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Case No. ER-2016-0285
Date testimony prepared: Nov. 29, 2016

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

In the Matter of	)	
Kansas City Power & Light Company's	)	File No. ER-2016-0285
Request for Authority to Implement	)	
a General Rate Increase for Electric Service	)	

DIRECT TESTIMONY OF NOAH GARCIA ON BEHALF OF

NRDC

NOVEMBER 30, 2016

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of	)	
Kansas City Power & Light Company's	)	File No. ER-2016-0285
Request for Authority to Implement	)	
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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 this direct testimony in question and answer form to be presented in the above case; that the answers in this direct 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

In witness whereof I have hereunto subscribed my name and affixed my official seal this 29 day of November, 2016.

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

Q. Please state your name and business 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 two 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.

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

A. The purpose of this testimony is to:

1) Explain the benefits of transportation electrification as it relates to Kansas City Power & Light's Clean Charge Network;
2) Identify target segments for charging station deployment;
3) Describe the substantial benefits of utility engagement in the transportation electrification process;
4) Elaborate on electric rates and rate structures that increase the benefits of transportation electrification.

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).[1] Light-duty vehicles (LDVs) are responsible for over half of the carbon emissions associated with the transportation sector.[2] 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.[3] Any comprehensive effort to beneficially reduce carbon emissions and

[1] 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)

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

[3] 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.

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.[4] 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 plug-in electric vehicles (PEVs) will need to account for 40 percent or more of new vehicle sales by 2030.[5]

Regrettably, the transportation policy space rivals the traditional utility policy world in its use of acronyms. Figure 1 harmonizes the categories of vehicle technology described in sources used in these comments.

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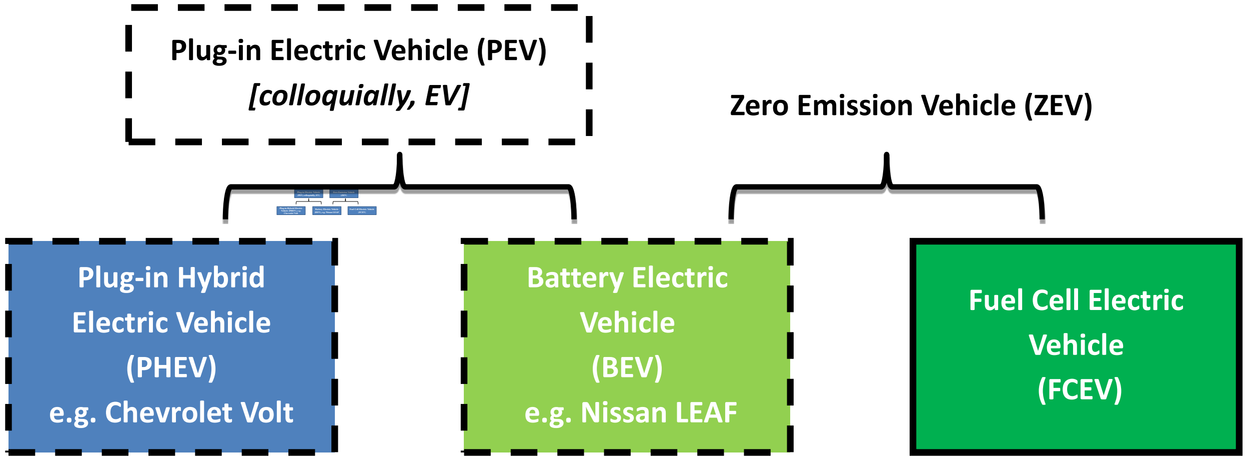
[4] California Council on Science and Technology, *California's Energy Future*, May 2011; Williams et al., *The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity, Science*, January, 2012; Joshua Cunningham (Air Resources Board), *Achieving an 80% GHG Reduction 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.

[5] 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 Clean Charge Network proposed by Kansas City Power & Light (KCP&L) 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.[6] Achieving significant PEV penetration levels requires the development of an extensive, well-planned charging station network that provides value to drivers.

Q. Please identify the target market segments where charging infrastructure will have the greatest impact in accelerating vehicle electrification.

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

A. The National Research Council of the National Academies of Science (commissioned by the Department of Energy at the direction of the U.S. Congress) identifies that the majority of PEV charging takes place at the home, and this is by far the most crucial segment to spur PEV adoption.[7] In its recent report 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.[8] 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.[9] To date, almost 90 percent of PEV drivers live in single-family detached homes.[10] 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."[11] It is essential for the PEV market to move beyond single family detached homes to scale up to achieve the benefits described in the

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[7] *Ibid*.

[8] 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.

[9] Traut et al., *US Residential Charging Potential for Electric Vehicles, (Transportation Research Part D)*, November, 2013.

[10] Center for Sustainable Energy, *California Plug-in Electric Vehicle Owner Survey Dashboard*.

[11] 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.

most recent Missouri Comprehensive State Energy Plan.[12] 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.[13]

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.[14] 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.[15] Workplace charging can effectively double the electric miles driven on a daily basis by PEVs. This is especially important for plug-in hybrid electric vehicles (PHEVs) that can operate on both electricity derived from the grid or gasoline, which have shorter all-electric ranges than battery electric vehicles (BEVs).[16] 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. 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 many drivers of the pure battery electric vehicles would begin to suffer from range anxiety, with about ten miles of fuel left to reach a destination with a charging station.[17] 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.

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[12] 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

[13] 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/

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

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

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

[17] Marcus Alexander, *Transportation Statistics Analysis for Electric Transportation*, Electric Power Research Institute, December, 2011.

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.*[18]

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.[19] 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.

Finally, 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

[18] 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.

[19] 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.

stations – will be critical for this particular segment.[20] They enable long-distance travel without significantly altering the time it takes to reach a particular destination. Currently, Missouri has very few 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.[21] Ameren Missouri has proposed to develop an electric vehicle pilot project that would install several DC Fast Chargers along Interstate 70.[22]

Although most PEV charging will occur at home, consumer research shows the lack of "robust DC fast charging infrastructure is seriously inhibiting the value, utility and sales potential" of BEVs.[23] 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.

Q. What challenges do current charging station providers face in the deployment of charging services in these segments?

A. Entities active in the PEV charging space today will likely not be able to develop the infrastructure necessary to achieve widespread electrification. First, automakers generally do not see themselves as the appropriate actor to make significant charging 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

[20] 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

[21] *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.

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

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

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. 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.[24] This problem may be acute for investments in DC Fast Chargers, which are generally more expensive per unit than AC charging stations today.

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. [25] 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 (potentially due to aforementioned range anxiety) and charging station providers may be unwilling 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."[26] In addition to the general market coordination problem, existing actors in the EV charging infrastructure space are confronted with the unique challenges that arise with

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

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

[26] 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.

deployment of infrastructure in multi-unit dwellings, where split incentives between tenants and property owners may not lead to any infrastructure development.[27]

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. A few utilities are already actively developing their own PEV infrastructure programs in the Midwest.[28]

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. Finally, utilities can 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 target market segments that are traditionally underserved by the existing market.

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

A. The prudent development of charging station networks 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.

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:*

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[27] 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. 86.

[28] 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/

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.[29]

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.

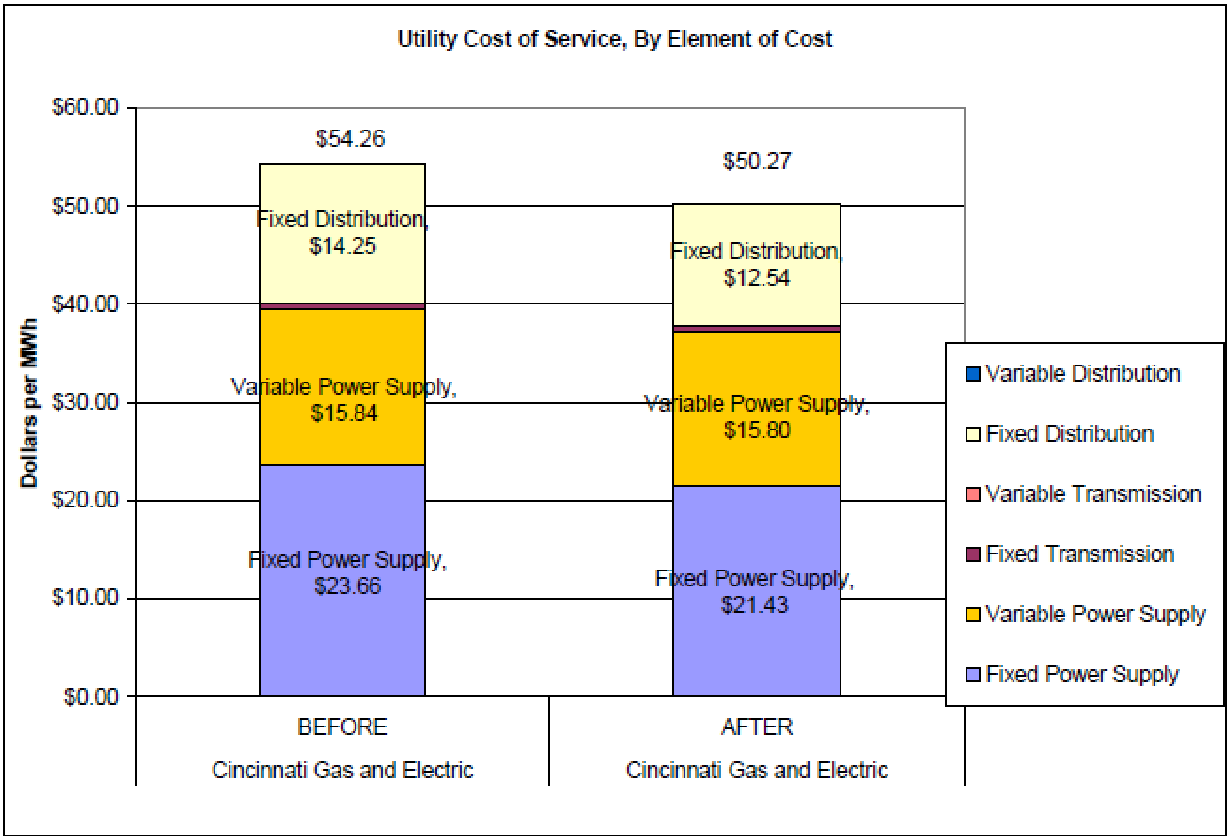
This downward pressure on rates as a result of increased electric vehicle load is consistent with the findings of researchers at the Pacific Northwest National Laboratory. They conclude there is sufficient spare generation capacity in the nation's electric grid to power virtually the entire light-duty 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.[30] 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. The results of a 100 percent PEV penetration scenario (~590,000 plug-in hybrid electric vehicles) in CG&E territory are illustrated in Figure 2.[31]

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

[30] 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

[31] 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.

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



Source: *Pacific Northwest National Laboratory*

These results should not be construed as a forecast, but the directional shift (approximately seven percent reduction in the cost of electricity) is significant. San Diego Gas & Electric saw approximately a 20 percent decrease in the cost of electricity.[32] Non-PEV customers would benefit from such efficient transportation electrification in the form of lower electricity bills. Kansas City Power & Light's Clean Charge Network 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.

[32] See footnote 30

Moreover, there is a public benefit associated with the reduction of greenhouse gas emissions relative to gasoline-powered vehicles. According to the Department of Energy, even with Missouri's coal-heavy generation mix in 2014, battery electric vehicles and still emit approximately 25 percent less CO_2 equivalent than gasoline-powered vehicles under equivalent driving conditions.[33] 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 percentage increases for zero-emitting generation.[34] This suggests that under the Department of Energy's assumptions, electric vehicles ran on cleaner fuel in 2015 than 2014. And we expect this phenomenon to continue. As market trends and policies shift Kansas City Power & Light's generation mix towards lower carbon generation sources, the clean air and carbon emissions benefits from PEVs will continue to increase. This concept – known as "environmentally beneficial electrification" – is becoming increasingly familiar with power sector experts.[35] 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, widespread vehicle electrification will allow the transportation sector to tap into and benefit from the de-carbonization of the electric sector.

Related to the power sector transition described above, electric vehicles 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.[36] Since PEV load is particularly flexible, it can managed in a manner such that it soaks up renewable generation, reducing the need for

[33] 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

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

[35] 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

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

curtailment and ensuring the value of new renewable assets.[37] In wind-rich states like Missouri, nighttime wind generation peaks can be absorbed by electric vehicles plugged in at home. 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.[38] 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 billion in 2012 on transportation fuels, the majority of which was gasoline for light duty vehicles.[39] 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."[40] 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.[41] 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.[42] In contrast, retail electricity rates are relatively stable over the last quarter century in real terms.[43] Historical gasoline and electricity prices are shown in Figure 3.

[37] "California Transportation Electrification Assessment Phase 2: Grid Impacts." Energy+ Environmental Economics. October 23, 2014.
[38] 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
[39] 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
[40] *Ibid*.
[41] 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
[42] U.S. Energy Information Agency, "Real Prices Viewer" (accessed November 22, 2016) available at: http://www.eia.gov/forecasts/steo/realprices/
[43] *Ibid*.

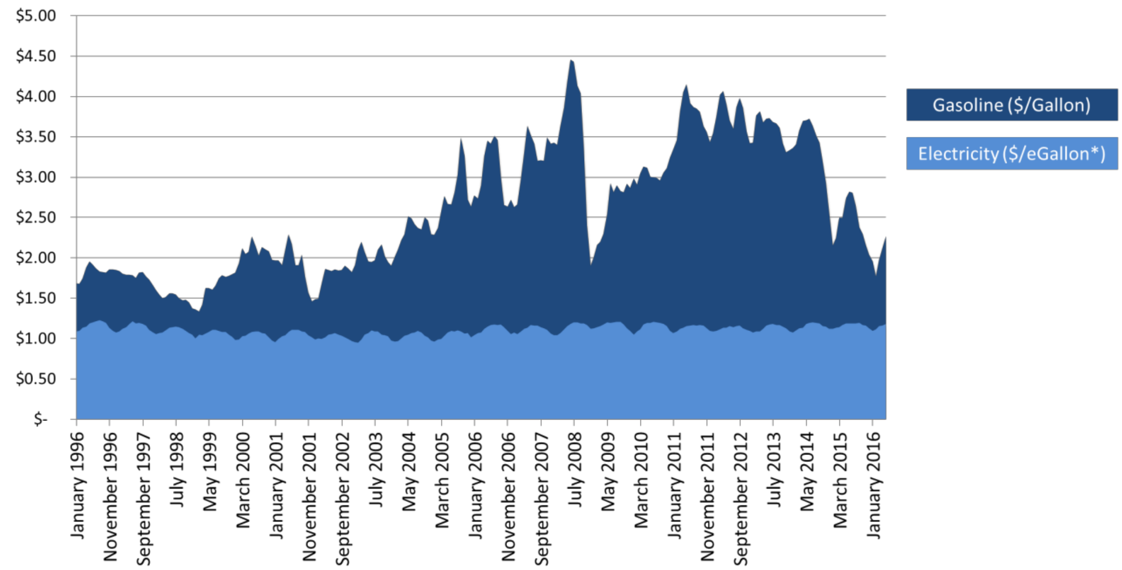


Figure 3: Historical Domestic Retail Gasoline and Electricity Prices: 1996 - 2016

*an **<u>"eGallon"</u>** 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.*

No one can accurately predict the future of gasoline prices, but there is almost no chance gas prices will drop to the equivalent electricity price of a dollar-a-gallon and remain constant at that level. Electricity prices are inherently more stable because electricity is produced from a diverse set of largely domestic resources and its price is carefully regulated by entities such as the Missouri Public Service Commission.

Q. Are there beneficial rates and rate structures that would be presumptively approvable by a utility regulator 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.[44] Therefore, to ensure that a

[44] 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.

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.

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.[45] 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.

In California – which now has over 200,000 PEVs – there have been virtually no electric system upgrades driven by increased electric vehicle load: approximately less than one tenth of one percent of PEV sales have resulted in service line or distribution system upgrades.[46] For comparison, Missouri Comprehensive State Energy Plan estimates that there are approximately 1,600 PEVs in Missouri.[47] Although PEV load does not appear to pose a significant threat to the reliability of the grid in the short-term, time-varying rates are an effective tool to manage flexible PEV load and encourage beneficial off-peak charging.[48] These rates are particularly important in

[45] 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

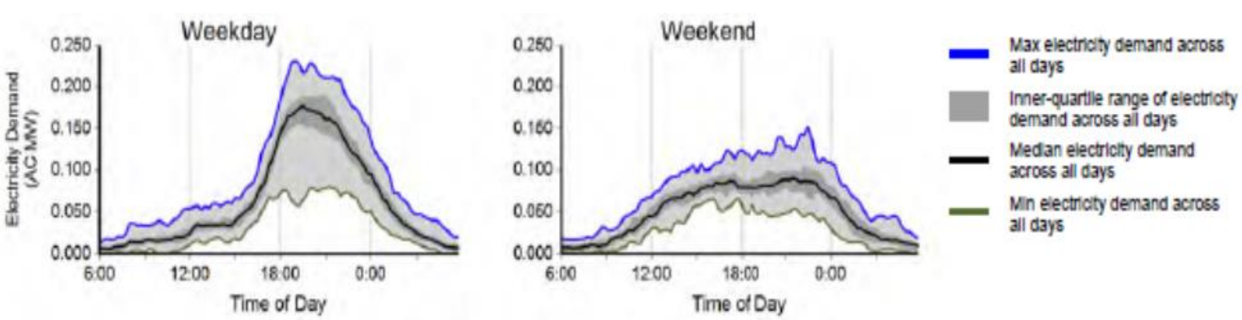
[46] See footnote 28

[47] 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

[48] While "off-peak" periods will differ by utility, nighttime periods when PEVs are parked in residential areas are generally considered off-peak. During this period when there is ample spare capacity on the grid, the additional revenue generated by the utility from PEV load will very likely be greater than the additional cost to the utility to serve that load. This allows existing distribution system assets to be used more efficiently and ultimately puts downward pressure on rates through greater kWh sales.

a residential context: not only does the majority of EV charging occur in residential settings, but residential EV load also has the potential to increase afternoon and evening electric system peaks.[49] Real world data from the Department of Energy's "EV Project" demonstrate that, in jurisdictions without active utility PEV programs where residential 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, potentially 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.[50] This is shown in Figures 4 and 5. 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 and maintains system reliability.

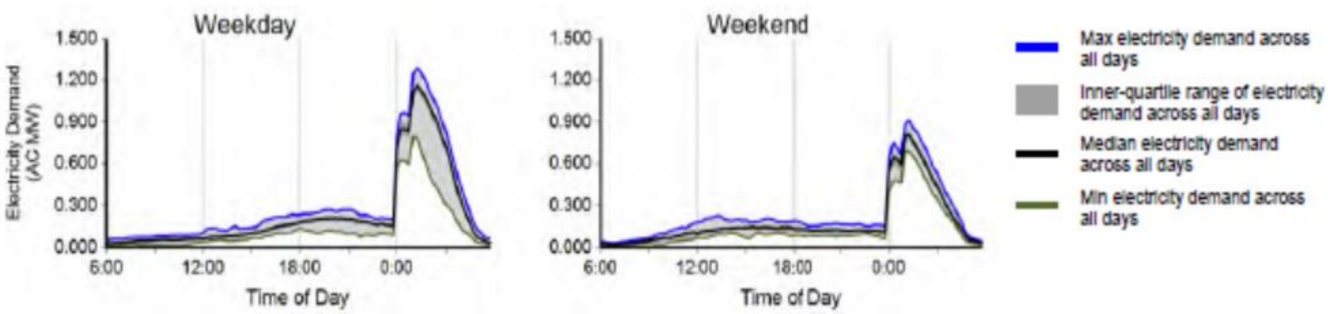
Figure 4: Dallas/Fort Worth Electric Utility PEV Load Profile



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

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

Figure 5: San Diego Electric Utility Load PEV Profile



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

Q. What is the impact of session charges on PEV fueling and vehicle electrification in general?

A. Session Charges – as described in this proceeding – are time-based (per hour) charges that are incurred by EV drivers when they use electric vehicle charging stations. In KCP&L's proposal, they are optional charges that site hosts may choose to impose. In his testimony, Mr. Rush describes the intended purpose of Session Charges as follows:

> *In addition to the Energy Charge rates, the tariff also includes guidelines for application of Session Charges, at the discretion of the host, to incent charging station users to move their vehicles promptly after charging to improve utilization of the stations.*[51]

A "per hour" charge is a relatively blunt tool for incentivizing efficient use of charging stations and may do little to actually influence charging behavior in the event it is a time-based Session Charge.[52] For example, in the event that an EV driver leaves her electric vehicle plugged

[51] Direct Testimony of Tim M. Rush, File No. ER-2016-0285 Filed July 1, 2016
[52] See footnote 49 "A charge-based Session Charge would start when the EV has stopped charging (but is still connected to the EV charging station) plus a defined grace period. The grace period allows the user time to end the Charge Session and move the EV."

in five minutes beyond some defined grace period, she would be charged the same Session fee whether or not she unplugs five minutes after the grace period or 55 minutes after the grace period. The "per hour" unit of time in this instance delivers a poor price signal to incentivize timely turnover.

Time-based pricing is also inherently unfair to drivers whose vehicles only charge at 3.3 kilowatts (kW), who will pay twice as much per kilowatt-hour as drivers whose vehicles charge at 6.6kW. Most plug-in hybrid vehicles (PHEVs), like the Chevrolet Volt, and even many pure battery electric vehicles (BEVs) can only charge at 3.3kW. They should pay the same dollar amount for the same amount of electricity as drivers whose vehicles can charge at higher kW.

In some cases, EV drivers will already be paying time-based fees for the parking spaces they occupy in public spaces. In this case, time-based Session Charges could potentially mean that EV drivers will be paying two separate time-based fees for occupying the same parking space.[53] This may make billing for charging services confusing and potentially frustrating for EV drivers.

The combined effect of separate energy charges and parking fees provides sufficient incentive for drivers to move their vehicles. There is no need to layer on time-based session charges, which would confuse drivers and result in many drivers paying twice as much for the same amount of energy.

The session charges as proposed by KCP&L are also excessive, and when combined with the proposed energy charges, the price of one hour of charging would jump from approximately one-third of the price of an eGallon to over five and a half times the price of an eGallon.[54] As

[53] See footnote 49 "A time-based Session Charge would start at either the time of initial plug-in of the EV or a predefined time in an active Charge Session (*e.g.*, two hours after initial plug-in) at the Host's discretion and may increase to a higher rate at a subsequent predefined time in an active Charge Session (*e.g.*, four hours after initial plug-in)."

[54] According to the U.S. Department of Energy, an eGallon in Missouri is currently $1.13/gallon available at: http://energy.gov/maps/egallon (last updated November 26, 2016) Assuming a vehicle with a 3.3 kW onboard charger charges for one hour at a Level 2 station with KCP&L proposed Level 2 tariff without a Session Charge, the cost of the charging event is 3.3kW * 1 hour * $.124/kWh = $0.41 and $0.41/$1.13 = .36x eGallon. Adding a $6 Session Charge to this hour of charging increases the total cost of the hour of charging to $6.41 and $6.41/$1.13 = 5.67x eGallon. For comparison, the average cost of gasoline in Missouri according to U.S. Department of Energy is $2.01; the total price for the quantity of electricity with the Session Charge effectively eliminates the fuel cost

described above, fuel cost savings are the single most important factor driving electric vehicle purchases.[55] In eliminating those fuel savings, the proposed incentive charges would undermine the potential of the Clean Charge Network to accomplish its purpose of accelerating EV adoption.

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

A. I have demonstrated that transportation electrification yields significant economic, environmental, and grid benefits to all utility customers. The deployment of widespread, strategic charging infrastructure is a critical component to the acceleration of PEV adoption, but market coordination issues have led to the stunted growth of the EV charging services market. I have also illustrated where investments in charging stations can best drive transportation electrification forward, and I have explained why electric utilities are uniquely positioned to effectively provide this infrastructure. Finally, I have identified charging station rates and rate structures that help beget the benefits of vehicle electrification. 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.

Q. Does this conclude your testimony?

A. Yes, it does.

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savings of driving on electricity. Although there are a variety of ways that a Session Charge can punitively drive up costs, this scenario – which is permissible under the existing proposal – is meant to serve as an illustrative example.