, it must be done in comparison to gasoline-powered vehicles.

To his benefit, Dr. Marke correctly points out that Ameren Missouri still relies heavily on coal generation. He presents a figure from the Department of Energy that shows – using 2014 data from the Energy Information Administration – that coal comprised approximately 82 percent of the state's generation. This is shown in Figure 3 below.

[27] Rebuttal Testimony of Geoff Marke p. 20, File No. ET-2016-0246 Filed November 29, 2016

Figure 3: Comparison of Annual Electric and Gasoline Vehicle Emissions with 2014 Missouri Generation Assumptions



Source: *Department of Energy Alternative Fuels Data Center*

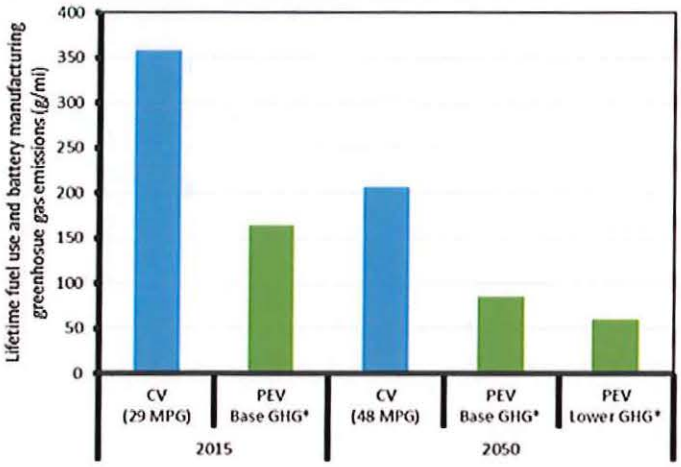
It is strikingly clear that even with Missouri's coal-heavy generation mix in 2014, PEVs still emit less CO_2 equivalent than gasoline-powered vehicles under equivalent driving conditions – approximately 27 percent less.[28] However, the Department of Energy's assumptions are already out of date: 2015 EIA state generation data reveals that coal's share of the generation mix dropped four percentage points from 82 percent in 2014 to 78 percent along with increases in zero-emitting generation.[29] This suggests that under the Department of Energy's assumptions, electric vehicles in Missouri ran on cleaner fuel in 2015 than in 2014. And we expect this phenomenon to continue. As market trends and policies shift Missouri's generation mix and that of the country as a whole towards lower carbon generation sources, the clean air and carbon emissions benefits from PEVs will continue to increase. As shown in Figure 4, on today's national electricity mix, PEVs emit half as much greenhouse gas pollution per mile (even when accounting for emissions resulting from the manufacturing of batteries) than current conventional vehicles, a margin that will only increase as the US electricity mix becomes less

[28] Alternative Fuels Data Center, "Emissions from Hybrid and Plug-In Electric Vehicles," U.S. Department of Energy (accessed November 22, 2016) available at: http://www.afdc.energy.gov/vehicles/electric_emissions.php#wheel
Upon rolling over the individual results on AFDCs website, one can see a battery electric (all electric) vehicle emits 8,328 lbs of CO2 equivalent and gasoline vehicles emit 11,435 lbs of CO2 equivalent. Hence, a 27% reduction compared to gasoline powered vehicles.

[29] U.S. Energy Information Administration, "Form EIA-923 detailed data" (accessed November 22, 2016) available at: https://www.eia.gov/electricity/data/eia923/

carbon intensive.[30] By 2050, under a base case, PEVs will still emit less than half as much carbon than a gasoline vehicle with a fuel economy of 48 miles-per-gallon. Under a scenario in which the transition to lower carbon generation sources occurs more quickly, PEVs emit only a quarter as much as a very efficient gasoline vehicle.[31]

Figure 4: Conventional Vehicle and Plug-In Electric Vehicle Lifecycle Greenhouse Gas Emissions



Source: *Electric Power Research Institute and Natural Resources Defense Council*

This concept – known as "environmentally beneficial electrification" – is becoming increasingly familiar with power sector experts.[32] All else equal, cleaner electric generation coupled with the improved efficiency of end-use technologies like electric vehicles and electric heat pumps *increases* electric generation while providing the opportunity to simultaneously *decrease* overall emissions relative to other non-electrified end-use technologies. In short, PEVs provide significant environmental benefits today and those benefits will only increase as the electric grid becomes cleaner. And as noted

[30] Marcus Alexander, Roland Hwang, and Luke Tonachel, *Environmental Assessment of a Full Electric Transportation Portfolio Volume 2: Greenhouse Gas Emissions*, Electric Power Research Institute and Natural Resources Defense Council (September 2015)

[31] *Ibid.*

[32] Keith Dennis, Ken Colburn, and Jim Lazar, "Environmentally Beneficial Electrification: The Dawn of 'Emissions Efficiency'", *The Electricity Journal* 29 (July 2016): 52-58 available at: http://ac.els-cdn.com/S1040619016301075/1-s2.0-S1040619016301075-main.pdf?_tid=c0ef3efe-ad0e-11e6-908a-00000aacb35d&acdnat=1479419136_7977bb870b5feb0cd2198d0783d05673

below, PEVs can also help reduce the costs of transitioning to renewable sources of electricity.

Q. Are there other public policy reasons for advancing vehicle electrification in Ameren Missouri?

A. Yes. Related to the power sector transition described above, electric vehicles could also facilitate the integration of renewable energy onto the grid. Missouri currently has a Renewable Portfolio Standard that requires the investor owned utilities in the state to source 15 percent of their annual electric sales from renewable generation by 2021.[33] PEV load is particularly flexible, so it can be managed in a manner such that it soaks up renewable generation, reducing the need for curtailment and ensuring the value of new renewable assets.[34] In wind-rich states like Missouri, nighttime wind generation peaks can be absorbed by electric vehicles plugged in at home. As early as 2009, BMW and the European utility Vattenfall demonstrated the potential for the PEVs to integrate variable wind generation by ramping charging up and down when the PEV drivers slept, awakening to fully charged vehicles.[35] The development of Missouri's renewable energy resources could also bolster the in-state clean energy economy. With 11 active wind manufacturing plants and over 112 solar companies throughout the state, Missouri could magnify the in-state economic benefits of vehicle electrification with increases in renewables manufacturing and deployment.[36] For these reasons, electric vehicle charging could allow Missouri to meet the requirements of its Renewable Portfolio Standard at lower cost while providing economic benefits to the state.

Finally, there is a public benefit associated with the decreased dependence on petroleum in Missouri. According to the Missouri Comprehensive Energy Plan, the state spent $15

[33] DSIRE, "Renewable Energy Standard", NC Clean Energy Technology Center available at: http://programs.dsireusa.org/system/program/detail/2622

[34] "California Transportation Electrification Assessment Phase 2: Grid Impacts." Energy+ Environmental Economics. October 23, 2014.

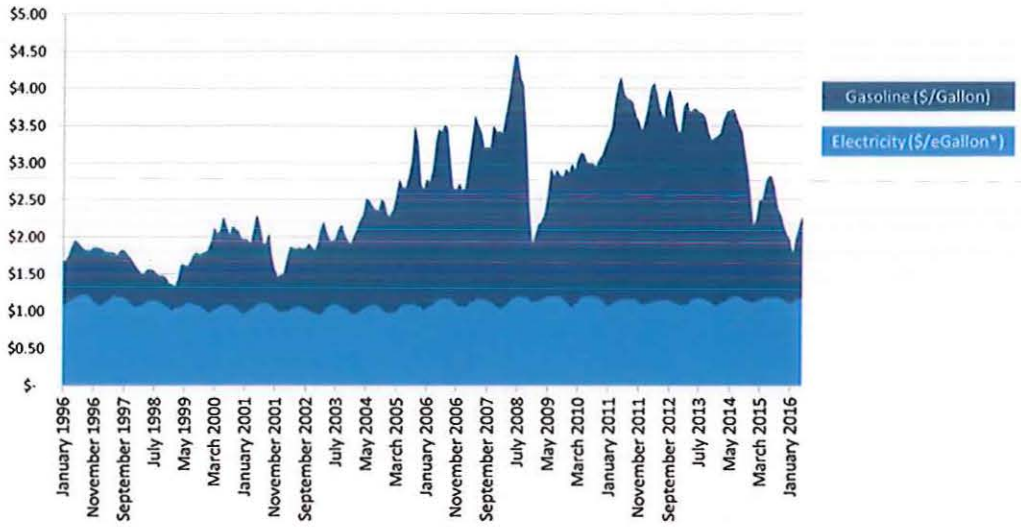
[35] Vattenfall AG, *Klimaentlastung durch den Einsatz erneuerbarer Energien im Zusammenwirken mit emissionsfreien Elektrofahrzeugen* ("Climate Change Mitigation Through Usage of Renewable Energy Sources in Combination with Emission Free Electric Vehicles"), March 2011.

[36] American Wind Energy Association, "Missouri Wind Energy" available at: http://awea.files.cms-plus.com/FileDownloads/pdfs/Missouri.pdf; Solar Energy Industries Association, "Missouri Solar" available at: http://www.seia.org/state-solar-policy/missouri

billion in 2012 on transportation fuels, the majority of which was gasoline for light duty vehicles.[37] While the state has an established renewable energy industry, "Missouri is not a major oil producer or refiner and therefore all gasoline used for transportation purposes is imported to the state."[38] It stands to reason that reducing the state's dependence on imported oil is a clear economic benefit for Missourians. Furthermore, despite recent increases in domestic production, the United States is still a major importer of oil.[39] Consuming less oil enhances Missouri's energy security by shielding utility customers and business from the volatility of global oil markets that can disproportionately impact low-income drivers.[40] In contrast, retail electricity rates are relatively stable over the last quarter century in real terms.[41] National historical gasoline and electricity prices in an equivalent eGallon format are shown in Figure 5.[42]

[37] Department of Economic Development – Division of Energy, *Missouri Comprehensive State Energy Plan*, October 2015, p. 101 available at: https://energy.mo.gov/energy/docs/MCSEP.pdf
[38] *Ibid.*
[39] U.S. Energy Information Agency, "U.S. Imports by Country of Origin" (accessed November 22, 2016) available at: https://www.eia.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_a.htm
[40] U.S. Energy Information Agency, "Real Prices Viewer" (accessed November 22, 2016) available at: http://www.eia.gov/forecasts/steo/realprices/
[41] *Ibid.*
[42] An eGallon is the cost of fueling a vehicle with electricity compared to a similar vehicle that runs on gasoline. See http://energy.gov/maps/egallon

Figure 5: Historical Domestic Retail Gasoline and Electricity Prices: 1996 - 2016



*an **"eGallon"** is the cost of fueling a vehicle with electricity compared to a similar vehicle that runs on gasoline.

Data source: *Energy Information Administration, June 2016. Monthly averages.*

In Missouri, the average price of regular gasoline as of December 3, 2016 was $2.04 per gallon; at the same time, the cost of an eGallon in Missouri, based on residential electricity prices, was $1.02.[43]

Q. What is Staff's recommendation regarding the proposed tariff and EV charging station regulation generally?

A. In testimony, Mr. Murray writes:

Staff recommends that the Commission only approve Ameren Missouri's revised tariff sheets on the condition that all revenues, expenses and investment associated with the program being recorded below-the-line in order to hold ratepayers harmless.[44]

[43] *Ibid.*

[44] Rebuttal Testimony of Byron Murray, File No. ET-2016-0246, Filed November 29, 2016

Q. What is your response to Staff's position?

A. NRDC appreciates Staff's consideration of these issues, but does not agree with Staff that all investment associated with the pilot be recorded "below-the-line." Between rebuttal testimony offered by Mr. Murray and recommendations offered by Ms. Payne, Staff offers little very little explanation to defend this position save for the following claim:

Staff notes that Ameren Missouri ratepayers should not be required to subsidize a program for which the majority of its ratepayers will receive no direct benefit.[45]

Given the explanation above on the benefits of vehicle electrification to all utility customers and the critical role charging infrastructure plays in that process, NRDC questions the merit of Staff's position. Ameren Missouri's pilot proposal has the ability to engender these aforementioned utility customer benefits; for that reason, the utility should have the opportunity to recover costs associated with the development of the pilot.

Q. Does this mean that entities other than utilities should be excluded from developing charging stations in Ameren Missouri or elsewhere?

A. No. Other entities should still have the ability to build, sell, install, own, operate, and maintain charging stations as they currently do. NRDC also supports Sierra Club's recommendation that the Commission make clear that these non-utility owners of electric vehicle charging stations are not public utilities subject to Commission jurisdiction simply by operating these stations.[46]

Ameren Missouri Charging Station Procurement

Q. What other concerns does the Office of the Public Counsel have regarding utility deployment of electric vehicle charging stations?

A. OPC appears to be concerned that utility engagement in the deployment of charging stations will create barriers to entry for new market participants and unjustly penalizes

[45] Recommendations of Whitney Payne, File No. ET-2016-0246, Filed
[46] Rebuttal Testimony of Douglas Jester p. 29, File No. ET-2016-0246, Filed November 29, 2016

private players in the market. Dr. Marke also explains that the utility can subvert competition and could potentially "reduce efficiency."[47] Additionally, OPC fears that utility assets will become stranded assets that become obsolete and outdated relative to private market alternatives.

Q. Within the context of Ameren Missouri's pilot proposal, do these issues merit the Commission's concern?

A. No. It must be made clear that in no way is Ameren Missouri proposing to develop, manufacture, or deploy its own charging station products to serve this project. As far as I am aware, no other approved or pending utility charging infrastructure proposal specifies that the utility itself will be responsible for providing its own charging station hardware and software. Instead, Ameren Missouri has developed a competitive solicitation or "Request for Proposals" through which private charging station companies have the opportunity to provide the equipment necessary for its EV pilot proposal. Anne Smart confirms there is an RFP in her testimony:

Q. Did ChargePoint respond to Ameren's EV charging pilot RFP?
A. Yes, ChargePoint responded to the RFP.

Other private charging station providers also presumably responded to the RFP. If it is designed well, it can sufficiently address OPC's concerns on several fronts. Rather than creating *market barriers* for new participants, Ameren Missouri's proposal provides new participants with opportunities for *market access* that did not exist before. Rather than penalizing market players and stifling competition, an RFP can engender the competition that OPC claims is missing from utility involvement to deliver the best possible products from the private market. Finally, because the hardware and software for the proposal is coming from private companies, there should be little concern that Ameren Missouri is not using competitive, quality products and services from the industry.

[47] See footnote 9

If OPC is concerned that the deployment of existing private technologies will be obsolete before the end of their useful lives, then by that logic, very few technologies these days would be procured or developed. Companies and consumers do not shy away from procuring iPhone 7s out of fear that the iPhone 8 will render their devices obsolete. Just the same, Ameren Missouri should not wait to procure technology that has not been developed yet, especially at this critical stage of the PEV market.

Q. Does NRDC have responses to other parties regarding the EV pilot procurement process?

A. Yes. With regard to the RFP, ChargePoint recommends the following in testimony:

Ameren should consider qualifying multiple RFP respondents to provide charging station equipment and services in its pilot.

While NRDC generally does not have a position on this aspect of utilities' RFP design for charging products and services, for the purposes of this pilot, it seems unreasonable and inefficient to require Ameren to qualify multiple vendors for such a small project. For scale, Ameren Missouri is proposing six charging islands with four ports each (24 ports); San Diego Gas & Electric and Southern California Edison were granted approval by the California Public Utilities Commission to procure 3,500 and 1,500 stations, respectively.[48] In this regard, NRDC agrees with and supports Sierra Club's recommendation that procurement be done through "utility procurement," as Douglas Jester describes, with equipment specifications that satisfy the utility's needs in this case.[49]

[48] The 1,500 stations approved in Southern California Edison (SCE) is considered to be part of Phase 1. Contingent upon Commission approval, SCE will be allowed to deploy up to 30,000 additional charging stations in Phase 2. Herman K. Trabish, "CA regulators approve $45M SDG&E electric vehicle charger rollout," February 1, 2016 available at: http://www.utilitydive.com/news/ca-regulators-approve-45m-sdge-electric-vehicle-charger-rollout/413015/

[49] Rebuttal Testimony of Douglas Jester p. 29, File No. ET-2016-0246, Filed November 29, 2016

Ameren Missouri Tariff Proposal

Q. Are there beneficial rates that would be presumptively approvable by the Commission that would help increase the benefits of vehicle electrification?

A. Yes. A survey of over 16,000 PEV drivers reveals that "saving money on fuel costs" is the single most important decision factor driving PEV purchases.[50] Therefore, to ensure that a utility charging infrastructure proposal achieves its goal of developing the electric vehicle market, it is crucial that PEV drivers generally realize fuel cost savings when switching from gasoline to electric fuel. Charging for electricity in excess of equivalent gasoline costs at certain stations would dilute the incentive to purchase a PEV or charge one at the stations in question, jeopardizing the use and usefulness of those charging stations as well as the overall success of a network. For these reasons, reasonable and transparent tariffs that give drivers the potential to achieve fuel cost savings relative to gasoline are an essential element of a utility charging network.

Q. Does Ameren Missouri's revised tariff provide EV drivers with the opportunity to realize these fuel cost savings?

A. Yes. Even though the AC and DC tariffs are above those for residential retail electric service, they still provide drivers with the opportunity to save money on fuel costs. Under the assumptions that average gasoline vehicle fuel efficiency is 28 miles per gallon, a gallon of gasoline in Missouri is $2.04, EV fuel efficiency is .32 kWh/mile, and electricity prices are $.20/kWh for AC stations and $.17/minute for 50 kW DC stations, I show the cost per mile of operating each vehicle shown below in Table 1.[51]

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[50] Center for Sustainable Energy (2016). California Air Resources Board Clean Vehicle Rebate Project, EV Consumer Survey Dashboard. Retrieved [date retrieved] from http://cleanvehiclerebate.org/survey-dashboard/EV.

[51] Tariff Revision (YE-2017-0052), File No. ET-2016-0246, Filed October 7, 2016
I make the assumption that gasoline powered vehicles attain an efficiency of 28 miles/gallon, EV efficiency is 0.32 kWh/mile (sales weighed average of 2016 model year vehicles in 2015), a gallon of regular gas is $2.04 (average Missouri gasoline price) and electricity is $0.20/kWh as specified in Ameren's tariff for AC and $.17/minute for 50 kW DC chargers. See http://www.afdc.energy.gov/vehicles/electric_emissions_sources.html for assumptions.

Gasoline Powered Vehicle Fuel Costs per mile: ($2.04/gal)/(28 miles/gal) = **$0.073/mile**
EV Fuel Costs per mile (AC): ($0.20/kWh)*(.32 kWh/mile) = **$0.064/mile**
EV Fuel Costs per mile (DC): ($.017/minute)*(60 minutes) /(50kWh) = ($.204/kWh)*(.32 kWh/mile) = **$0.065/mile**

Table 1: Vehicle Fuel Cost Comparison using Ameren Missouri's Revised Pilot Tariff

Vehicle Type and Charger	Cost per Mile of Operation
Gasoline Vehicle	$0.073 per mile
EV – AC Charger ($.20/kWh)	$0.064 per mile
EV – DC Charger ($.17/minute)	$0.065 per mile

In sum, under the proposed tariffs, PEV drivers will still enjoy modest savings relative to gasoline while re-fueling during the occasional trip along the I-70 corridor, and will continue to enjoy significant savings from their everyday charging which will generally occur at home overnight.[52]

Q. Are there beneficial rate structures that would be presumptively approvable by the Commission that would further increase the benefits of vehicle electrification?

A. Yes. Consistent with the findings in Staff's report from *A Working Case Regarding Electric Vehicle Charging Facilities* (File No. EW-2016-0123) and the Missouri Comprehensive State Energy Plan, NRDC generally finds a time-of-use rate to be effective in managing *residential* PEV load and augmenting the benefits of vehicle electrification.[53] Transportation electrification done at a scale necessary to meet air quality and climate goals will have significant implications for the electrical grid. If it is done poorly, the costs will be substantial and could undermine the viability of a strategy that is critical to meet mid- and long-term goals. However, with the right policies and programs in place, the electrification of the transportation sector could be cost-effective and maximize benefits for all utility customers. It is important to note that current and near-term EV penetration in Ameren Missouri's service will very likely not pose any significant challenges for the utility's existing grid infrastructure:

[52] See https://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet54Rate1MRES.pdf

[53] Department of Economic Development – Division of Energy, *Missouri Comprehensive State Energy Plan*, October 2015, p. 101 available at: https://energy.mo.gov/energy/docs/MCSEP.pdf; Missouri Public Service Commission Staff Report, File No. EW-2016-0123, Filed August 5, 2016

Ameren Missouri's electric grid, like most others across the nation, operates below maximum capacity for most of any given year. Aided by thoughtful load management, a considerable EV population could root itself in the service territory without the need for generation or line infrastructure upgrades, hence applying a consistent downward pressure on electric rates. This carries a necessary presumption that Ameren Missouri's grid infrastructure is, in its present form, ready to accommodate considerable growth at the hands of the electric transportation movement, without the burden of such investment.[54]

In California – which now has over 250,000 PEVs – there have been virtually no electric system upgrades driven by increased electric vehicle load: approximately 0.1 percent of PEV sales have resulted in service line or distribution system upgrades.[55] According to the Missouri Comprehensive State Energy Plan, there were approximately 1,600 PEVs in Missouri in 2015.[56] Real world data from the Department of Energy's "EV Project" demonstrate that, in jurisdictions without active utility PEV programs where time-of-use tariffs are either not available or not widely adopted, PEV customers will plug in and charge immediately upon returning home from work, exacerbating evening system-wide peak demand, but that in jurisdictions with effective utility education and outreach and time-variant price signals, the vast majority of PEV charging occurs during off-peak hours.[57] This is shown in Figures 6 and 7. In other words, active utility programs, time-variant rates, and effective customer education and outreach will be needed to ensure that efficient transportation electrification benefits all utility customers in the long-term.

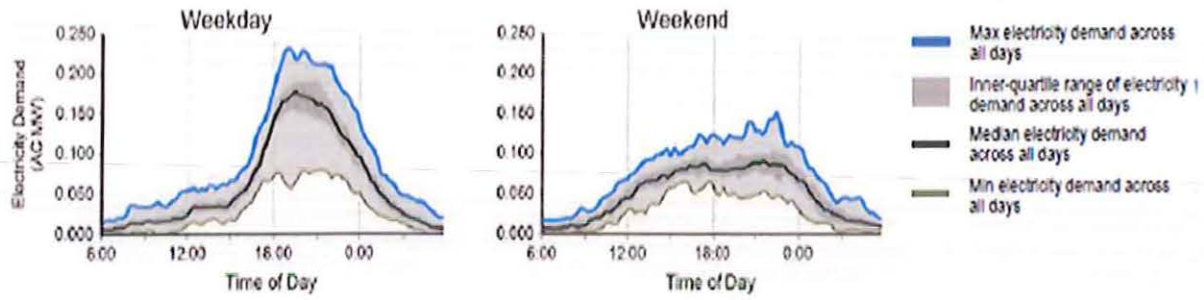
[54] Direct Testimony of Mark Nealon at 32, File No. ET-2016-0246 Filed August 15, 2016

[55] *See* California Auto Outlook, February, 2016; Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison, *Joint IOU Electric Vehicle Load Research Report 4th Report*, Filed on December 24, 2015. ; California Plug-In Electric Vehicle Collaborative, "PEV Sales Dashboard," (accessed December 12, 2016) available at: http://www.pevcollaborative.org/pev-sales-dashboard

[56] Department of Economic Development – Division of Energy, *Missouri Comprehensive State Energy Plan*, October 2015, p. 106 available at: https://energy.mo.gov/energy/docs/MCSEP.pdf

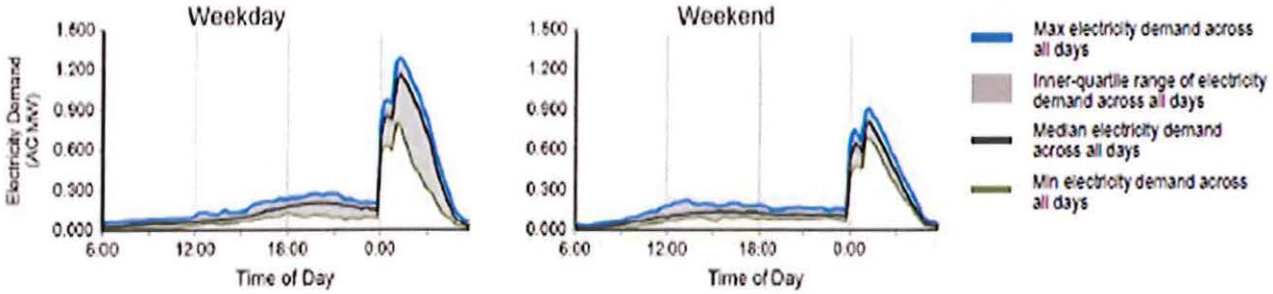
[57] *Idaho National Laboratory, 2013 EV Project Electric Vehicle Charging Infrastructure Summary Report,* January 2013 through December 2013.

Figure 6: Dallas/Fort Worth Electric Utility PEV Load Profile



Source: *The EV Project, U.S. Department of Energy*

Figure 7: San Diego Electric Utility Load PEV Profile



Source: *The EV Project, U.S. Department of Energy*

Q. What is ChargePoint's view on pricing at Ameren Missouri's proposed charging stations?

A. On the topic of pricing, ChargePoint shares the following in testimony:

ChargePoint is not opposed per say to the pricing proposed by Ameren in its tariff revision filed on October 7. However in order to support competition, the site host, rather than the utility, should control pricing to drivers who are using the charging service located on their own property.

Q. What is your response to ChargePoint's position on pricing at Ameren Missouri's proposed charging stations?

A. PEV drivers charging at the stations Ameren proposes to deploy in the pilot should pay the prices proposed in the associated tariff approved by the Commission and should not be subject to discretionary mark-ups by site-hosts and third-party charging service providers. As noted above, the margin between the proposed tariffs and the equivalent gasoline costs is slim; any mark-up by site-hosts and third-party charging service providers would erase that margin.

Conclusion

Q. In summary, what have you illustrated in this testimony?

A. I have explained the necessity of charging infrastructure in the development of the electric vehicle market in Missouri, and I have shown that there is currently a dearth of charging stations along the route where Ameren Missouri proposes to develop its pilot. For several reasons, non-utility entities are not filling this infrastructure gap. However, utilities are well-positioned to address this highway corridor charging market segment, as well as other segments. I describe the benefits that would be experienced by all utility customers with the development of pilot, and recommend that Ameren Missouri receive cost recovery for the costs incurred for the pilot. I address market and competition concerns related to the utility deployment of charging stations, and I find that the tariff proposal will generally allow drivers to realize fuel cost savings relative to gasoline. Finally, I have identified charging station rate structures that further beget the benefits of vehicle electrification.

For the reasons described in testimony, I recommend the Commission approve the revised tariff submitted by Ameren Missouri on October 7, 2016.[58] With performance improvements to existing PEV models and the advent of a new, affordable, and long-range generation of PEVs on the horizon, it is imperative that a robust and reliable charging network is in place to sustain the growth of this market.

[58] Tariff Revision (YE-2017-0052), File No. ET-2016-0246, Filed October 7, 2016

Appendix 1: Other Critical Electric Vehicle Charging Station Market Segments

Q. Please identify target market segments – in addition to highway corridors – where charging infrastructure will have the greatest impact in accelerating vehicle electrification.

A. Ameren Missouri correctly points out that the majority of PEV charging takes place at the home, and this is the most essential segment to spur PEV adoption. In a recent report of the National Research Council of the National Academies of Science (commissioned by the Department of Energy at the direction of the U.S. Congress) entitled, "Overcoming Barriers to the Deployment of Plug-in Electric Vehicles," the authors characterize home charging as follows:

> *First, home charging is a virtual necessity for all EV classes given that the vehicle is typically parked at a residence for the longest portion of the day. Accordingly, the home is (and will likely remain) the most important location for charging infrastructure, and homeowners who own EVs have a clear incentive to install home charging. Residences that do not have access to a dedicated parking spot or one with access to electricity clearly have challenges to overcome to make EV ownership practical for them.*

Following this argument, drivers are very unlikely to purchase plug-in vehicles if they cannot plug in at home, where cars are typically parked for 12 hours out of the day.[59] Unfortunately, less than half of U.S. vehicles have reliable access to a dedicated off-street parking space at an owned residence where charging infrastructure could be installed.[60] To date, almost 90 percent of PEV drivers in the country's largest EV market live in

[59] Adam Langton and Noel Crisotomo, *Vehicle-Grid Integration*, California Public Utilities Commission, October, 2013, p. 5; *see also* Marcus Alexander, *Transportation Statistics Analysis for Electric Transportation*, Electric Power Research Institute, December, 2011.

[60] Traut et al., *US Residential Charging Potential for Electric Vehicles, (Transportation Research Part D)*, November, 2013. Available at: http://www.cmu.edu/me/ddl/publications/2013-TRD-Traut-etal-Residential-EV-Charging.pdf

single-family detached homes.[61] As the National Research Council notes: "Lack of access to charging infrastructure at home will constitute a significant barrier to PEV deployment for households without a dedicated parking spot or for whom the parking location is far from access to electricity."[62] It is essential for the PEV market to move beyond single family detached homes to scale up to achieve the benefits described in the most recent Missouri Comprehensive State Energy Plan.[63] Installing charging stations at apartment buildings and other multi-unit dwellings could unlock the potential for a broader, younger, and more diverse market for PEVs. This targeted approach to charging station deployment at multi-unit dwellings has been adopted by San Diego Gas and Electric, Southern California Edison, and Avista Utilities in their respective approved PEV infrastructure programs.[64]

The range-extending function and visibility of charging stations in the social context of a workplace can also spur additional vehicle sales. Nissan credits a workplace charging initiative with a five-fold increase in monthly PEV purchases by employees at Cisco Systems, Coca Cola, Google, Microsoft, and Oracle.[65] Likewise, the Department of Energy recently concluded that employees of companies who participated in its "Workplace Charging Challenge" were 20 times more likely to drive a PEV than the average worker.[66] Workplace charging can effectively double the electric miles driven on a daily basis by PEVs. This is especially important for PHEVs.[67] Workplace charging can also improve the utility of BEVs and help alleviate "range anxiety" for drivers who want to make the occasional longer trip after work.

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[61] Center for Sustainable Energy, *California Plug-in Electric Vehicle Owner Survey Dashboard*, available at: https://cleanvehiclerebate.org/eng/survey-dashboard/ev

[62] National Research Council of the National Academies of Sciences, *Overcoming Barriers to the Deployment of Plug-in Electric Vehicles*, the National Academies Press, 2015, p. 116.

[63] Department of Economic Development – Division of Energy, *Missouri Comprehensive State Energy Plan*, October 2015, p. 104 available at: https://energy.mo.gov/energy/docs/MCSEP.pdf

[64] Herman K. Trabish, "If you build it, will they charge? Utilities cautious in plans to spur electric vehicle adoption," August 10, 2016, available at http://www.utilitydive.com/news/if-you-build-it-will-they-charge-utilities-cautious-in-plans-to-spur-elec/423982/

[65] Brandon White, Senior Manager of EV Sales Operations, Nissan North America, at EPRI Plug-in 2014, "Taking the 'Work' Out of Workplace Charging."

[66] U.S. Department of Energy, *Workplace Charging Challenge – Progress Update 2014: Employers Take Charge*.

[67] California New Car Dealers Association, *California Auto Outlook*, February, 2015.

In brief, workplace charging can drive the adoption of both BEVs and PHEVs, as summarized by the National Research Council:

Charging at workplaces provides an important opportunity to encourage the adoption of PEVs and increase [electric vehicle miles traveled]. BEV drivers could potentially double their daily range as long as their vehicles could be fully charged both at work and at home, and PHEV drivers could potentially double their all-electric miles. Extending the electric range of PHEVs with workplace charging improves the value proposition for PHEV drivers because electric fueling is less expensive than gasoline. For BEVs and PHEVs, workplace charging could expand the number of people whose needs could be served by a PEV, thereby expanding the market for PEVs. Workplace charging might also allow households that lack access to residential charging the opportunity to commute with a PEV.[68]

Workplace charging is also essential to allow the Commission to leverage the growing customer investment in PEVs to support the integration of variable renewable generation. Missouri PEV drivers have already purchased batteries that collectively represent about 40 megawatt-hours of advanced chemical energy storage that could be used to address this new load shape by absorbing afternoon solar generation and overnight wind generation.[69] The Commission should take advantage of that growing sunk investment to benefit all utility customers. Combining both workplace and residential charging will provide maximum availability to help cost-effectively integrate renewables. Workplace and home charging are needed to make this possible; PEVs that are not connected to the grid cannot support the grid.

Q. Does this conclude your testimony?

A. Yes, it does.

[68] National Research Council of the National Academies of Sciences, *Overcoming Barriers to the Deployment of Plug-in Electric Vehicles*, the National Academies Press, 2015, p. 117.

[69] Assuming sales-weighted average battery size of 24.6 kWh, based on sales data from the Department of Energy's Alternative Fuels Data Center and the Missouri Department of Economic Development's estimate of 1,600 PEVs in the state.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric	)	
Company d/b/a Ameren Missouri for Approval	)	**File No. ET-2016-0246**
Of a Tariff Setting a Rate for Electric Vehicle	)	
Charging Stations	)	

County of Cook)
State of Illinois)

AFFIDAVIT OF NOAH GARCIA

Noah Garcia, of lawful age, on his oath states: that he has participated in the preparation of the following surrebuttal testimony in question and answer form, consisting of 31 pages to be presented in the above case; that the answers in the following surrebuttal testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such answers are true to the best of his knowledge and belief.

Noah Garcia

14th In witness whereof I have hereunto subscribed my name and affixed my official seal this day of December, 2016.

OFFICIAL SEAL
JENNIFER R DALY
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:05/28/17