WHITE PAPER

Electric Utility Roles in the Electric Vehicle (EV) Market: Consensus Principles for Utility EV Program Design

MIDCONTINENT TRANSPORTATION ELECTRIFICATION COLLABORATIVE (M-TEC)

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About the Midcontinent Transportation Electrification Collaborative (M-TEC)

M-TEC is composed of representatives from automakers, state government, electric utilities and cooperatives, charging companies, and environmental organizations. M-TEC coordinates regionally in the Midcontinent region[1] to increase electric vehicle (EV) use, decarbonize the transportation sector, improve air quality, improve electric system efficiency, provide a great customer experience, and build infrastructure to support EV travel throughout the Midcontinent region. The group aims to inform decision-makers' thinking around policies and initiatives to speed the electrification of transportation in the region. The group carries out collective research, develops white papers and policy recommendations, and hosts public workshops for policymakers and stakeholders in the Midcontinent region.

M-TEC is co-convened by the Midcontinent Power Sector Collaborative and the Charge Up Midwest coalition.

About the Great Plains Institute (GPI)

GPI convenes the Midcontinent Power Sector Collaborative and is a member of the Charge Up Midwest coalition. GPI is a nonpartisan, nonprofit organization transforming the energy system to benefit the economy and environment. GPI works on solutions that strengthen communities and provide greater economic opportunity through creation of higher-paying jobs, expansion of the nation's industrial base, and greater domestic energy independence while eliminating carbon emissions.

1 Including participants from Illinois, Iowa, Louisiana, Michigan, Minnesota, Missouri, Ohio, Wisconsin, and national organizations.

Participants

The following participating entities took part in the discussion of M-TEC and the development of this white paper.

The signatories to the M-TEC Guiding Principles for utility EV programs are invited to use the principles in their efforts to advance transportation electrification.

Nothing in the Guiding Principles binds any signatories to any specific position. Nothing in the Guiding Principles authorizes any signatory to speak on behalf of other signatories, though signatories are welcome to use the existence of co-signatories as evidence of the appropriateness of these principles.

- 5 Lakes Energy
- Alliant Energy
- Ameren
- ChargePoint
- Clean Fuels Ohio
- Clean Wisconsin
- Dairyland Power Cooperative
- Dane County Office of Energy and Climate Change
- Ecology Center
- EDP Renewables North America
- Entergy Services, Inc.
- Environmental Law and Policy Center
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- Natural Resources Defense Council
- Nissan-USA
- Sierra Club
- Union of Concerned Scientists
- Vermont Energy Investment Corporation
- WEC Energy Group
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- WPPI Energy
- Xcel Energy
- ZEF Energy

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Executive Summary

The Midcontinent Transportation Electrification Collaborative (M-TEC) is composed of representatives from automakers, state government, electric utilities and cooperatives, charging companies, and environmental organizations. M-TEC coordinates regionally in the Midcontinent region[1] to increase electric vehicle (EV) use, decarbonize the transportation sector, improve air quality, improve electric system efficiency, provide a great customer experience, and build infrastructure to support EV travel throughout the Midcontinent region. The group aims to inform decision-makers' thinking around policies and initiatives to speed the electrification of transportation in the region. The group carries out collective research, develops white papers and policy recommendations, and hosts public workshops for policymakers and stakeholders in the Midcontinent region.

M-TEC is co-convened by the Midcontinent Power Sector Collaborative and the Charge Up Midwest coalition.

EVs are expected to become an ever-increasing part of the Midcontinent region's transportation mix. As the demand and utilization of EVs increases, so does the EV-specific demand for electricity, raising many important questions for electric utilities and state and local policymakers. The efforts of M-TEC suggest there is broad stakeholder support for greater utility involvement in the EV sector, including working collaboratively with those in the market (e.g., charging companies and automakers) to accelerate EV adoption and associated EV charging services. Utility participation in the EV sector will support broader economic development and cleaner communities, and this white paper is designed to provide initial guidance on how that involvement should proceed.

EVs offer a variety of potential benefits to society, including:

- Cost savings for drivers and fleet managers for a variety of different use cases;
- Reduced greenhouse gas emissions (GHGs);
- Reduced reliance on fossil fuels, including imported fuels;
- Cleaner air;
- Benefits to the electric grid; and
- Benefits to electric customers.

Furthermore, utilities have a significant role to play; working together with key stakeholders (e.g., charging companies, automakers, city planners, etc.) to accelerate transportation electrification to achieve and enhance those benefits. Utility engagement in EV programs should allow all parties to work collaboratively to better understand the implications for consumers and the electric system, consistent with the guidelines below, and to continue to move forward based on initial programs.

Background

This white paper reviews existing literature on vehicle electrification and finds the following:

- EV manufacturing and demand is poised to increase.
- There is significant investment and start-up activity exploring the intersection of shared, autonomous, electric, and connected mobility.
- EVs can offer benefits to all electric customers.
- Because of the steady decarbonization of the electric grid in this region, EVs already offer GHG reductions relative to internal combustion engine vehicles, and deeper reductions will accrue in the future as decarbonization trends in the electricity sector are expected to continue. An EV powered by today's grid in the Midcontinent Independent System Operator (MISO) region offers a 40 percent GHG reduction. An EV powered by 100 percent zero carbon electricity offers a 95 percent GHG reduction (refer to Figure 4).

Utility Involvement is Necessary and Desirable

A host of studies demonstrate benefits to society and to all electricity consumers from increased EV adoption. What is also clear is that utilities can support increased adoption and beneficial integration of EVs into the electric system to benefit their customers. Several studies demonstrate that public charging infrastructure availability can accelerate adoption of EVs.

Utilities, in partnership with charging companies, state and federal government, and other partners, can work to close the infrastructure gap. Utilities are a trusted source of information about charging solution choices, have established relationships with their customers, and can communicate and educate on the benefits of EVs.

Finally, many studies demonstrate that the level of benefit from EVs can vary, and that more benefit to the electric system can be achieved through deliberate and careful planning that steers EV charging load off-peak to reduce the need for unnecessary distribution system upgrades and better integrates variable renewables into the grid.

Utilities around the region are already demonstrating leadership in the EV sector and developing programs that benefit customers. M-TEC supports increased utility engagement in the EV sector and supports the following principles to guide the development of utility EV programs. The precise mix of principles, regulatory options, and policies to achieve the principles will be different for each utility and jurisdiction depending on the policies, stakeholders, culture, economics, and characteristics of the utility's service territory.

1 Including participants from Illinois, Iowa, Louisiana, Michigan, Minnesota, Missouri, Ohio, Wisconsin, and national organizations.

Guiding Principles

A. Benefit customers

- **Principle:** Utility EV programs should be designed with the intention of benefitting all customers, not only customers with EVs.
- **Principle in detail:** Properly designed utility EV programs can benefit all utility customers, even those who do not choose to use EVs. Over the long term, it is anticipated that EV programs can put downward pressure on rates in large part due to increased utilization of utility system assets. EV programs can also be designed to benefit all communities and customer classes. Efforts should include serving communities that might otherwise be left behind from receiving the benefits of EVs, such as rural communities, low-income communities, and communities with a high proportion of multi-family dwellings without access to off-street parking.

B. Decarbonization

- **Principle:** Utility EV programs should facilitate the decarbonization of the electric grid and the transportation system.
- **Principle in detail:** Utility plans should use EV deployment as a strategy for aiding in the decarbonization of both the electric sector and the transportation sector. Utility and transportation decarbonization strategies have the potential for complementary benefits. EVs can offer a flexible load that assists in integrating higher levels of renewables into the electricity system, while charging EVs from a decarbonized electricity system should accelerate transportation decarbonization.

C. Reliability, resilience, and economic benefits

- **Principle:** Utility EV programs should strive to benefit energy security, reliability, and the economy.
- **Principle in detail:** Utility EV programs should seek to benefit consumers by offering a reliable and resilient source of energy for transportation and by offering a local economic benefit by reducing the cost of transportation energy. These programs should benefit the electric grid, for example, by providing the opportunity to manage load, optimize existing and new generation, transmission, and distribution assets, and efficiently integrate renewables.

D. EV adoption

- **Principle:** Utility EV programs should help to overcome barriers to adoption of EVs.
- **Principle in detail:** Because the benefits of EVs will be greater with increased scale of adoption, utility programs should actively work to remove barriers to adoption of EVs.

E. EV charging

- **Principle:** Utility EV programs should support strategic deployment of EV charging.
- **Principle in detail:** Although preferences of regulators and stakeholders will vary from state-to-state, there is a justification for utility support for increased access to EV charging, particularly when this support contributes to the other principles. Consistent with the other goals, EV charging access can be a critical tool for increasing EV adoption.

F. Clean air and public health

- **Principle:** Utility EV programs should seek to offer cost-effective environmental and public health benefits from EVs.
- **Principle in detail:** EVs promise steep reductions in GHG emissions and criteria air pollutants. EV programs can include a focus on achieving air pollution reductions in areas that are disproportionately impacted.

G. Competitive marketplace and consumer experience

- **Principle:** Utility EV programs can contribute to a competitive marketplace while maintaining a good consumer experience.
- **Principle in detail:** Utility program design can include encouraging the development of a robust marketplace for EV charging with a variety and choice of options to serve different needs. This market will become more viable and competitive over time (e.g., as hardware costs decrease, as installations become more streamlined through enabling building codes, and as station utilization improves). But this early market currently requires additional investment and support—including utility programs—to close the infrastructure gap. At the same time, efforts should be made to encourage collaboration among market participants (e.g., charging companies and automakers) on common standards for charging and transparent payment to avoid consumer confusion. Utility EV programs should support a variety of business models; there is no "one-size fits all" approach. These programs should leverage private dollars where possible. Different states will also have different approaches.

H. Contribute to electrifying advanced mobility

- **Principle:** Utility EV programs should contribute to the progression of advanced mobility, multi-modal, and shared options that offer additional choices for consumers.
- **Principle in detail:** Numerous market participants are pursuing advanced mobility strategies, including major automakers, trucking companies, software companies, and others. Advanced mobility incorporates one or more of the following features: electric; shared; autonomous (driverless); and connected (networked). Utilities have a major opportunity to encourage the electrification of these advanced mobility options, including access to electrified options across retail and commercial applications as well as ensuring vehicle-grid integration that offers positive multiplier effects for smart-grid concepts. These options have the potential to generate education and outreach for transportation electrification as well as serve certain consumers that may not be in the market for a personal vehicle, thereby helping to contribute additional customer benefit.

Introduction

Electric vehicles (EVs) are expected to become an ever-increasing part of the Midcontinent region's transportation mix. As the demand and utilization of EVs increases, so does the EV-specific demand for electricity, raising many important questions for electric utilities and state and local policymakers. The efforts of the Midcontinent Transportation Electrification Collaborative (M-TEC) suggest that there is broad stakeholder support for greater utility, automaker, and charging company involvement and collaboration in the EV sector, and this white paper is designed to provide initial guidance on how that involvement and collaboration should proceed.

Active utility involvement will enable utilities to seize the opportunities that will benefit their customers and enhance the reliability and cost-effectiveness of the electricity system. Many utilities in the region are already demonstrating leadership in developing new EV programs to benefit customers. Utility involvement will also ensure that any challenges EVs present to the system will be met prudently and with advanced planning. Utility initiatives can also provide utility regulators with important information and experience, allowing regulators to adopt policies that maximize consumer benefit.

This white paper begins with background on the growing EV market, including a range of projections for EV adoption. Next, the paper explores the opportunities and challenges EVs present for utilities and electricity regulators. The paper concludes with the M-TEC's consensus principles for utility EV program design.

Background: EVs on the Rise

Even the most pessimistic forecasts of EV penetration suggest that EVs will grow rapidly. These projections are in line with emerging public policies across the globe, as evidenced by the recent announcement from China, making it the seventh nation that has committed or is considering a commitment to completely phase-out internal combustion engines. Automakers also see this trend. GM and Ford have recently added their names to the list of automakers with plans to release many new EV models–both full battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV)–within the next two to eight years.

Table 1. Nations Phasing Out Gasoline/Diesel Cars

Country	Year
Britain	2040
China	2030
France	2040
Germany	In discussion
Netherlands	2025 - In discussion
Norway	2025 - Already 40 percent of new car sales

Table 2. Automakers with EV Plans

Automaker	EV Plan
BMW	12 BEV, 13 PHEV by 2025
Daimler	10 new EVs (PHEV and BEV) and electric alternatives for all Mercedes-Benz model series by 2022
Ford	40 EV (PHEV and BEV) models by 2022
GM	20 EVs by 2023
Jaguar	All new models electrified by 2020
VW	Electric versions of all 30 models by 2030
Volvo	All new models electrified (hybrid electric vehicle, PHEV, and BEV)

Tables 1 and 2 show a selection of national targets and automaker plans.

With rapidly dropping battery prices, most analyses suggest dramatic increases in EV adoption. Although projections range from high (Bloomberg New Energy Finance) to low (Exxon Mobil), most models suggest a significant increase in adoption.

- Bloomberg New Energy Finance EV Outlook: By 2040, 54 percent of new car sales and 33 percent of the global car fleet will be electric (~530 million EVs).
- International Energy Agency: 60 million electric cars in 2030.
- Exxon Mobil: In 2040, 15 percent of all cars will be hybrids, 10 percent of new car sales in the US will be EV (~100 million).
- BP: 100 million EVs on the road by 2035 (around 6 percent of global fleet).
- Statoil: By 2050, 47.3 million in global sales (growth rate of 11.4 percent per year from 2014-2050).

If the most skeptical assessments project rapid growth in EVs, the prudent course for utilities and policymakers is to pay attention and plan accordingly.

EVs and Consumers

Studies suggest that EVs are already among the least expensive vehicles for consumers to own and operate today based on total cost of ownership.[2] Although EVs often have higher upfront costs, they can offer considerable savings in fuel and maintenance. Bloomberg New Energy Finance projects that EVs will have the lowest upfront cost as well by the latter half of the 2020s.

2 Marco Motti et al. "Personal Vehicles Evaluated against Climate Change Mitigation," *Environmental Science and Technology*, *50*, 20 (2016): 10795-10804, doi: 10.1021/acs.est.6b00177.

Despite the optimism across numerous studies, EVs still face some challenges with consumers. Although EVs offer many benefits including the potential for lower cost of operation, lower maintenance hassle and expense, silent operation, the added convenience of being able to charge at home, and fast acceleration, there is currently inadequate charging infrastructure available to meet driver needs.

Furthermore, consumer surveys suggest that perceptions of inadequate range on a charge, slow charging times, and a lack of EV options in many vehicle categories create apprehension amongst consumers. These challenges will need to be addressed if EV projections are to be realized.

EVs and Advanced Mobility

As several trendlines converge—declining battery costs, Internet of Things (IoT), urbanization—nearly every company involved in transportation, from public transit agencies to automakers, is rethinking every aspect of transportation. The future is likely to involve far more reliance on transportation services that to some degree are shared, autonomous, electric, connected, or some combination of the four. While the degree and speed of the expected change is vigorously debated, numerous start-up companies, new initiatives in well-established companies, and public-private partnerships are emerging to test the appetite of the marketplace for advanced mobility services. Ride-hailing companies alone had over $11 billion in investment in 2015.

A variety of types of companies and services are being contemplated, with some examples as follows:

- A variety of car-sharing and ride-hailing business models exist including:
  - Operator car-sharing (e.g., Zipcar, Car2go, Hourcar)
  - On-demand ride-hailing (e.g., Uber, Lyft, Gett)
  - Peer-to-peer car-sharing (e.g., Easycarclub, Flightcar)
  - Peer-to-peer ride-sharing (e.g., BlaBlaCar, Scoop)
- Companies like Maven are working to electrify ride-hailing and car-sharing operations. A variety of EV car-sharing options like BlueLA are emerging.
- Rapid innovation in autonomous driving, with active research programs at Volvo, Uber, Ford, GM, Tesla, Audi, BMW, Daimler, Jaguar, and Nissan and multiple consumer product introductions expected between now and 2025. For example, GM's Cruise Automation is currently testing self-driving cars based on the fully electric Chevrolet Bolt model, and recently announced a production-ready version with no steering wheel or pedals.
- A variety of manufacturers are producing fully electric buses that offer a premium experience for consumers (silent operation, zero tailpipe emissions, smoother acceleration) while eventually reducing costs for transit operators. Companies include Proterra, New Flyer, and BYD.

> "Numerous trends, ranging from energy decentralization to the Internet of Things, are likely to come together to create drastic changes in mobility systems over the next 10-15 years…several key mobility trends—electrification, shared mobility, and autonomy—are poised to take off."
>
> - McKinsey & Company and Bloomberg New Energy Finance, "An Integrated Perspective on the Future of Mobility," October 2016

- A wide variety of companies are developing enabling technology for autonomous vehicles, including predictive traffic information, cloud-based information services, GPS tracking, geospatial software, smart fleet software, on-demand valet service, Lidar, 3D mapping, hands-free systems, security software, truck-linking, and pay-per-mile insurance.
- Many transit systems are looking at autonomous features and shared mobility options to supplement or replace existing transit systems in order to serve additional passengers and reduce operational costs.
- Cities like Los Angeles, Houston, and Phoenix have introduced policy initiatives aimed at increasing the use of new advanced mobility technologies.
- Smart Columbus is working to implement an urban vision that includes decarbonization, EV fleet adoption, autonomous and multi-modal transportation, consumer EV adoption, and charging infrastructure.

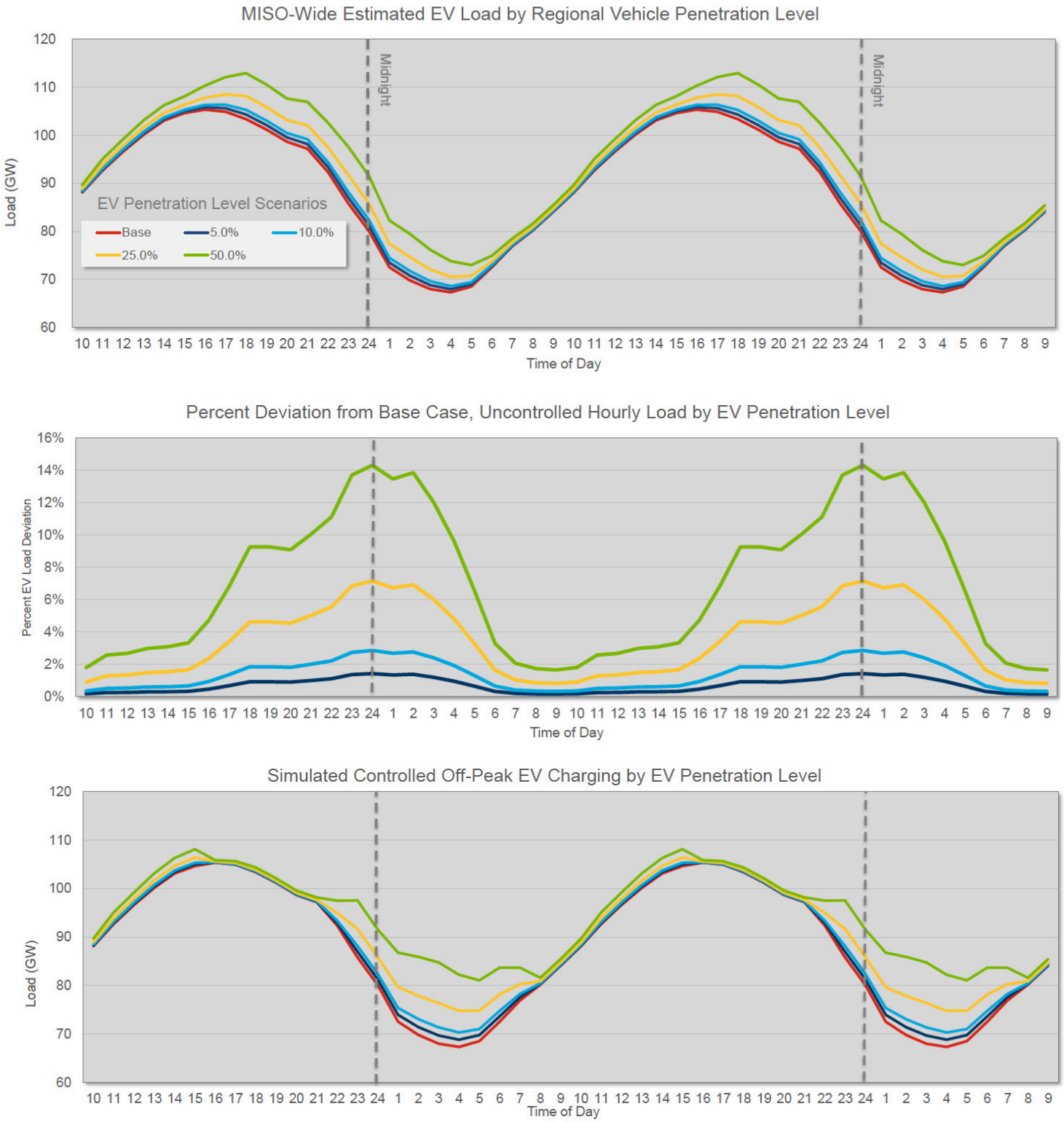
Growth in advanced mobility options could impact utilities in numerous ways: by increasing demand for electricity; modifying charging patterns relative to traditional residential or workplace charging; and potentially increasing the opportunity to integrate transportation and the grid through better communication and data integration. Although the precise future is unknown, some of the trends are clear, and increased electrification is clearly one of them. It is prudent for utilities to study this trend and consider how they can serve this new demand.

EVs and Utilities: Why Should Utilities Get Involved?

System and Consumer Benefits

Electric vehicles (EVs) offer the potential for benefits to the electric system, for electricity consumers, and for utilities themselves. Increased revenue from growth in transportation electrification can support necessary investments to enable the transition to a modern system, while turning the conventional wisdom about stagnant load growth on its head.

Figure 1: EV Charging Can Be Controlled to Maximize Efficient Use of the System (for illustrative purposes only)



Source: Figure authored by the Great Plains Institute (2018). Based on observed charging data from Xcel Energy's Electric Vehicle Charging Station Pilot Evaluation Report (May 2015), this figure shows potential effects of EV charging on the overall regional load profile of increasing penetrations of EVs in the Midcontinent Independent System Operator (MISO) region on a typical summer day (therefore it cannot be extrapolated across seasons). Using the observed charging data from the Xcel pilot, we estimated the region-wide hourly load profile with 5 percent, 10 percent, 25 percent, and 50 percent EV penetrations relative to current vehicle populations in the MISO states for both uncontrolled and off-peak-controlled EV charging. We also calculated the estimated deviation from the observed base case MISO load profile for the uncontrolled case. Note that the base data was observed in Xcel's Colorado territory and was used due to a lack of available region-specific charging behavior data.

Electric vehicles can add a significant additional load without an equivalent increase in peak demand, thus improving the utilization of existing infrastructure and avoiding the need for significant new investment.

Figure 1 is an example of how EV charging at night can increase load while only minimally increasing the daily peak of the system, thereby avoiding the need for new infrastructure investment. Designing technological or behavioral programs to enable optimal EV charging will need to consider seasonal load variations and grid topology constraints.

Local conditions will likely drive the need to make incremental investments to support EV charging, but planning and behavioral incentives can help avoid the most costly or detrimental outcomes. Through sound regulatory policy and smart technologies, the charging of EVs can in part be scheduled to take place where and when charging offers the most benefits and the least cost to the system, through both technological and behavioral solutions.

Numerous studies demonstrate that EV adoption at scale, under the right circumstances, can offer benefit for utility customers. Several studies from M.J. Bradley project that the additional utility revenues from EV charging will likely exceed the cost to supply that demand. This translates to a downward pressure on utility rates and benefits for all utility customers (whether or not they themselves purchase an EV). A recent study conducted in Illinois[3] considered the impacts of a "moderate" and "high" adoption scenario for EVs in the state, with EVs reaching either 18 percent or 56 percent of light duty vehicles in 2050. In both scenarios, the net present value (benefit minus cost) of benefits to utility customers, Illinois drivers, and society at large would total $12.2 billion (moderate) or $43 billion (high).

A similar study conducted in Michigan had similar results:[4] $8.6 billion in cumulative net benefits in 2050 under a "moderate" adoption scenario, and $31 billion in a "high" adoption scenario.[5]

A recent study looking at the impacts of EVs for American Electric Power's (AEP) Ohio service territory[6] found that increased EV adoption under two scenarios resulted in $380 million in regional net benefits in a "high" adoption case and $256 million in a "low" adoption case, with a regional net benefit of $1,595 per vehicle sold in the high adoption case.

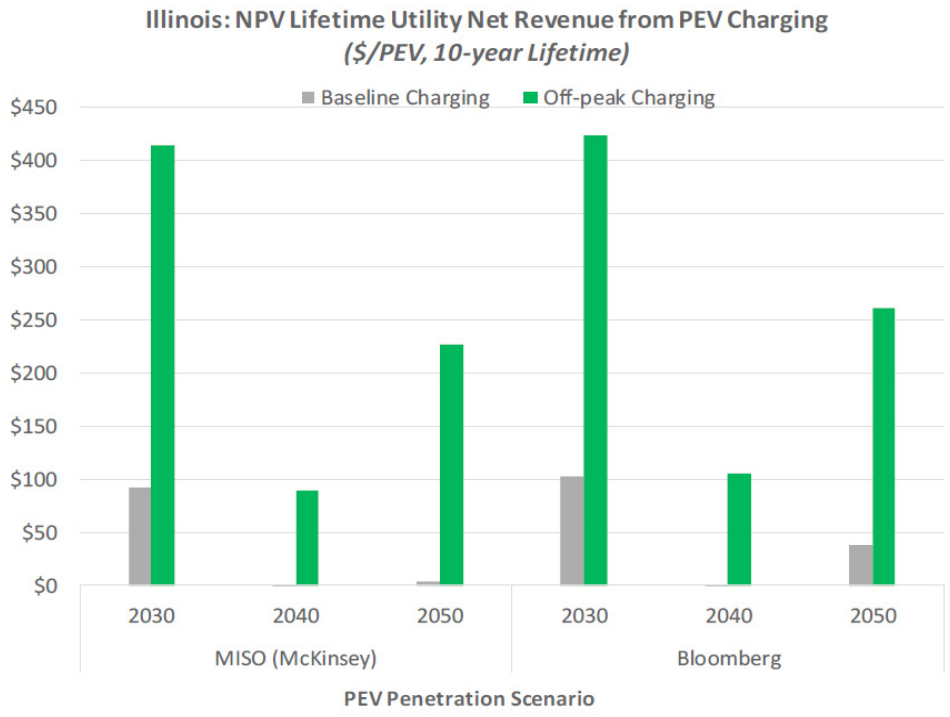
3 M.J. Bradley & Associates, "Electric Vehicle Cost-Benefit Analysis: Plug-in Electric Vehicle Cost-Benefit Analysis: Illinois," September 2017, http://mjbradley.com/sites/default/files/IL%20PEV%20CB%20Analysis%20FINAL%2026sep17.pdf. (accessed March 2018)

4 M.J. Bradley & Associates, "Electric Vehicle Cost-Benefit Analysis: Plug-in Electric Vehicle Cost-Benefit Analysis: Michigan," August 2017, http://www.ourenergypolicy.org/wp-content/uploads/2017/08/mi-pev-cb-analysis.pdf. (accessed March 2018)

5 M.J. Bradley & Associates, EV analysis for Illinois.

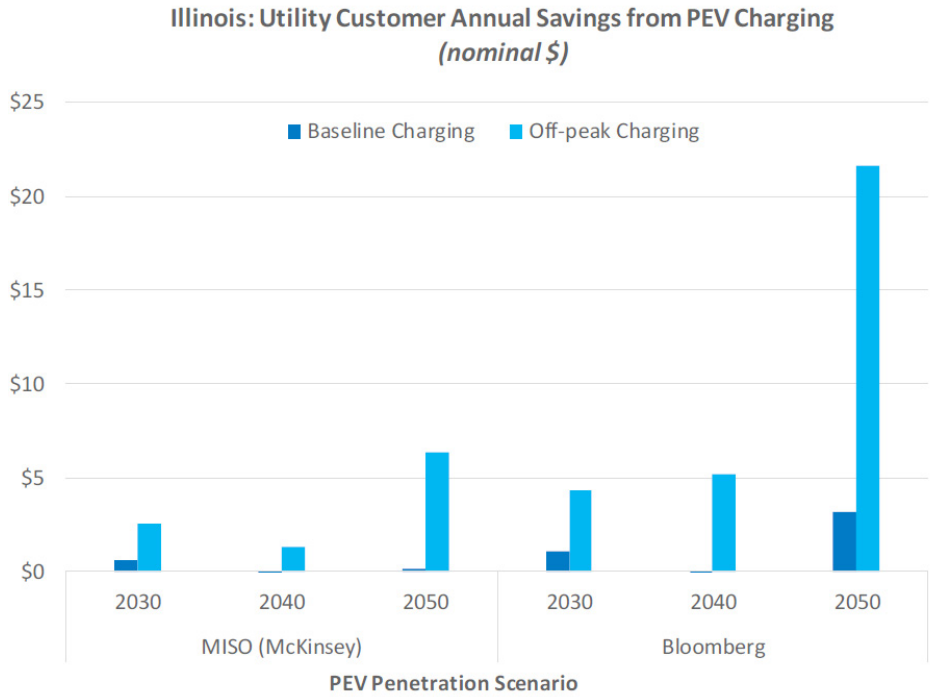
6 Energy + Environmental Economics, "Cost-Benefit Analysis of Plug-in Electric Vehicle Adoption in the AEP Ohio Service Territory," April 2017, https://www.ethree.com/wp-content/uploads/2017/10/E3-AEP-EV-Final-Report-4_28.pdf. (accessed March 2018)

Figure 2: Net Present Value (NPV) of Projected Lifetime Utility Net Revenue Per Plug-In Electric Vehicle (PEV)



Source: Reprinted with permission from M.J. Bradley & Associates, "Electric Vehicle Cost-Benefit Analysis: Plug-in Electric Vehicle Cost-Benefit Analysis: Illinois," September 2017, http://mjbradley.com/sites/default/files/IL%20PEV%20CB%20Analysis%20FINAL%2026sep17.pdf. (accessed March 2018)

Figure 3: Potential Effect of PEV Charging Net Revenue on Utility Customer Bills (nominal $)

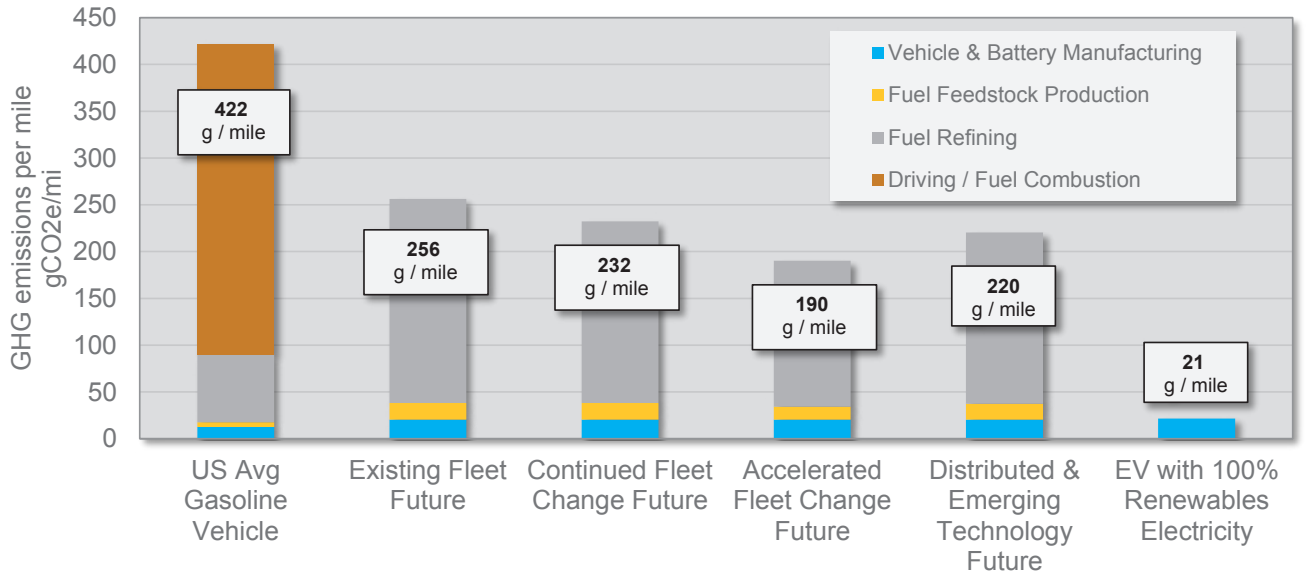


Source: Reprinted with permission from M.J. Bradley & Associates, EV analysis for Illinois (September 2017).

(continued from p.11) From a ratepayer perspective, net benefits from EV adoption range from $351 million to $278 million, with a $1,470 per vehicle benefit. These benefits accrue because EVs in the AEP Ohio territory pay more in electric bills than the incremental cost for the utility to supply them with electricity. EV adoption can complement other regional goals and provide additional electricity demand that can help utilities achieve existing energy efficiency goals by adding to utility revenue and integrating renewable electricity into the electricity system.

The emissions profile of an EV is driven by the generation mix of the electric grid serving the EV's load. In the Midwest, the electric grid is operated by an entity called the Midcontinent Independent System Operator (MISO). MISO operates a wholesale electric market for its fifteen-state footprint which is used to determine which generation resources will serve the load throughout the region on the most economically efficient basis that is achievable.

Figure 4: Wells-to-Wheels GHG Emissions: In the Midcontinent, EVs are Already Much Cleaner that Gasoline Vehicles



Source: Figure authored by the Great Plains Institute (2018) using Argonne National Laboratory's GREET model. Data includes scenarios from the Midcontinent Independent System Operator as shown in Figure 5.

As Figure 5 shows, the generation mix for the MISO footprint has been shifting since the early 2000s from coal to a more diverse portfolio and is expected to continue to do so for the foreseeable future. Taking these average fuel mixes for the MISO footprint, we are able to estimate the emissions factors attributable to EVs charged by the MISO grid in 2032.

In the Midcontinent region, EVs can play a useful role in helping to integrate the intermittent wind resource. Wind generation has increased rapidly in the past 15 years and is expected to continue to increase. EVs can make increased wind integration more efficient by helping to balance supply and demand. For example, nighttime wind generation is often met by low demand for electricity; EVs can be charged at night to absorb excess wind generation. Similarly, as solar generation increases, EV charging in a workplace or fleet setting can help absorb late afternoon excess solar generation.

Aside from the benefits for renewable integration, EVs can offer a flexible, controllable electricity demand that over time can flatten the load curve and increase overall system efficiency.

As the industry's collective understanding of demand response evolves from that of simple load shedding programs to more sophisticated technological and behavioral programs to curtail, shift, or even increase load to meet the emerging flexibility needs of the grid and its operators, EVs can play an important role in supplying grid services.

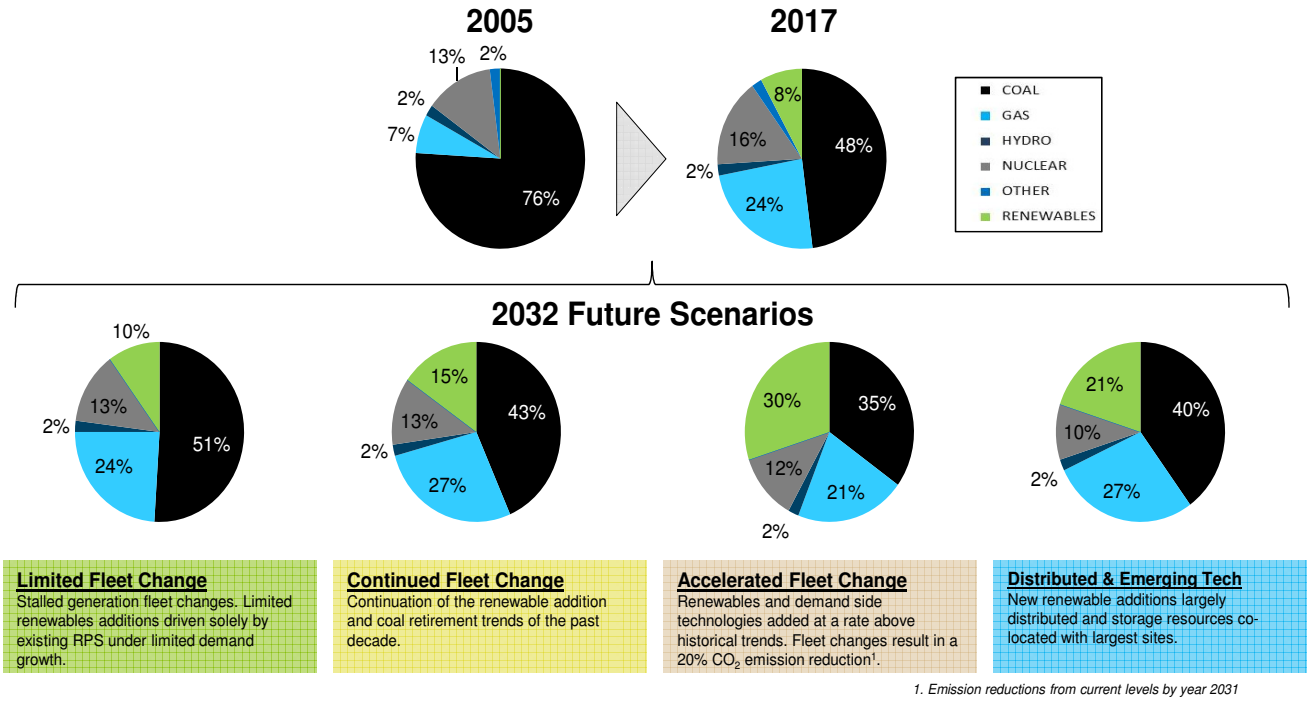
Given the steady decarbonization of the electric grid, the electricity sector is well-positioned to lend a helping hand in decarbonizing transportation. This is a role electricity can and should play with broad support from stakeholders.

In addition to helping decarbonize the electric grid and the transportation sector, zero emission EVs can contribute to improved air quality in the form of reduced NOx and particulate emissions. Emissions from road transportation accounted for 53,000 premature deaths in the US in 2005. It is the sector with the greatest number of emissions-related premature deaths.[7]

7 Fabio Caiazzo et al., "Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005," *Atmospheric Environment*, Vol. 79 (Nov. 2013): 198-208.

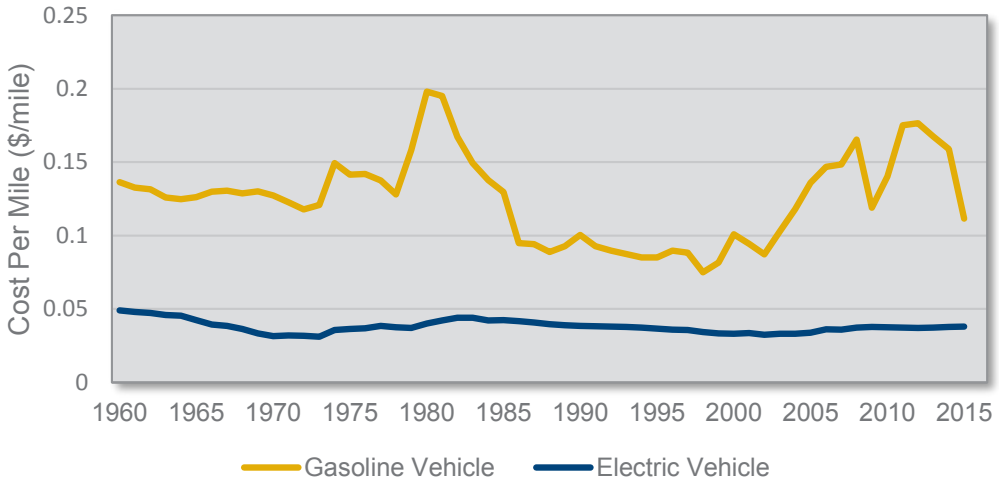
Figure 5: MTEP18 Energy Projections by Future (2017 through 2032)*—The Grid is Getting Cleaner

*Energy mix does not consider transmission constraints—outputs from the electric generation expansion analysis system model.



Source: Reprinted with permission from the Midcontinent Independent System Operator Planning Advisory Committee's "MTEP18 Futures Resource Forecast and Siting Review," September 2017, https://cdn.misoenergy.org/20170927%20PAC%20Item%2003d%20MTEP18%20Futures%20Results%20Review89925.pdf. (accessed March 2018)

Figure 6: Cost Per Mile of Driving Gasoline Vehicles vs. Electric Vehicles (2015$)



Source: Figure authored by the Great Plains Institute (2018). Data for electric vehicles includes US Department of Energy, Energy Information Administration, "January 2018 Monthly Energy Review," January 26, 2018: Average Retail Price of Electricity, Residential, 1960-2018; GREET Lifecycle Model, Argonne National Laboratory, Miles per kilowatt-hour (3.33 miles/kWh), October 9, 2017. Data for gasoline vehicles includes: US Department of Transportation, Bureau of Transportation Statistics, "Average Fuel Efficiency of U.S. Light Duty Vehicles, 1980-2015," May 20, 2017; US Department of Transportation, Federal Highway Administration, "Fuel efficiency for 1960-1980: Annual Vehicle Distance Traveled in Miles and Related Data, 1936 – 1995, Average [miles] per Gallon Consumed," April, 1997; US Department of Energy, Energy Information Administration, "February 2016 Monthly Energy Review," February 24, 2016: Table 9.4 Average Annual Gasoline Pump Price, 1929 – 2015; US Department of Commerce, Bureau of Economic Analysis, "Implicit Price Deflators for Gross Domestic Product," February 2016: Economic index coefficient for 2015 US Dollars from National Income and Product Accounts, Table 1.1.9.

In addition to electricity consumer benefits, EVs can offer fuel savings benefits for the region by displacing imported oil with local expenditures on energy and by allowing fuel savings to be reinvested (see Figure 6). According to the US Energy Information Administration, consumers of gasoline and diesel in the Midwestern region use 58.7 billion gallons of gasoline and diesel annually, spending $125.5 billion. This is as compared to the 49.3 billion gallons that are produced in the region. Increased EV adoption can contribute to energy security and economic benefit in the region.

Critical Gaps to Fill

The Midcontinent region is falling behind other regions and falling behind what analysis indicates is needed in preparing for increased EV adoption. Numerous recent studies have demonstrated that the US in general is underinvesting in EV charging infrastructure. Adequate public charging is a prerequisite for increased EV adoption as cited by numerous studies that establish a connection between EV adoption and adequate charging infrastructure.[8]

One study found that the leading urban EV markets had at least 350 level 2 and 30 DC fast charger (DCFC) points per million people; many experts have pointed out that even this number is inadequate, and that level 2 and DCFCs serve different needs. By contrast, most markets in the Midcontinent region have far less than the leading markets.[9] A recent study from the National Renewable Energy Laboratory analyzes the need for new EV charging under likely EV adoption scenarios. They find that 25,000 DCFC plugs (3.4 plugs to support 1,000 EVs) and 600,000 level 2 plugs (40 per 1,000 EVs) will be required to support 15 million EVs in the US. Furthermore, 400 DCFC stations will be required along interstate highways between cities to enable long-distance travel and travel between cities. These studies are not a substitute for localized and regional infrastructure planning, but all support the idea that additional charging infrastructure is needed for a growing EV market in the region.

8 *See* Nic Lutsey et al., "Sustaining Electric Vehicle Market Growth in US Cities," International Council on Clean Transportation, October 2016; Sydney and Belinda Chen, "Understanding Variations in U.S. Plug-In Electric Vehicle Markets," UC Davis Institute of Transportation Studies, Research Report: UCD-ITS-RR-14-25, 2014; Uwe Tietge et al, "Comparison of Leading Electric Vehicle Policy and Deployment in Europe," International Council on Clean Transportation White Paper, 2016; Stephanie Searle et al., "Leading Edge of Electric Vehicle Market Development in the United States: An Analysis of California Cities," International Council on Clean Transportation White Paper, 2016; and Sjoerd Bakker et al., "Policy Options to Support the Adoption of Electric Vehicles in the Urban Environment," *Transportation Research Part D*, Vol. 25 (Dec. 2013): 18-23.

9 Lutsey, 2016.

Utility Involvement is Necessary and Desirable

The studies summarized above demonstrate the benefits to society and to all electricity consumers provided by increased EV adoption. Along with these benefits, there are opportunities for utilities to support increased adoption and beneficial integration of EVs into the electric system to benefit their customers. There is also a need for adequate public charging infrastructure to enhance adoption.[10] However, the US currently has insufficient charging infrastructure.[11]

Utilities, in partnership with charging companies, state and federal government, and other partners, can work to close this current infrastructure gap. Utilities are a trusted source of information about charging solution choices, have established relationships with their customers, and have the ability to communicate the benefits of EVs to their customers.

Finally, many studies demonstrate that the level of benefit from EVs can vary, and that more benefit to the electric system can be achieved through a deliberate and careful planning framework that steers EV demand off-peak to reduce the need for unnecessary distribution system upgrades and better integrate variable renewables into the grid.

It is the view of the Midcontinent Transportation Electrification Collaborative that EVs can offer a variety of benefits to society, including:

- Cost savings for drivers and fleet managers for a variety of different use cases;
- Reduced greenhouse gas emissions;
- Reduced reliance on fossil fuels, including imported fuels;
- Cleaner air;
- Benefits to the electric grid; and
- Benefits to electric customers.

It is furthermore the view of this group that there is a utility role in supporting transportation electrification to achieve and enhance those benefits. There are uncertainties in the level of adoption that will occur and the evolution of the technology. Nevertheless, it is prudent for utilities to begin introducing pilot EV programs to begin to understand the implications for consumers and the electric system, consistent with the Guiding Principles in this white paper, and to continue to move forward based on initial pilot programs.

10 *See* Dale Hall and Nic Lutsey, "Emerging best practices for electric vehicle charging infrastructure," International Council on Clean Transportation, October 2017; and US Department of Energy Office of Energy Efficiency and Renewable Energy, "National Plug-In Electric Vehicle Infrastructure Analysis," September 2017.

11 Ibid.

Guiding Principles

What follows is a list of consensus guiding principles for utility EV program design, and some options for utilities to consider under each principle. M-TEC provides these principles with the hope that they will set the stage for effective multi-stakeholder collaboration going forward to capture the benefits and meet the challenges of an increasingly electrified transportation system.

The precise mix of principles, regulatory options, and policies to achieve the principles will be different for each utility and jurisdiction depending on the policies, stakeholders, culture, economics, and characteristics of the utility's service territory.

A. Principle: Utility EV programs should be designed with the intention of benefitting all customers, not only customers with EVs.

In detail: Properly designed utility EV programs can benefit all utility customers, even those who do not choose to use EVs. Over the long term, it is anticipated that EV programs can put downward pressure on rates in large part due to increased utilization of utility system assets. EV programs can also be designed to benefit all communities and customer classes. Efforts should include serving communities that might otherwise be left behind from receiving the benefits of EVs, such as rural communities, low-income communities, and communities with a high proportion of multi-family dwellings without access to off-street parking.

Program options:

- EV demand can increase utility revenue and target new load to off-peak times, reshaping the load curve to benefit the system. This can allow new EV demand to make efficient use of existing infrastructure and new renewable generation. When deployed at sufficient scale, this can result in EV deployment that increases revenue more than cost and puts downward pressure on rates for all utility customers. Encouraging adoption will help ensure that EV adoption reaches a sufficient scale necessary to have a rate impact.
- EV programs should consider emphasizing minimized rate increases in the early years of the programs when adoption levels are still low and aim to lower rates over the long term. There are many benefits from increased EV adoption, and commensurate costs and investments from utilities. Investments should be timed thoughtfully as adoption increases to minimize rate increases in early years.
- EV programs should consider rural areas. This might mean a commitment to a "minimum basic network" of charging throughout the utility service territory. This might mean supporting DC fast charging (DCFC) corridors that bring service everywhere. This might mean an effort to identify economically beneficial use cases in rural areas such as vehicle fleets.
- EV programs should consider low-income areas. This means assuring that charging investments are made in low-income as well as high-income areas. Examples of programs needing utilities and other entities include supporting the use of EV school and transit buses in low-income neighborhoods, electrifying polluting industries (e.g., replacing diesel freight-switchers with electric) and supporting EV car-sharing and ride-hailing pilots that can benefit low-income neighborhood residents as well as those who drive as a profession. There should be an intent to maximize benefits to low-income areas while minimizing any rate increases in early years of EV programs while investments are being made.
- EV programs should consider improvements in urban air quality. An effort to target urban air quality by replacing conventional vehicles with EVs could offer benefits to communities disproportionately impacted by air pollution.
- EV programs should consider increased mobility for the elderly and disabled. Ride-hailing and ride-sharing programs and EV bus initiatives have the potential to also offer mobility benefits to disabled people and the elderly.
- EV programs should consider supporting charging for multi-family buildings. Creative efforts are needed to find ways to share the benefits of low-cost EV charging with residents of multi-family buildings, particularly those buildings lacking off-street parking. In addition to enabling access to DC fast charging, partnerships with cities and developers can help assure availability of low-cost public level 2 charging.
- EV programs might include multi-use charging hubs. The development of multi-use charging hubs can help bring charging to underserved areas. Collaboration with area fleet managers to adopt EVs into fleets and charge at the multi-use hubs can assure adequate usage of the chargers to justify the investments despite possible low utilization by local residents in early years. City vehicles, taxis, ride-hailing drivers, and ride-share operators are all potential initial users of multi-use charging hubs.

B. Principle: Utility EV programs should facilitate the decarbonization of the electric grid and the transportation system.

In detail: Utility plans should use EV deployment as a strategy for aiding in the decarbonization of both the electric sector and the transportation sector. Utility and transportation decarbonization strategies have the potential for complementary benefits. EVs can offer a flexible load that assists in integrating higher levels of renewables into the electricity system, while charging EVs from a decarbonized electricity system should accelerate transportation decarbonization.

Decarbonization is important for a variety of reasons, including physical risk from coastal erosion and extreme weather, stakeholder expectations, the possibility of regulation in the future, shareholder and investor expectations, expectations of state regulators and policymakers, and changing technology and economics.

Program options:

- EV programs can measure the emissions impact of EVs on the electric system and report the results publicly.
- EV programs can offer renewable purchasing programs for EV drivers.
- EV programs can incorporate EVs into resource planning.
- EV programs can include rates that encourage charging at non-peak times.
- There can be recognition in public utility commission proceedings of potential for utilities to achieve GHG reductions in other sectors, like transportation.
- EV programs can include smart charging programs that maximize utilization of and support deployment of renewable resources.

C. Principle: Utility EV programs should strive to benefit energy security, reliability, and the economy.

In detail: Utility EV programs should seek to benefit consumers by offering a reliable and resilient source of energy for transportation and by offering a local economic benefit by reducing the cost of transportation energy. These programs should benefit the electric grid, for example, by providing the opportunity to manage load, optimize existing and new generation, transmission, and distribution assets, and efficiently integrate renewables.

Program options:

- EV programs should consider taking into account the load management benefits of EVs. Charging site hosts, EVs, and groups thereof, should be eligible to participate in demand response programs through smart charging or other verifiable load shedding on demand. Demand response programs should be targeted where they offer the most benefit, making sure to still offer a good consumer experience. Utilities may consider whether EVs, or groups of them, should be eligible to provide stored power on demand.
- EV programs can create residential and commercial time-of-use rates that encourage charging when it offers the most benefit.
- Utilities can initiate smart EV charging pilots that incentivize consumers to allow some degree of utility control over when charging occurs in order to achieve greater benefit to the grid.
- Utilities can partner with fleets (for example, school bus fleets, corporate or government light duty fleets, transit agencies) to demonstrate the potential grid benefits of EVs at a greater initial scale than is possible with residential vehicles.

D. Principle: Utility EV programs should help to overcome barriers to adoption of EVs.

In detail: Because the benefits of EVs will be greater with increased scale of adoption, utility programs should actively work to remove barriers to adoption of EVs.

Program options. Utilities can seek to increase EV adoption in the following ways:

- By creating financial incentives—potentially working with automakers—for EV adoption through favorable rates and direct rebates and incentives for vehicles and charging.
- By partnering with large customers to support adoption of EVs in vehicle fleets.
- By conducting education and outreach to all customers about the potential benefits from EV adoption.
- By supporting public and private charging access to benefit all potential EV customers. For example, utilities can increase EV adoption by supporting increased investing in regional DCFC corridors that can overcome a perceived barrier to buying an EV–the ability to travel longer distances from home. More detail is found below under Principle E.
- By leading by example, encouraging adoption of EVs by employees and transitioning utility vehicle fleets to EVs.

E. Principle: Utility EV programs should support strategic deployment of EV charging.

In detail: Although preferences of regulators and stakeholders will vary from state-to-state, there is a justification for utility support for increased access to EV charging, particularly when this support contributes to the other principles. Consistent with the other goals, EV charging access can be a critical tool for increasing EV adoption. Incentives for charging can be a tool for encouraging participation in time-of-use rates and smart electric vehicle supply equipment (EVSE) programs that help increase the benefits of EVs to the electric system.

Program options. EV programs can:

- Encourage deliberate and strategic infrastructure planning.
- Address customer affordability and ensure that charging is available at a reasonable cost.
- Encourage utility investment in charging, especially in underserved areas such as rural areas, low-income neighborhoods, and multi-family buildings.
- Help create a common set of rules to allow third parties and utility investments to coexist, including encouragement of customer affordability, network reliability, well-maintained and customer-friendly chargers, interoperability, easy-to-use and pay, ability to shape the load curve and push charging when most beneficial to the grid where practical.
- Support build-out of DCFC corridors to address a critical barrier to adoption.
- Support increased workplace charging.
- Support multi-stakeholder infrastructure planning that identifies needs and encourages the right charging technology in the right place.
- Support charging for large customers. Examples include large employers with fleet vehicles, EV charging hubs for ride-sharing/ride-hailing, transit and school bus fleets, and package delivery.
- Aim for deployment of charging infrastructure that ensures a simple and consistent consumer experience.
- Address higher capacity charging for fleet applications though rates and programs.

F. Principle: Utility EV programs should seek to offer cost-effective environmental and public health benefits from EVs.

In detail: EVs promise steep reductions in GHG emissions and criteria air pollutants. EV programs can include a focus on achieving air pollution reductions in areas that are disproportionately impacted.

Program options. EV programs can:

- Include measuring the emissions reductions accomplished through EVs on the utility's system and report those measurements.
- Include a focus on replacing diesel engines with EVs in disadvantaged communities that are disproportionately impacted by fine particulates pollution. Examples include school buses, transit buses, step trucks, and freight yard switchers. Neighborhoods near highways with high traffic volume, neighborhoods near existing bus routes, and neighborhoods with freight yards and other heavy industries could all benefit in this way.
- Support programs that speed replacement of gasoline vehicles with EVs to reduce air pollution, particularly in areas disproportionately impacted.

G. Utility EV programs can contribute to a competitive marketplace while maintaining a good consumer experience.

In detail: Utility program design can include encouraging the development of a robust marketplace for EV charging with a variety and choice of options to serve different needs. This market will become more viable and competitive over time, (e.g., as hardware costs decrease, as installations become more streamlined through enabling building codes, and as station utilization improves). But this early market currently requires additional investment and support—including utility programs—to close the infrastructure gap.

At the same time, efforts should be made to encourage collaboration among market participants (e.g., charging companies and automakers) on common standards for charging and transparent payment policies to avoid consumer confusion.

Program options:

- Support a variety of business models. There is no "one-size-fits-all" approach. Different states will also have different approaches.
- Leverage private dollars where possible.

H. Utility EV programs should contribute to the progression of advanced mobility, multi-modal, and shared options that offer additional choices for consumers.

In detail: Numerous market participants are pursuing advanced mobility strategies, including major automakers, trucking companies, software companies, and others. Advanced mobility incorporates one or more of the following:

- Electric;
- Shared;
- Autonomous (driverless); and
- Connected (networked).

Utilities have a major opportunity to encourage the electrification of these advanced mobility options, including access to electrified options across retail and commercial applications as well as ensuring vehicle-grid integration that offers positive multiplier effects for smart-grid concepts. These options have the potential to generate education and outreach for transportation electrification as well as serve certain consumers that may not be in the market for a personal vehicle, thereby helping to contribute additional customer benefit.

Program options:

- Utilities should consider partnering with third parties to explore and support advanced mobility projects in their service territory. Examples include EV car-sharing, EV ride-hailing, transit integration including traditional (e.g., buses) and non-traditional services (e.g., dynamic shuttles), and many others.
- Because high-powered charging will be required for some of these options, utilities should consider playing a role in developing models for higher capacity fast charging for fleets.

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