MidAmerican Energy
106 East Second Street
P.O. Box 4350
Davenport, Iowa 52808

December 15, 2010

Illinois Commerce Commission Initiative on Plug-In Electric Vehicles
160 North LaSalle, Suite C-800
Chicago, IL 60101

Dear Chairman Flores and Commissioner O'Connell-Diaz:

MidAmerican Energy Company (MidAmerican) appreciates the opportunity to participate in the Initiative Committee's examination of the impact of plug-in-electric vehicles (PEVs) on utility electric systems. Because of these issues, and because MidAmerican's service area was not selected for an initial roll-out site, MidAmerican believes the adoption rate for PEVs in its service territory will be slow.

Attached you will find MidAmerican's initial assessment of the impact of PEVs on its electric system. We stress that this is a preliminary assessment and may be subject to substantial change as plug-in-electric vehicle technology advances and matures. We offer special thanks to the Electric Power Research Institute, who provided valuable assistance in the preparation of this assessment.

MidAmerican looks forward to further participation in the committee's collaborative effort to position Illinois as a leader in the successful adoption of PEVs.

Sincerely,

Dean A. Crist

Dean Crist,
Vice President, Regulation
MidAmerican Energy Company

Initial Assessment of the System Impact of Plug-in Electric Vehicles
MidAmerican Energy Company

I. Summary

MidAmerican Energy Company (MidAmerican) is monitoring the development and deployment of plug-in electric vehicles (PEVs) with great interest. While electric vehicle technologies offer the possibility of lower carbon dioxide emissions, lower fuel costs and decreasing dependence on foreign oil. It is uncertain whether the PEVs will gain widespread acceptance because of high initial cost, limited range, time required to recharge batteries, infrastructure availability and issues with degraded performance in hot or cold weather extremes. Because of these issues MidAmerican believes the adoption rate for PEVs in its service territory will be slow.

In order to better assess the level of vehicle penetration and potential system impacts, MidAmerican requested assistance from the Electric Power Research Institute (EPRI). EPRI has substantial expertise in this area, having worked extensively with both vehicle manufacturers and utilities with service areas targeted for early rollout. EPRI has developed models to assess both vehicle penetration rates and associated system loads and has applied these models using MidAmerican-specific information. All information in this assessment is presented for MidAmerican's system as a whole, of which Illinois is approximately 10 percent.

Based on the EPRI information that assumes low adoption rates, MidAmerican estimates the number of PEVs added in its service territory over the next five years will be approximately 2,000 vehicles, with added peak load of about 4 MW. MidAmerican anticipates that, for the foreseeable future, impacts on its total system load related to PEVs may be minimal. There could be isolated impacts on MidAmerican's distribution system, however. Small residential transformers may be subject to overload, depending on the current loading on the transformer and whether charging occurs in an on-peak or off-peak time period. Since the adoption rates in MidAmerican's territory will be slow, MidAmerican believes it will be able to identify customers or locations where electric vehicles will be charged, assess potential impacts on the system and take appropriate action to avoid potential overloading conditions. MidAmerican anticipates this will require a combination of customer education and work with electric vehicle dealers and others to identify potential charging sites.

MidAmerican does not believe changes to its electric rates are warranted at the current time in response to the introduction of PEVs. MidAmerican does not anticipate offering an end-use electric vehicle rate, as MidAmerican's experience with end-use rates in other jurisdictions has not been particularly positive. The lack of an end-use rate should not create any barrier to PEV adoption, as both MidAmerican's existing standard residential rate and residential time-of-use rate offer relatively low-priced options.

MidAmerican has no current plans to enter the business of offering public charging but would be willing to work with any party who wished to do so. MidAmerican does, however, caution the

Illinois Commerce Commission (Commission), however, that it believes current statutes could be interpreted to require either public utility or alternative retail electric service provider status for the providers of public charging services. The Commission may wish to explore whether a change to the Public Utilities Act granting an exception to electric vehicle charging stations similar to that included for compressed natural gas fueling stations might be desirable.

II. Electric Vehicle Technology[1]

Background

There are three basic types of vehicles that utilize electricity for transportation. They are hybrid electric vehicles, plug-in hybrid electric vehicles and all-electric vehicles.

Hybrid Electric Vehicles (HEVs)

Hybrid Electric Vehicles are powered by conventional or alternative fuels as well as by electric power stored in a battery. The battery is charged through regenerative braking and the internal combustion engine and is not plugged in to charge.

Plug-in Hybrid Electric Vehicles (PHEVs)

Plug-in Hybrid Electric Vehicles are powered by conventional or alternative fuels as well as by electric power stored in a battery. The vehicle can be plugged into an electric power source to charge the battery. PHEVs are sometimes called extended range electric vehicles.

All-Electric Vehicles (EV)

All-Electric Vehicles use a battery to store the electric energy that powers the motor. EV batteries are charged by plugging the vehicle into an electric power source. EVs are sometimes referred to as battery electric vehicles.

Plug-In Hybrid Electric Vehicles

Plug-In Hybrid Electric Vehicles have a larger battery pack than HEVs. This makes it possible to drive for some distance (about 10 to 40 miles) using only electricity, commonly referred to as the all-electric range of the vehicle.

During urban driving, most of a PHEVs power comes from stored electricity. For example, a light-duty PHEV driver might drive to and from work on all-electric power, plug in the vehicle

[1] U.S. Department of Energy

to charge it at night, and be ready for another all-electric commute the next day. For longer trips or periods of higher acceleration, the internal combustion engine is used. Heavy-duty PHEVs sometimes work just the opposite, using the internal combustion engine while a worker drives to and from a job site and using electricity to power the vehicles equipment or to keep the vehicles cab at a comfortable temperature at the job site.

Plug-in hybrid electric vehicle batteries can be charged by an outside electric power source, by the internal combustion engine or through regenerative braking. During braking, the electric motor acts as a generator, using the energy to charge the battery.

There are different designs for combining the power from the electric motor and the engine:

- Parallel plug-in hybrids connect the engine and the electric motor to the wheels through mechanical coupling. Both the electric motor and the engine can drive the wheels directly.
- Series plug-in hybrids use only the electric motor to drive the wheels. The internal combustion engine is used to generate electricity for the motor. General Motors refers to this design as an extended range electric vehicle. This design is used in the Chevy Volt.

All-Electric Vehicles

All-Electric Vehicles are sometimes referred to as battery electric vehicles (BEV). EV batteries are charged by plugging the vehicle into an electric power source. All-electric vehicles are considered zero-emission vehicles because the motors produce no exhaust or emissions. Because EVs use no other fuel, petroleum consumption's reduced.

All-electric vehicles will have a shorter range per charge than conventional vehicles. The custom-order, all-electric Tesla Roadster has a 220-mile range while less-expensive vehicles under development are targeting a 100-mile range. According to the U.S. Department of Transportation Federal Highway Administration, 100 miles is sufficient for more than 90% of all household vehicle trips in the United States.

Charging Options

Charging equipment for plug-in hybrid electric and all-electric vehicles - Electric Vehicle Supply Equipment (EVSE) - is classified by the maximum amount of power in kilowatts provided to the battery. Charging times vary based on how empty the battery is, how much energy it holds and the type of battery. The charging time can range from 30 minutes to 20 hours or more, depending on the type of charging equipment used.

Level 1

Level 1 equipment provides charging through a 120-volt, alternating-current plug (up to 15-amperes and 1.8 kW). Level 1 EVSE is portable and does not require installation of charging equipment. On one end of the cord is a standard, three-prong household plug. On the other end is a connector, which plugs into the vehicle.

Level 1 works well for charging at home, work, or when there is only a 120-V outlet, or trickle charge, available. Based on the battery type, Level 1 charging can take eight to 20 hours to reach a full charge, adding about five to six miles of range per hour of charging time, depending on the vehicle.

Level 2

Level 2 equipment offers charging through a 240-V, AC plug and requires installation of home charging or public charging equipment. This charging option can operate at up to 80-amperes and 19.2 kW. However, most residential Level 2 EVSE will operate at lower power. Many such units operate at 30-amperes, delivering 7.2 kW of power. These units require a dedicated 40-amp circuit.

Most homes have 240-V service available, and because Level 2 EVSE can easily charge a typical EV battery overnight, this will be a common installation for homes. Level 2 equipment also uses the same connector on the vehicle as Level 1 equipment. Based on the battery type and circuit capacity, Level 2 charging can take three to eight hours to reach a full charge, adding about 25 miles of range per hour of charging time, depending on the vehicle.

Level 3

Level 3 charging will enable a faster AC charging option. Level 3 equipment is still in development. This charging option will operate at a higher voltage and current than Level 2, and it would be installed at public charging stations. Level 3 charging could take less than 30 minutes to reach a full charge.

DC Fast Charging

Direct current fast charging equipment (480-V) provides 50 kW to the battery. This option enables charging along heavy traffic corridors and at public stations. A direct current fast charge can take fewer than 30 minutes to fully charge a battery.

Inductive Charging

Inductive charging equipment installed for all-electric vehicles in the early 1990s, such as the Toyota RAV4 EV and the Chevy S10 EV, is still used in certain areas. Some companies are working on inductive charging options for future electric drive vehicles.

Connectors and Plugs

The standard J1772 receptacle (right) can receive charge from Level 1 or Level 2 equipment. The DC fast charge receptacle (left) uses a different type of connector.

Modern charging equipment and vehicles have a standard connector and plug receptacle. This connector is based on the Society of Automotive Engineers J1772 standard. Any vehicle with this plug receptacle can use any Level 1 or Level 2 EVSE. All major vehicle and charging system manufacturers support this standard, which should eliminate drivers' concerns about whether their vehicle is compatible with the infrastructure. The DC fast charging connector has not been standardized. To receive DC fast charging, most EVs and PHEVs are using the Tokyo Electric Power Company (TEPCO) connector and receptacle, which have not become standard. Manufacturers may offer the TEPCO DC fast charge receptacle as an option on vehicles until a standard is in place.

Installation Costs

Currently available Level 2 charging equipment costs approximately $1,500 to $2,500 (installed) before a 50 percent federal tax credit (up to $2,000) and potential state incentives. Nissan and Tesla have information on Level 2 equipment for their vehicles.

Installation contractors can inform homeowners if their home has adequate electrical capacity for vehicle charging. Most people will prefer Level 2 equipment for faster charging, but older homes might have insufficient electric capacity. Homeowners can add circuits to accommodate the capacity needed for Level 2 charging.

Codes and Standards

Electric vehicle supply equipment installations must comply with local, state and national codes and regulations, and installation requires permitting and licensed contractors. Contractors should check with the local planning department before installing equipment. Homeowners should consult EV and PHEV manufacturer guidance for information about the required charging equipment and find out the specifications before purchasing equipment and electric services.

The Underwriters' Laboratory has several standards that cover EV charging systems from the wall all the way to the charger in the vehicle. Installing UL-approved equipment is a best-practice to aid in the fastest implementation of charging hardware. Available UL-certified products can be viewed online at UL Online Certifications Directory. The results are as of May 20, 2010, and a list of applicable standards are shown in Attachment 1.

Fuel Efficiency

The fuel efficiency of an all-electric vehicle is usually measured in cost per mile rather than miles per gallon. To calculate the cost per mile of an all-electric vehicle, the cost of electricity (in dollars per kilowatt-hour) and the efficiency of the vehicle (how much electricity is used to travel one mile) must be known. If electricity costs $0.12 per kilowatt-hour and the vehicle consumes 200 watt-hours to travel one mile, the cost per mile is approximately $0.02.

If electricity costs $0.12 per kilowatt-hour, charging an all-electric vehicle with a 100-mile range (assuming a 20-kWh battery) will cost approximately $2.40 to reach a full charge. This cost is about the same as operating an average central air conditioner for five hours. General Motors estimates the annual energy use of the Chevy Volt to be 2,520 kilowatt-hours, which is less than that required for a typical water heater or central air conditioner.

Energy Storage Systems

The following energy storage systems are used in hybrid electric vehicles, plug-in hybrid electric vehicles and all-electric vehicles.

Lithium-Ion Batteries

Lithium-ion batteries are used in most portable consumer electronics, such as cell phones and laptops, because of their high energy per unit mass. They also have a high power-to-weight ratio, high energy efficiency, good high-temperature performance and low self-discharge. Some components of lithium-ion batteries can be recycled. Most near-term plug-in hybrid electric vehicles and all-electric vehicles will use lithium-ion batteries. Development to reduce cost and improve calendar and life cycle is ongoing.

Nickel-Metal Hydride Batteries

Nickel-metal hydride batteries, used routinely in computer and medical equipment, offer reasonable specific energy and specific power capabilities. Nickel-metal hydride batteries have a much longer life cycle than lead-acid batteries and are safe and abuse tolerant. These batteries have been used successfully in all-electric vehicles and are widely used in hybrid electric vehicles. The primary challenges with nickel-metal hydride batteries are their high cost, high self-discharge and heat generation at high temperatures and the need to control hydrogen loss.

Lead-Acid Batteries

Lead-acid batteries can be designed to be high power and are inexpensive, safe and reliable. However, low specific energy, poor cold temperature performance and short calendar and life cycle impede their use. Advanced high-power lead-acid batteries are being developed, but these batteries currently are not used in most electric drive vehicles other than for ancillary loads.

Lithium-Polymer Batteries

Lithium-polymer batteries with high specific energy, initially developed for electric vehicle applications, also can provide high specific power for hybrid electric vehicle applications. Like lithium-ion batteries, they could become commercially viable if the cost was lowered and life cycle improved.

Ultracapacitors

Ultracapacitors store energy in a polarized liquid between an electrode and an electrolyte. Energy storage capacity increases as the liquids surface area increases. Ultracapacitors provide additional power during vehicle acceleration and hill climbing and help recover braking energy. They also are useful as secondary energy storage devices in electric drive vehicles because they help electrochemical batteries level load power. Additional electronics are required to maintain a constant voltage due to low energy density.

Recycling and Reusing Batteries

The battery recycling market is small. Recycling exists for small lithium-ion batteries, such as battery packs from cell phones, laptops and other electronics. As the market grows, the recycling infrastructure likely will grow with it as it did for lead-acid batteries in the past, driven by hazardous waste regulatory requirements. Lithium batteries are slightly difficult to handle, but procedures for recycling do exist and can be cost-effective. The components of nickel-metal hydride batteries used in most electric drive vehicles are recyclable, but a recycling infrastructure is not yet in place. Batteries could be resold for secondary use before eventual recycling, making them more valuable. See the report from Sandia National Laboratory: Technical and Economic Feasibility of Applying Used EV Batteries in Stationary Applications.

Battery Swapping

For long-distance travel, where fast charging is not available, battery swapping might be a solution. Drivers would pull into battery-switching stations and exchange a depleted battery with a fully charged one. Use of battery swap stations requires a vehicle that has been designed with a swappable battery pack.

Maintenance

Vehicle Maintenance

Because hybrid electric vehicles and plug-in hybrid electric vehicles have internal combustion engines, maintenance requirements are similar compared with conventional vehicles. The electrical system (battery, motor and associated electronics) does not require scheduled maintenance. Due to the effects of regenerative braking, brake systems on these vehicles typically last longer than on conventional vehicles.

All-electric vehicles typically require less maintenance than conventional vehicles because:

- The battery, motor and associated electronics require no regular maintenance
- There are no fluids to change, aside from brake fluid
- Brake wear is significantly reduced due to regenerative braking
- There are far fewer moving parts compared to a conventional gasoline engine.

Battery Maintenance

The advanced batteries used in these vehicles have a limited number of charging cycles (the number of times the battery can be charged and discharged).

The batteries in electric drive vehicles are designed to last for the expected lifetime of the vehicle. The Toyota Prius HEV, which has been sold in the U.S. since 2001, has had fewer than 0.003 percent battery failures (source: HybridCars.com). Nissan (source: Autoblog) and General Motors (source: Autoblog Green) have both announced 8-year/100,000 mile warranties for the batteries in the LEAF and the Volt.

Although manufacturers have not published pricing for replacement batteries, if the battery does need to be replaced outside the warranty, it is expected to be a significant expense.

Safety

Safety Requirements

Electric drive vehicles must meet the same safety standards required for conventional vehicles sold in the U.S. The exception is neighborhood electric vehicles, which are subject to less-stringent standards because they are typically limited to roadways specified by state and local regulations. All other electric drive vehicles undergo the same rigorous safety testing as conventional vehicles and must meet all the same standards for safety, including crash testing and airbags.

HEVs, PHEVs and EVs have a high-voltage electric system that ranges from 36 to 300 volts. Manufacturers have been careful to design these vehicles with safety features that deactivate the electric system in the event of an accident. In addition, EVs tend to have a lower center of gravity than conventional vehicles, making them less likely to roll over.

Emergency Response and Training

Emergency response for electric drive vehicles is not significantly different from conventional vehicles. Electric drive vehicles are designed with cutoff switches to isolate the battery and disable the electric system, and all high-voltage power lines are colored orange.

Benefits of Electric Vehicles

Hybrid electric vehicles, plug-in hybrid electric vehicles, and all-electric vehicles have many benefits compared with conventional vehicles: better fuel economy, lower emissions, lower fuel costs, increased energy security and more fueling flexibility. Learn about the benefits of electric drive vehicles in the table below and consider the factors below the table.

Benefits	Hybrid Electric Vehicles	Plug-in Hybrid Electric Vehicles	All-Electric Vehicles
Fuel Economy	Better than similar conventional vehicles For example, the 2010 Honda Civic Hybrid gets 40 miles per gallon in the city and 45 mpg on the highway compared to the conventional Civic — 25 mpg city and 36 mpg	Better than similar HEVs and conventional vehicles PHEVs get about 40% better fuel economy than HEVs and permit driving at slow and high speeds using only electricity. Fuel economy above that of HEVs varies based on	No liquid fuels Fuel economy of all-electric vehicles is usually expressed as cost per mile, which is discussed below.

	highway. This amounts to fuel savings of about 38% in the city and 20% on the highway.	how often the vehicle is driven on only electricity.	
	Sources and Related Reports • North American PHEV Demonstration—Idaho National Laboratory • FuelEconomy.gov		
Low Emissions	Lower emissions than similar conventional vehicles HEV emissions vary by vehicle and type of hybrid power system. HEVs are often used to offset fleet emissions to meet local air-quality improvement strategies and federal requirements.	Lower emissions than HEVs and similar conventional vehicles PHEV emissions are projected to be lower than HEV emissions because they are driven on electricity some of the time. Most categories of emissions are lower for electricity generated from power plants than from engines running on gasoline or diesel.	Zero emissions EV emissions do not come from the tailpipe, so EVs are considered zero-emission vehicles. However, emissions are produced from the electric power plant. Most categories of emissions are lower for electricity generated from power plants than from engines running on gasoline or diesel. If electricity is generated from nonpolluting, renewable sources, there are no emissions.
	Sources and Related Reports • Environmental Assessment of Plug-In Hybrid Electric Vehicles—Electric Power Research Institute • Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional U.S. Power Grids—Part 1: Technical Analysis—Pacific Northwest National Laboratory		
Fuel Cost Savings	Less expensive to operate than a conventional vehicle Because of their improved fuel economy,	Less expensive to operate than an HEV or conventional vehicle When operating on electricity, a PHEV can	Less expensive to operate than gasoline and diesel vehicles Because EVs operate using only electricity, a

	HEVs usually cost $0.05 to $0.07 per mile to operate compared to conventional vehicles, which cost $0.10 to $0.15 per mile to operate.	be expected to cost $0.02 to $0.04 per mile (based on average U.S. electricity price). When operating on gasoline, the same vehicle will cost $0.05 to $0.07 per mile compared to conventional vehicles, which cost $0.10 to $0.15 per mile to operate.	typical electric vehicle costs $0.02 to $0.04 per mile for fuel (based on average U.S. electricity price).
	Sources and Related Reports • Comparing Energy Costs per Mile for Electric and Gasoline-Fueled Vehicles—Idaho National Laboratory		
Energy Security	Reduce U.S. reliance on imported petroleum The U.S. imports more than 60% of its petroleum, two-thirds of which is used in the transportation sector. Light-duty vehicles (typical passenger vehicles) consume 76% of the energy used by the on-road transportation sector.		
	HEVs use less petroleum because they have better fuel economy than conventional vehicles. Some HEVs use renewable and domestically produced alternative fuels instead of gasoline or diesel.	PHEVs use electricity produced from coal, nuclear, natural gas, and renewable sources. Some PHEVs use renewable and domestically produced alternative fuels instead of gasoline or diesel.	EVs use electricity produced domestically from coal, nuclear, natural gas, and renewable sources.
	Sources and Related Reports • U.S. Energy Information Administration's petroleum statistics • Oak Ridge National Laboratory's Transportation Energy Data Book		
Fueling Flexibility	Same as conventional vehicles	Can get fuel at gas stations or charge at home or public charging stations	Can charge at home or public charging stations

Vehicle Cost

HEVs are typically more expensive than similar conventional vehicles before tax credits or other incentives. In 2007, the average incremental price — the additional price of an HEV over a comparative non-hybrid — was $3,500 for cars and $4,500 for light-duty trucks. This price is expected to drop to $1,500 for cars by 2015, according to a study by Argonne National Laboratory: The Cost of Vehicle Electrification: A Literature Review. Light-duty PHEVs and EVs that are nearing market availability are expected to be more expensive than similar conventional vehicles. However, the cost premiums for PHEVs and EVs can be offset by fuel cost savings, a federal tax credit and state incentives.

For more information, see a cost-analysis study from the National Renewable Energy Laboratory: Cost-Benefit Analysis of Plug-In Hybrid Electric Vehicle Technology, which shows battery costs, fuel costs, vehicle performance attributes and how driving habits greatly influence the relative value of PHEVs.

III. Charging Infrastructure

The majority of charging activities will take place at locations where the electric vehicle owner resides. Therefore, development of charging infrastructure to support residential charging will be a key factor in the initial development of electric vehicles. It is unclear at this point to what extent workplace and public charging will be needed or required.

General Information

Residential Charging – While predominantly consisting of charging performed in single family homes (most likely in garages), residential charging also includes the more challenging scenarios of rental properties, condominium or other association-managed housing, and apartments or other residential housing without dedicated vehicle parking.

Residential charging is widely considered the highest priority for PEV infrastructure — fleetwide, vehicles spend 66 percent of their time parked at home and 95 percent of vehicles end their day at their home location.

Currently available Level 2 charging equipment costs about $1,500 to $2,500 installed, before a federal tax credit. Installation contractors can determine if the home has adequate electrical capacity for the Level 2 charging. In most cases, a dedicated 40-amp circuit will be required.

Workplace Charging – This category includes employer-provided chargers for both personal and company-owned vehicles. For personal vehicles, the ability to charge at work effectively doubles the daily feasible commuting distance. It also allows fleet vehicles to charge overnight. After home, work is the second most frequent location for vehicles (14 percent) and most convenient second option for charging in the event that a PEV owner is unable to charge at home. Workplace charging is likely the least impactful to the grid, with a peak of approximately 8 a.m., as shown in the figure below.

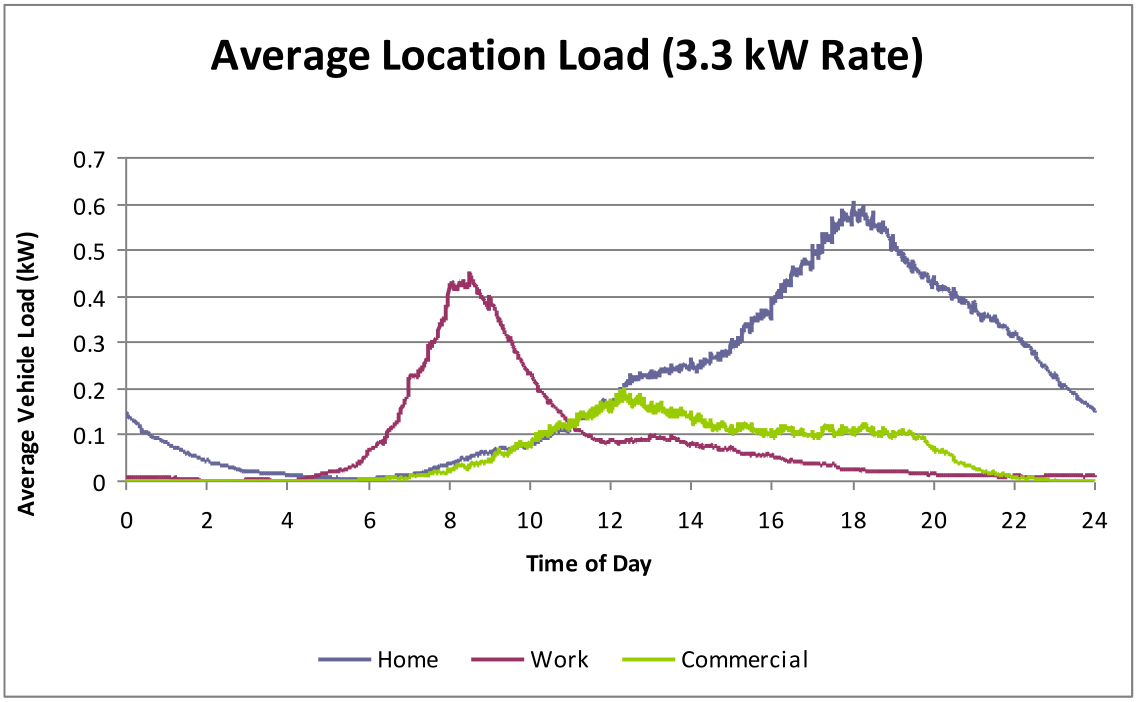


Figure 1
Charge profile of a nationwide fleet with universal access to 3.3-kW charging infrastructure and home, work and all commercial locations.

<u>Public Charging</u> – Public charging is likely the most expensive and uncertain of the three categories. In the near-term, public charging is capital intensive and has uncertain economic benefits vs. cost. At this point, it is difficult to predict the magnitude of public infrastructure required and the suitable placement of public EVSE.

Public charging has two primary functions:

1. Critical Infrastructure – Enable the drivers of battery electric vehicles to safely and securely operate their vehicles without anxiety about being stranded or having insufficient range to complete their trips. As most battery electric vehicles have a minimum of twice the range (80 to 100 miles) of a typical driver's daily needs (40 miles), it is unlikely that they will often use the infrastructure out of this need – but on the occasions it is used, it provides a critical service.
2. Convenience Infrastructure – Enabling drivers to charge when it is convenient, during errands and other stops. Convenience infrastructure has a societal benefit – it enables PHEV owners to increase their use of electricity and decrease their use of gasoline, as shown in the figure, below.

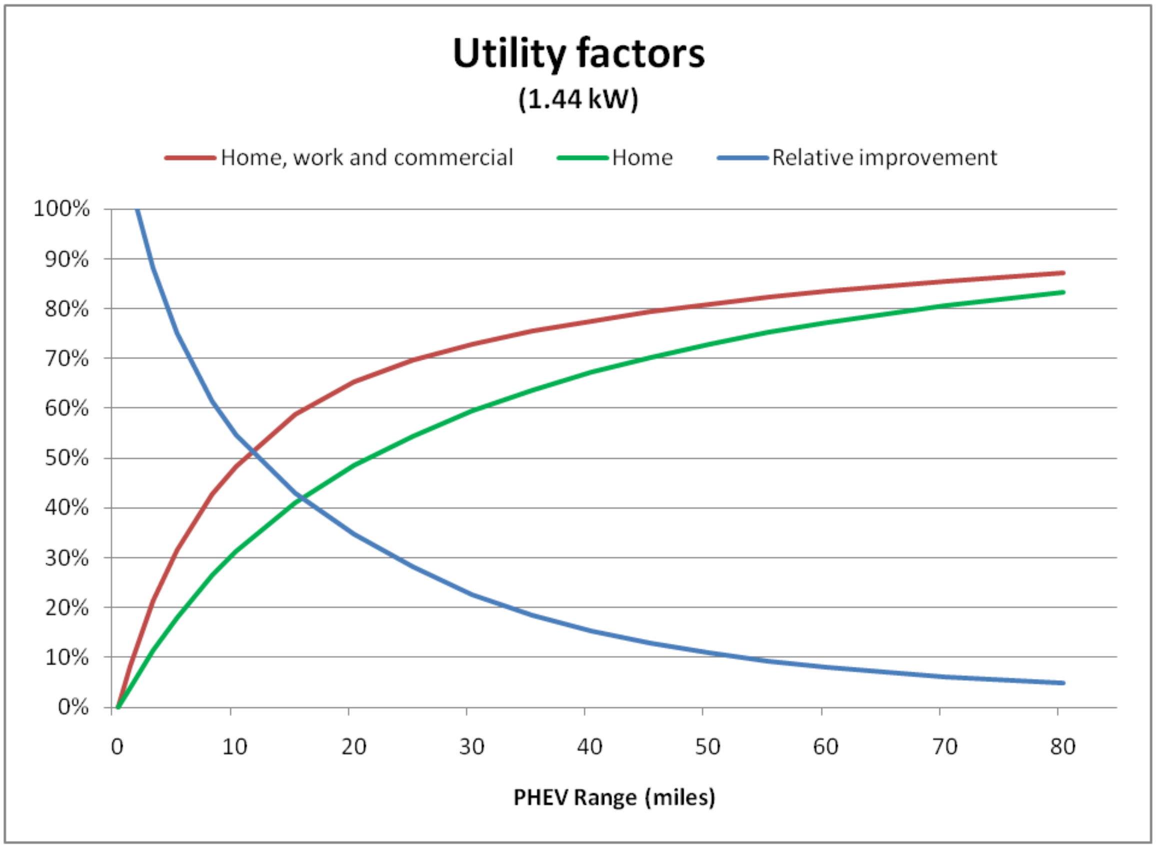


Figure 2
Percentage of PHEV driving performed with electricity when only home recharging is available (green), versus recharging at all other locations, including home (red). The relative improvement is greatest for PHEVs with smaller batteries.

PHEVs are unlikely to need critical infrastructure, as they rely on their gasoline engine when their battery is depleted. Also, battery EVs will often convenience charge, which does extend their range; however, convenience charging does not have a significant impact on BEV utilization as it does for PHEV.

Conclusions

1. Infrastructure to support residential charging will be the primary requirement since the majority of charging will occur at or near the home residence.
2. Workplace charging has the potential to double feasible commuting miles powered by electricity. It also offers the opportunity to charge fleet vehicles during overnight hours. It is unclear what incentives or disincentives businesses will have to pursue to offer workplace charging.
3. Public charging is the most uncertain. The cost of public charging is capital intensive and demand is uncertain. This leads to challenging economics to pursue such projects in the current environment.

4. Other utilities that are in high electric vehicle growth environments should be monitored to gain information on charging infrastructure requirements. Activities of Edison Electric Institute (EEI) electric vehicle committees should continue to be monitored.

IV. Market Penetration Analysis

Vehicle Development Status

Both the Obama Administration and the U.S. Department of Energy have pledged significant funds toward the development of advanced vehicle technologies, including $2.4 billion in the Recovery Act to establish 30 electric vehicle battery and component manufacturing plants and to support some of the first electric vehicle demonstration projects (DOE, 2010). As of July 2010, construction has begun on 26 of 30 battery and component manufacturing plants. In addition, "more than 20 breakthrough research projects to support potential game-changing technologies like semi-solid flow batteries … and 'all-electron' batteries … are being funded" (DOE, 2010).

A representative from EEI describes the status of known vehicles as follows (Mealiea, 2010):

> Nissan will produce 13,000 LEAFs each year for the next two years and 150,000 a year beginning in 2013; GM will produce 10,000 Volts this year and 30,000 beginning in 2012. There also are going to be a limited number of other vehicles (Mini-E, iMiEV, Ford Focus EV, etc.) that are in preproduction. Lastly, there are hundreds of Tesla Roadsters out there already.

Suitability of Vehicles for Midwest Climate

While drivers are accustomed to dealing with many of the challenges faced by their vehicles during cold weather, such as frozen engine coolant and cold batteries that cannot turn over the engine, they likely are unaware of the special issues facing PEVs in the cold. PEVs utilize batteries to store their power. When batteries get cold, the chemical reactions that occur within the battery that create power slow down significantly. It is estimated that a change of only 10 degrees can sap 50 percent of a battery's output, and in extreme cold, the reaction can happen so slowly that the battery will appear to be dead (CEAG, 2009). When that reduction in output is combined with the need to heat the inside of the car to ensure driver comfort, the range of the PEV is further reduced.

Experts suggest that PEV owners who live where winters get cold, as they do in the Midwest, must keep their PEV in a garage and should invest in "some kind of plug-in battery warmer" (CEAG, 2009). In 1997, Bob Tripolsky, corporate communications manager with Saturn Corporation stated there are various measures drivers can take to minimize the climate control system's energy consumption in extreme climate conditions, including preconditioning the car while it is still plugged in to its charger (Public Broadcasting System, 1997).

Commercial Availability of Vehicles

There will be a variety of plug-in electric vehicles available starting in 2011. However, it is difficult to determine where these cars will penetrate. The DOE-funded EV Project will be providing a free residential charger for roughly 8,300 vehicles in 16 targeted cities in Arizona, California, Oregon, Washington, Texas and Tennessee, as well as in the District of Columbia (ECOtality, Inc., 2009). Beyond these initial plans, projections vary widely.

> Pike Research estimates that 3.2 million PEVs will be sold globally between 2010 and 2015 at a compound annual growth rate of 106 percent. The U.S. is predicted to have roughly 840,000 of those vehicles sold, or 26 percent of the global market, just behind China. Deloitte Consulting estimates that PEVs will represent 2-5 percent of the U.S. market share by 2020. JPMorgan estimates that by 2020, HEVs (PEVs some unspecified portion of that) will account for roughly 20 percent of all vehicles sold in the U.S. The Boston Consulting Group estimated that HEVs will achieve market penetration of somewhere between 12 percent and 45 percent by 2020 depending on various factors over the next decade (Mealiea, 2010).

Technology Adoption Demographics

According to a recent national survey conducted by the Edison Electric Institute, 73 percent of residential electric customers feel it is important to expand the use of electric vehicles as a way to reduce the country's dependence on oil (EEI, 2010). The same survey indicates strong agreement (73 percent) with the idea that customers' electric utilities "should begin working and investing now to ensure that the needed infrastructure will be in place for convenient recharging of electric vehicles", and somewhat weaker agreement (61 percent) with the idea that their utility should "take a leadership role in encouraging a shift toward electric vehicles as manufacturers introduce them" (EEI, 2010). Interestingly, only 32 percent of customers feel their utility "has the expertise and ability to make the shift to electric vehicles possible" (EEI, 2010).

That same EEI survey asked residential electric customers to rate the likelihood that they "personally will be driving an electric vehicle within the next 10 years;" the results of that question follow (EEI, 2010):

<table>
<tr><td>Very likely – 14%</td><td rowspan="2">Total likely – 50%</td></tr>
<tr><td>Somewhat likely – 36%</td></tr>
<tr><td>Somewhat unlikely – 20%</td><td rowspan="2">Total unlikely – 40%</td></tr>
<tr><td>Not at all likely – 20%</td></tr>
<tr><td>Don't know – 10%</td><td></td></tr>
</table>

A recent survey of MidAmerican's residential customers indicates similar trends in terms of the desire for utility leadership and slightly more pessimistic findings in terms of actual electric vehicle ownership; those results are shown in the following two tables (Market Strategies International, 2010).

"I would like to see my electric utility take a leadership role in supporting the electric vehicle industry."		
Strongly agree	37%	Total agree – 70%
Somewhat agree	33%	
Neither agree nor disagree	7%	
Somewhat disagree	11%	Total disagree – 22%
Strongly disagree	11%	

"How interested do you think you will be <in the next five years> in considering an electric vehicle for use by you and members of your family?"		
Very interested	15%	Total interested – 48%
Somewhat interested	33%	
It depends	1%	
Only slightly interested	24%	Total not interested – 51%
Not at all interested	27%	

At MidAmerican's request, EPRI put together a PEV market adoption scenario construction for MidAmerican service territory. They derived three scenarios: low adoption, medium adoption and high adoption. The low adoption scenario is based on the adoption trends for hybrid vehicles over the past 10 years, whereas the medium adoption scenario reflects a successful rollout of PEV technology as well as robust adoption by vehicle owners (EPRI, 2010a and b). The high adoption scenario is considered to be very optimistic and "would generally reflect significant technological or economic breakthroughs in vehicle production and/or external influences that significantly favored plug-in vehicles" (EPRI, 2010b).

Attachment 2 provides an estimate of the total number of PEVs and associated electric loads on MidAmerican's system in 2015 and 2030 under the three different market adoption scenarios. The growth scenarios were derived as follows:

<u>Low Scenario</u>

- The PEV market share in 2010-2018 is based on the HEV sales performance in the overall passenger vehicle market in the U.S. from 2000-2008.
- From 2019 onward, the PEV share is based on an extrapolation of HEV sales performance 10 years earlier.

- The PEV share in a particular region (MidAmerican's service territory) is biased up or down depending on the 2008 market share of HEVs in the region compared to the U.S. However, based on an assumption that PEV technology becomes mainstream after 15-20 years, the regional bias is partially phased out in later years.

Medium Scenario

- From 2010-2015, the estimate of the PEV share of new vehicle sales is based on "ground-up" sales estimates, which in turn are derived from PEV launch announcements and (where available) production estimates.
    - In 2010-2011, the majority of PEV sales will occur in the launch markets announced by General Motors and Nissan for the Volt and Leaf, respectively. The rollout area extends beyond the EV Project area.
    - From 2012 through 2015, there is a decreasing residual effect where the launch markets have higher penetration than the U.S. average.
    - The PEV share in a particular region also is biased up or down depending on the 2008 market share of HEVs in the region compared to the PEV launch markets.

- After 2015, the PEV market share is based partially on an extrapolation of the "ground-up" estimates and partially on the past sales performance of HEVs.
    - The weighting of the "ground-up" extrapolation decreases in later years.
    - The weighting applied to past HEV sales performance increases in later years. The effect of past HEV sales, *before weighting*, is calculated as follows:
        - The PEV market share in 2016-2018 is based on the HEV sales performance in the region from 2006-2008, adjusted for the fact the HEVs were only available in a portion of the passenger vehicle market.
        - From 2019 onward the PEV share is based on an extrapolation of HEV performance in the region 10 years earlier. However, based on an assumption that PEV technology becomes mainstream after 15-20 years, the regional bias is partially phased out in later years.

High Scenario

- The PEV market share is based on an average of publicly available forecasts. This scenario considers only the top third of the available studies.
- The PEV share in a particular region is biased up or down depending on the 2008 market share of HEVs in the region compared to the U.S. However, based on an assumption that PEV technology becomes mainstream after 15-20 years, the regional bias is partially phased out in later years.

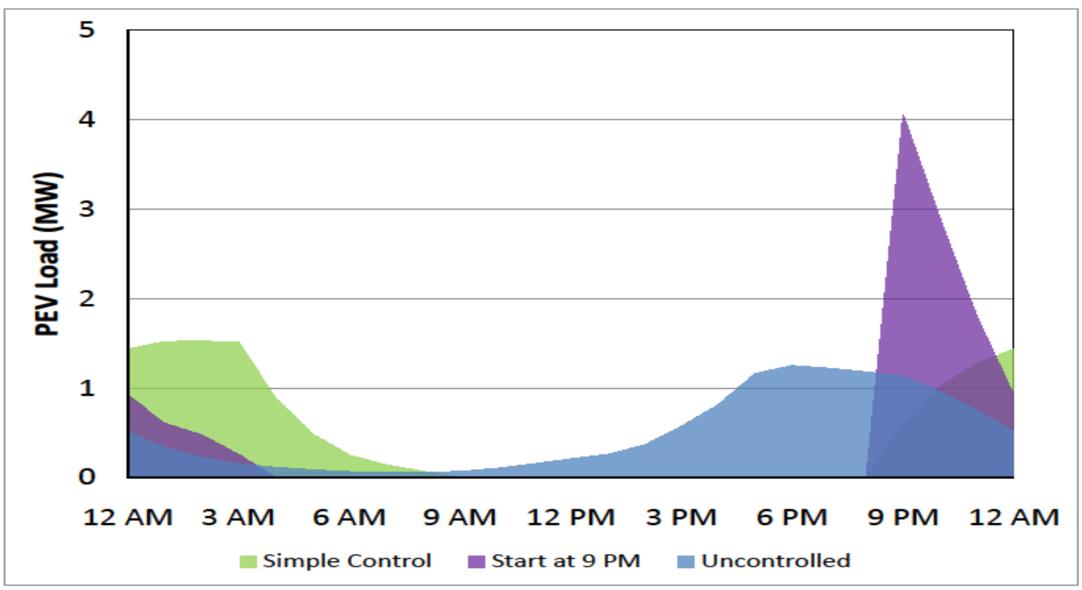
The split of PEVs into PHEVs and EVs is the same for all three scenarios. The mix begins with 50 percent PHEV40s (PHEV's that can travel 40 miles on a charge) and 50 percent EVs in 2010. PHEV10s (PHEV's that can travel 10 miles on a charge) are introduced in 2012 as 10 percent of the PEV market, ramping to 50 percent of PEVs by 2016. Over the period of 2012 to 2016, PHEV40s and EVs ramp down from 45 percent each to 25 percent each.

Because of the potential impact of Midwestern cold winters on electric vehicle performance and the lack of an early Midwest vehicle rollout, it seems most reasonable to assume the low growth scenario most accurately describes MidAmerican customers' adoption of PEVs.

V. Impact on System Load

Under any reasonable market penetration assumptions, the impact of PEVs on MidAmerican's system load for the foreseeable future will be small. Assuming the low adoption scenario modeled by EPRI and uncontrolled charging, the added PEV load at the time of MidAmerican's late-afternoon peak in 2015 is slightly more than 1 MW and in 2030 still only approximately 30 MW. Under the high adoption scenario, those amounts increase to 5 MW in 2015 and 135 MW in 2030.

However, as can be seen in the following figure, with implementation of a simple control strategy, impacts to the system peak could be avoided almost entirely.



Hourly load added by PEVs in 2015 in Low Adoption Scenario

Potential impacts on MidAmerican's total system load under various scenarios are shown in Attachment 2.

Charging Pattern Assumptions

In addition, loads are shown using three different load patterns and charging assumptions.

Simple Charge Control

It is possible to achieve any load shape with sophisticated control; various parties have proposed 'valley filling' strategies, 'renewable matching' strategies, and others. A "simple" control strategy would shift the charge load to nighttime but spread it out relatively evenly over six hours. This can be accomplished by staging vehicles to start charging during one of seven hours from 9p.m. to 3a.m. Controlled this way, PEV charging would not require additional generation capacity and would have a relatively small system impact. More sophisticated control strategies could optimize this even further.

Set-Time Charge Control (9 p.m.)

Significant problems could be caused by ill-conceived charge control strategies. For instance, if vehicles were controlled with the algorithm "wait until 9 p.m. and then turn on," (presumably with the assumption that this would move the load off of the peak), the load from charging could quickly ramp from no load to a high load. Based on EPRI's analysis of National Personal Transportation Survey data, about 73 percent of vehicles would be available to charge and had been driven that day. Even though this load typically would be toward the end of the system peak, this could present a difficult control problem for utilities, even with a relatively small number of vehicles.

Uncontrolled Charging

Vehicle home arrival is correlated with peak load, so it often is assumed that vehicle charging could create a large load coincident with the peak. However, vehicles will not all be connected at the exact same time. EPRI's analysis of NPTS data reveals that even without smart charging the load of vehicle charging is relatively well-distributed. The uncontrolled charging scenario is a plausible high case for PEV charging, which assumes that the PEV fleet will begin charging at full power immediately upon arriving at home.

VI. Distribution System Impacts

In the foreseeable future, significant upgrades to MidAmerican's electric distribution system will not be required to handle load from the projected addition of PEVs. There is potential that some smaller residential transformers may become overloaded due to charging activities at residences during peak load periods. By monitoring load additions due to electric vehicles, overloading conditions should be identified in advance and issues addressed.

Plug-in Vehicle Charging and Impact on Distribution Facilities

Plug-in vehicles most frequently will be recharged by an AC supply at either 120- or 240-V, AC at a charging station located at the customers premise.

Charging from 120-V, AC termed Level 1 Charging requires a relatively simple cordset that is supplied with the vehicle and can be used with a standard 120-volt outlet. Level 1 charging is limited to 12-amps continuous (80 percent of the circuit rating) and typically supplies the vehicle with between 1.2 and 1.4 kW. This typically is sufficient to supply approximately 40 miles of driving per day in either a plug-in hybrid electric vehicle like the Chevrolet Volt (this would be a full charge) or a battery electric vehicle (partial charge — a full charge for a Nissan Leaf from Level 1 would require up to 24 hours). The probability of potential residential transformer overloading due to Level 1 charging is small due to the small load increase unless the transformer is already nearly fully loaded and the charging occurs during a peak period.

Charging from 240-V, AC, termed Level 2 Charging requires a dedicated charging appliance, termed an EVSE, permanently connected to a dedicated circuit and with a fixed cordset and connector. Level 2 charging can deliver up to 80-amps — 19.2 kW — to the vehicle in continuous charging. For 2011, both the Chevrolet Volt and Nissan Leaf are designed for a 3.3-kW charge rate (this is set by the vehicle), however 6.6 kW is expected to be a typical charge rate for battery electric vehicles in the near future. Per literature review, a full charge would take approximately four hours. Level 2 charging will likely require the customer to add a 30- or 40-amp circuit. The increased load from Level 2 charging could cause an overloading situation on a residential transformer, depending on the current loading level of the transformer when the charging activities occur.

Roughly 75 percent of drivers travel fewer than 40 miles per day. Assuming that residential charging is the sole means of supplying energy to the vehicle, most vehicles would require less than 10 kWh per day, with a typical recharge on the order of five to six kWh.

EPRI was consulted to provide information on potential system impacts. EPRI has performed a number of electric vehicle analyses, including detailed component level analyses of distribution feeders at nearly 20 utilities. There were a number of conclusions from EPRI’s distribution impacts analysis, including:

- Distribution impacts from plug-in vehicles are most likely to occur in residential areas due to customers adding an additional circuit of 20- to 40-amps capacity (for Level 2 charging) and charging their plug-in vehicle during summer peak hours.
- Asset overloading tends to impact residential transformers, with small units (25 kVA and below) more likely to be overloaded.
- Most distribution feeders could handle a minimum of 8 percent penetration of electric vehicles with uncontrolled charging, usually equivalent to 200 to 400 vehicles per circuit. Many circuits could handle in excess of 20 percent penetration. Note: overall penetration levels of 8 percent or higher are not projected on MidAmerican’s system until 2024.
- Managed or controlled charging that avoids the weekday summer peak would reduce or even eliminate most distribution impacts.
- Systems designed to accommodate either extensive air conditioning or significant use of electric heat typically were more robust to PEV charging loads.

Monitoring

Even though significant distribution system impacts are not projected for more than 10 years, several items need to be monitored:

- Means of identifying locations that are adding electric vehicle load. Some utilities have been working with automotive companies on voluntary early identification. Another source may include EVSE vendors.
- Experience of other utilities that are serving communities that are early adopters of electric vehicles. MidAmerican is participating on an EEI committee that is reviewing the development of electric vehicles and their impact on utilities.

Overall Conclusions:

1. In the foreseeable future, significant upgrades to the electric distribution system will not be required as a direct result of PEV added load.
2. Some smaller, isolated residential transformers may become overloaded due to charging activities at their residences during peak load periods. Some smaller distribution transformers may need to be replaced with larger units. It is not anticipated that there will be a widespread or significant impact.
3. Management of the timing of charging will have an impact on the loading of distribution facilities. This may include things such as incentive rates to encourage charging during non-peak periods, remote control of charging facilities or coordination of air conditioner usage and charging activities. By managing charging times, impacts on the distribution system could be reduced.
4. Early identification of customers or locations where electric vehicles are being used will allow the utilities to identify any issues in advance and take appropriate action.
5. Other utilities that are in high PEV growth environments should be monitored to gain information on impacts on their distribution systems and any other issues identified. Activities of EEI electric vehicle committees should continue to be monitored.

VII. Management of System Impacts

Tariff Provisions

MidAmerican will be responsible for system upgrades necessary to manage additional load caused by electric vehicles. The current tariff does not include provisions for the customer to pay for system upgrades. Specific tariff provisions include:

- In the event the service line becomes inadequate (for example, when a customer installs charging equipment) the service line will be upgraded for the customer at no charge.
- Customers are required to notify the company of significant increases in load to allow the company to upgrade its equipment. There is no charge to the customer for the upgrade; however, customers may be responsible for damage to company-owned equipment caused by the increase in load if they have not properly notified the company.

- MidAmerican provides metering. In the event the customer requests a separate meter for electric vehicle charging, the company would provide it at no charge. The customer, however, would pay any costs associated with connecting to the separate meter and pay a second basic service charge for this additional account.

Customers are likely unaware of whether or to what extent increased load at their site would be detrimental to MidAmerican's system and would require MidAmerican to make upgrades. Costs for upgrades could vary widely from situation to situation, depending on existing load, existing facilities and the specific resulting upgrade. There is no, or at least not yet, rule of thumb regarding the likelihood or cost of system upgrades caused by vehicle charging load. This lack of information may be a barrier to customers managing their load in a manner that avoids detrimental impacts on MidAmerican's system. MidAmerican may need to seek a rate increase before significant electric vehicle penetration occurs in its service territory. If deemed necessary at that time, a rate case could provide an opportunity to add tariff requirements for customers to pay for system upgrades caused by increased loads.

Customers will need to install charging equipment to accommodate Level 2 or Level 3 charging. If utilities are aware of this installation, it would be an ideal time to educate customers on the potential system impacts and request the customer's cooperation in avoiding peak time charges. However, MidAmerican does not plan to police the addition of electric vehicles in its territory.

In summary, MidAmerican's Illinois tariff does not create a barrier to the adoption of electric vehicles in its territory, and MidAmerican does not currently have plans to make changes to the tariff. MidAmerican will monitor system impacts and may adjust future tariffs if appropriate.

Pricing

Actual pricing must be differentiated between at-home charging and public charging; however, there are several pricing issues common to both.

End-use rates allow costs related to the specific end-use to be tied directly to the cost causer and provide an opportunity to send appropriate price signals to the end-user. However, end-use rates require policing to ensure ongoing eligibility for the rate. MidAmerican does not have specific end-use rates in Illinois but has experience with such rates in other states. Based on that experience, MidAmerican would not favor end-use rates for vehicle charging. Further, until electric vehicle utilization and customer behavior is better known, MidAmerican believes offering an end-use rate is premature.

Separately metered end-use rates would allow MidAmerican to specifically track electric consumption related to vehicle charging for analysis and reporting. Such information might be important if utilities are allowed to capture carbon credits for electric vehicles or if reporting is required for road use taxes and the like. However, the separate meter will increase monthly costs for the customer, which may create a barrier. Lower priced, separately metered end-use rates may also create an incentive for customers to inappropriately shift non-vehicle charging load to the end-use meter. Further, until electric vehicle utilization and customer behavior is better known, MidAmerican believes requiring separately metered end-use rates is premature.

At-Home Charging

MidAmerican has relatively low residential rates. While energy rates are higher in the summer, the summer period is only four months long, leaving the majority of all potential charging hours under winter rates. In addition, standard Illinois[2] residential rates have a declining block at 800 kWh in the winter. This pricing already makes at-home vehicle charging attractive without any incentive to charge off-peak. (Winter blocks are at 1,000 kWh under Iowa and South Dakota base use rates. Electric heat, water heating and apartment rates are even more attractive for at-home charging.)

Separately metered residential time-of-use rates under MidAmerican's current Illinois tariff would cost a customer more for off-peak at-home charging than under standard residential seasonal rates. This phenomenon is driven by the demand component of MidAmerican's current residential time-of-use rate. Assuming a 3 kW demand and 8 kWh per day for low Level 2 charging, a customer would pay about 37 percent more on MidAmerican's off-peak time-of-use rates than under standard residential rates. However, combining vehicle charging with other normal domestic electric usage may make the time-of-use rate more attractive if no higher demand is established and significant portions of the normal domestic load occurs off peak.

MidAmerican does not have a requirement under Illinois law and does not currently offer a residential real-time pricing rate. MidAmerican does not have an automated system in place to bill real-time prices so manual billing would be required. Given the limited number of electric vehicles expected in early deployment in MidAmerican's service territory, real-time pricing for at-home charging does not appear to be practical.

In conclusion, MidAmerican's current tariff does not create a barrier for residential customer at-home charging. MidAmerican offers customers the choice of standard or time-of-use pricing, enabling them to choose the most cost-effective rate for their circumstances. No changes are needed to MidAmerican's residential rates to accommodate electric vehicle at-home charging.

Public Charging

MidAmerican has relatively low commercial and industrial rates in all jurisdictions. As with residential rates, commercial and industrial rates include higher charges during the four summer months. Illinois Rate 22, which serves most small commercial customers includes a declining winter block. Many larger customers are served under Rate 42, an hours-use rate including declining blocks in winter and summer. MidAmerican offers a time-of-use option for both of these rates. This optional rate includes an additional metering charge and a premium of $.0079 per kWh for on-peak usage but only a $.0066 discount for off-peak usage regardless of the season. This optional time-of-use pricing will only provide an incentive to publicly charge vehicles during off-peak periods if the charging load is a substantial portion of the customer's total load or he can move significant non-charging load off peak. MidAmerican's large commercial and industrial rates in Illinois are already time-of-use rates.

As described above, except for Rate 22, all of MidAmerican's Illinois commercial and industrial rates have a demand component. The demand component will help recover costs related to

[2] Throughout this discussion, Illinois rates are considered to be bundled service only. No consideration has been given to delivery service rates at this time.

spikes in demand caused when vehicles plug-in. However, Illinois traditionally has opposed demand ratchets that would be even more effective in recovering demand related costs.

Review of MidAmerican's tariffs did not indicate any barriers to non-residential customers providing charging services. No pricing changes were deemed necessary.

Peak Reduction

Some believe that electric vehicles could become effective sources of distributed generation or at least be smart enough not to charge during peak periods. However, in the short term, utilities do not have in place the bi-directional equipment to enable the distributed generation scenario. In addition, MidAmerican does not have and does not have plans for smart meters capable of communicating energy prices to end-users. Until such changes could be made on MidAmerican's system, low-tech equipment and processes would need to be employed. Simple timers to delay energy consumption to off-peak hours coupled with effective consumer education could be employed immediately.

Analysis of the Need for Separate Metering to Track Usage of Electric Vehicles

Current discussion on the need for separate metering for electric vehicles has generally outlined the following reasons for separately metering the electricity for plug-in vehicles:

1. To enable the provision of a distinct rate plan (typically time-of-use to incent off-peak charging).
2. To track the usage of electricity for transportation for the imposition and collection of road taxes.
3. To track the usage of electricity for the purpose of assigning credit for reduction in carbon emission, criteria emissions or the generation of renewable fuel/energy credits.
4. To track the usage of electricity for the purpose of administering fuel switching or some other type of utility program to encourage the use of electric vehicles.

MidAmerican does not believe that separate metering to track usage of electric vehicles is necessary at this time and would not recommend to the Commission that separate metering be required for the following reasons:

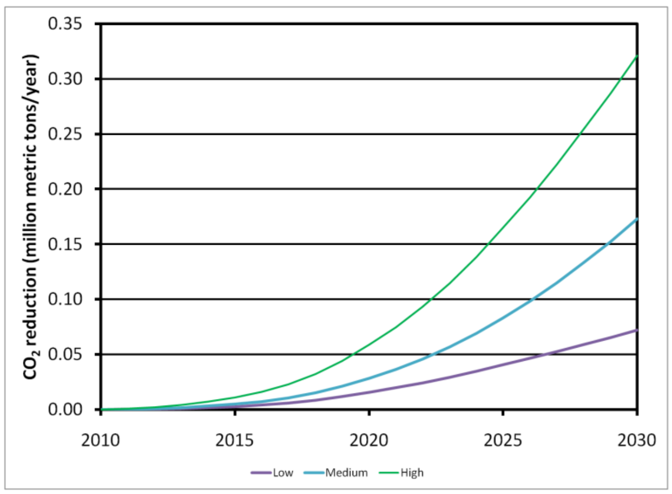
- MidAmerican does not intend to provide a separate rate plan specifically for electric vehicle usage and therefore does not need to track electric vehicle usage for its own purposes.
- System load impacts from electric vehicle charging are expected to be small in the near term, and the system benefits of understanding the impacts of electric vehicle charging with precision will not justify the costs of metering this load in the near term.
- MidAmerican believes that customers will not want metering to specifically identify the electricity used to charge their electric vehicle and would not want the additional hassle of having to wait for the utility to install a meter before they can use their electric vehicle.

The downside to not having separate electric metering is that usage related to electric vehicles cannot be tracked for other purposes (see Items 2-4 above). If at a later time, it is desirable to know with precision the electricity used for electric vehicle charging, either for the imposition of taxes or for the assignment of carbon reduction credits, separate metering may be warranted. If that occurs, metering can be put in place over a longer period of time with relatively little inconvenience to the customer. If it is desirable to estimate electric vehicle usage (as opposed to knowing with precision), an end-use load research program can be put in place to sample meter customers with electric vehicles in order to develop estimates of electric vehicle usage.

VIII. Carbon Dioxide Emissions Impacts

MidAmerican's resource portfolio is part of a larger regional market and the marginal resource from that market would ultimately serve Illinois customers. Therefore, an analysis of the regional resource stack provides a better opportunity for understanding what mix of generation fuels would functionally displace gasoline as the energy source for PEVs than does MidAmerican's system fuel profile.

EPRI has developed a carbon intensity forecast (metric tons/megawatt-hour) for each NERC reliability area, using a standard production cost and capacity expansion model to forecast changes in each area. The resulting levels of emissions reductions expected in the MAIN reliability area (a suitable proxy for the Midwest) were estimated from 2010-2030 for each market penetration scenario. Total reductions were .5 million, 1 million and 2 million metric tons for the low, medium and high penetration scenarios respectively – the reduction rate over time is shown at right.



Notably, EPRI's carbon intensity estimate for MAIN is among the highest for any of the NERC regions, due to the continuing presence of coal on the margin during off-peak and shoulder periods when charging is most likely to occur. This assumption should be viewed as subject to considerable uncertainty, given the long time horizon for substantial levels of PEV adoption. Over that time frame, significant changes in the cost of fuel, transportation and environmental compliance could lead to a shift in the blend of resources that serve our customers in Illinois. Given the assumptions underlying the EPRI analysis, those shifts would result in lower regional carbon intensity. Carbon intensities below those assumed in this analysis would imply a greater net emissions reduction than the estimate presented above.

IX. Regulatory and Legal Issues

<u>Legal Status of Public Charging Providers</u>

Under the current statutory definitions, it is possible that public charging station operators would be considered public utilities in Illinois. The Illinois statutory definition of a public utility is very broad. 220 ILCS 5/3-105(a) provides, in pertinent part, that public utility:

> “. . . means and includes, except where otherwise expressly provided in this Section, every corporation, company, limited liability company, association, joint stock company or association, firm, partnership or individual, their lessees, trustees, or receivers appointed by any court whatsoever that owns, controls, operates or manages, within this State, directly or indirectly, for public use, any plant, equipment or property used or to be used for or in connection with, or owns or controls any franchise, license, permit or right to engage in:
>
> (1) The production, storage, transmission, sale, delivery or furnishing of heat, cold, power, electricity, water, or light, except when used solely for communication purposes; …”

There are several exceptions to the definition of public utility. 220 ILCS 5/3-105(b)(8) provides that “public utility” does not include:

> “. . . the ownership or operation of a facility that sells compressed natural gas at retail to the public for use only as a motor vehicle fuel and the selling of compressed natural gas at retail to the public for use only as a motor vehicle fuel.”

It would appear that a similar exception for the ownership or operation of a facility, i.e., a public charging station, that sells electricity at retail to the public for use only as a motor vehicle fuel, and the selling of such electricity for such a limited purpose, would be necessary to avoid a public charging station being considered to be a public utility.

It should also be noted that several other entities are excluded from the definition of a public utility, including municipal utilities [220 ILCS 5/3-105(b)(1)], electric cooperatives [220 ILCS 5/3-105 (b)(3)], cogeneration facilities, small power production facilities and other qualifying facilities, as defined in the Public Utility Regulatory Policies Act [220 ILCS 5/3-105(b)(7)], alternative retail electric suppliers [220 ILCS 5/3-105(b)(9), and the Illinois Power Agency [220 ILCS 5/3-105(b)(10).

Similar to the definition of a public utility, it is possible that public charging station operators would be considered alternative retail electric suppliers, subject to the exceptions listed in the statute. The current statutory definition of an alternative retail electric supplier also is very broad. 220 ILCS 5/16-102 provides, in pertinent part, that alternative retail electric supplier:

> “. . . means every person, cooperative, corporation, municipal corporation, company, association, joint stock company or association, firm, partnership, individual, or other entity, their lessees, trustees, or receivers appointed by any court whatsoever, that offers electric power or energy for sale, lease or in exchange for other value received to one or more retail customers, or that engages in the delivery or furnishing of electric power or energy to such retail customers, and shall include, without limitation, resellers, aggregators and power marketers, . . .”

There are six exceptions to the definition of alternative retail electric supplier listed in the statute: (1) electric utilities; (2) electric cooperative or municipal systems; (3) a public utility owned and operated by a public institution of higher education; (4) a retail customer obtaining its electric power and energy from its own cogeneration or self-generation facilities; (5) an entity that owns, operates, sells or arranges for the installation of a customer's own cogeneration or self-generation facilities; and (6) an industrial or manufacturing customer that owns its own distribution facilities.

Unless a public charging station operator falls within one of these exceptions, it would appear that the current definition of alternative retail electric supplier is sufficiently broad to include public charging station operators.

Sale for Resale

The sale by a public utility to a charging station that resells that electricity to a retail customer would appear to be a sale for resale. It is possible that the Federal Energy Regulatory Commission would assert jurisdiction over such wholesale transactions.

Building Codes

Local building codes could present barriers to the availability and location of public charging station operators. One example would be if there were zoning or other restrictions that would prohibit the placement of retail electric service public charging stations in residential areas.

Interoperability Standards

MidAmerican is a member of the Smart Grid Interoperability Panel (SGIP) convened by the National Institute of Standards and Technology (NIST) to provide a stakeholder forum for input into NIST's directive under the Energy Independence and Security Act of 2007 to *"coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…"* (NIST Smart Grid Interoperability Standards Project web site). It is MidAmerican's intent to monitor and participate in the activities of the panel and to participate as appropriate in the standards adoption process at the Federal Energy Regulatory Commission.

Of particular interest to plug-in electric vehicles are:

- Priority Action Plan 3, *Common Price Communications Model*, scheduled for completion in April 2011
- PAP 4, *Common Schedule Communication Mechanism*, scheduled for completion in February 2011
- PAP 7, *Electric Storage Interconnection Guidelines*, scheduled for completion in November 2011
- PAP 9, *Standard DR and DER Signals*, scheduled for completion in April 2011
- PAP 11, *Common Object Models for Electric Transportation*, scheduled for completion in October 2010
- PAP 18, *PEV Implementation*, a new PAP to start when PAP 11 wraps up
- Plug-in Electric Vehicle Domain Expert Working Group (DEWG)

Information regarding the activities of the SGIP can be found at: http://www.nist.gov/smartgrid/ and information about the priority action plans can be accessed at the SGIP collaborative web site: http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/

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Initial Assessment of the Impact of Plug-in Electric Vehicles

MidAmerican Energy Company

UL Certified Devices

EV Connectors and Inlets

- Avcon Corp
- BMW of North America LLC
- ITT Corp BIW Connector Systems
- Yazaki Parts Co LTD

EV Chargers

- Aerovironment Inc
- EBus Inc
- ETEC
- Panasonic
- Toyota

EV Supply Equipment

- Avcon
- ClipperCreek
- Panasonic

Applicable Standards

UL 458: Standard for Power Converters/Inverters and Power Converter/Inverter Systems for Land Vehicles and Marine Craft
This standard is used to cover inverters or converters used to modify voltages on board an EV. These products can be stand alone devices or used within other devices, such as part of a charger.

UL 2202: Standard for Electric Vehicle (EV) Charging System Equipment
This standard covers both on-board and off-board chargers, where a charger is a device that supplies charging current to a battery. The products may be used indoors or outdoors unless considered on-board, in which case they are considered outdoor use. These products include all charging levels, including Level 3.

UL 2231-1: Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits; Part 1: General Requirements
UL 2231-2: Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits; Part 2: Particular Requirements for Protection Devices for Use In Charging Systems
These standards are used to cover the particular Personnel Protection System that is required by the National Electrical Code under Article 625 (paragraph 625.22).

UL 2251: Standard for Plugs, Receptacles, and Couplers for Electric Vehicles
This standard is used to cover the actual EV connector and EV inlet provided to connect a vehicle to the power source. If the parts on the vehicle side of the cable, they are considered to be connectors and inlets (the combination of which is a coupler), or if on the power source side of the cable, a receptacle and plug. These particular components are not intended for direct connection to a normal receptacle in the wall, and NEMA type receptacles are not included in the scope of this standard.

UL Subject 2580: Outline of Investigation for Batteries for Use In Electric Vehicles
This outline covers batteries for use in electric vehicles. Specifically, Nickel, Lithium Ion, Lithium Ion Polymer cells, cell modules, and battery packs, for use in EVs.

UL Subject 2594: Outline of Investigation for Electric Vehicle Supply Equipment
This outline covers supply equipment, which is defined as a device that delivers power to an on-board charger. These products include portable or stationary cord sets, charging stations, and power outlets. The differences in these products are as follows: EV cord sets consist of a power cord for connection to the typical NEMA receptacle in the owner's garage, an electrical enclosure in the middle to house personnel protection components and other control type components, up to 25 feet of EV cable and the EV connector. This product may be transported from place to place (portable) or hung in a dedicated space for use in one location (stationary). Charging stations are products that are provided with a cable or a means to connect a cable, and the personnel protection equipment components required by the National Electrical Code are housed in the device. Power outlets are similar to charging stations, but they are not provided with personnel protection equipment, as they rely on the portable cord set to be brought to the charging location and the personnel protection is provided by the cord set.

UL 62: Standard for Flexible Cords and Cables
This standard is used to cover the cable types EV, EVJ, EVE, EVJE, EVT, and EVJT, which are the six cable types defined in the National Electrical Code as a suitable cable type for use with electric vehicles. See 625.17 of the National Electrical Code.

UL Subject 2733: Outline of Investigation for Surface Vehicle On Board Cable
This outline covers the cable and wiring harnesses used on board an EV for interconnection of the different components within the charging path.

UL Subject 2734: Outline of Investigation for Connectors for Use With On Board Electric Vehicle (EV) Charging Systems
This outline covers the actual connectors at the end of the cables covered under UL Subject 2733

above and these connectors are used to provide an electrical connection between the components in the charging path.

UL 1004-1: Standard for Rotating Electrical Machines: General Requirements
UL 1004-2: Standard for Impedance Protected Motors
UL 1004-3: Standard for Thermally Protected Motors
UL 1004-4: Standard for Electric Generators
UL 1004-5: Standard for Fire Pump Motors
UL 1004-6: Standard for Servo and Stepper Motors
UL 1004-7: Standard for Electronically Protected Motors
UL 1004-8: Standard for Inverter Duty Motors
This series of standards covers the motor construction, tests and protection means by combining the general requirements with the appropriate part of the series. Not all of these are relevant for EV's.

UL Subject 2735: Outline of Investigation for Utility Metering Equipment
This outline will cover the utility meter for smart grid applications.

This covers the standards currently in place. Please note, UL Subject 2733, UL Subject 2734 and UL Subject 2735 are not yet published, but will be soon as they are already in the process.

MidAmerican Energy Company
Electric Vehicle Load Study

2015 Medium Penetration Scenario

Total Electric Vehicles: 3917

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	2.62	1.67	0.93	2,613	2,615.62	2,614.67	2,613.93
2	2.77	1.10	0.61	2,437	2,439.77	2,438.10	2,437.61
3	2.79	0.87	0.41	2,366	2,368.79	2,366.87	2,366.41
4	2.76	0.47	0.28	2,348	2,350.76	2,348.47	2,348.28
5	1.62	-	0.21	2,403	2,404.62	2,403.00	2,403.21
6	0.89	-	0.15	2,469	2,469.89	2,469.00	2,469.15
7	0.45	-	0.12	2,650	2,650.45	2,650.00	2,650.12
8	0.25	-	0.10	2,937	2,937.25	2,937.00	2,937.10
9	0.12	-	0.10	3,210	3,210.12	3,210.00	3,210.10
10	-	-	0.12	3,480	3,480.00	3,480.00	3,480.12
11	-	-	0.19	3,726	3,726.00	3,726.00	3,726.19
12	-	-	0.28	3,927	3,927.00	3,927.00	3,927.28
13	-	-	0.38	3,964	3,964.00	3,964.00	3,964.38
14	-	-	0.47	4,116	4,116.00	4,116.00	4,116.47
15	-	-	0.66	4,157	4,157.00	4,157.00	4,157.66
16	-	-	1.04	4,196	4,196.00	4,196.00	4,197.04
17	-	-	1.49	4,198	4,198.00	4,198.00	4,199.49
18	-	-	2.12	4,209	4,209.00	4,209.00	4,211.12
19	-	-	2.28	4,105	4,105.00	4,105.00	4,107.28
20	-	-	2.23	4,060	4,060.00	4,060.00	4,062.23
21	-	-	2.15	3,954	3,954.00	3,954.00	3,956.15
22	1.09	7.40	2.07	3,856	3,857.09	3,863.40	3,858.07
23	1.85	5.28	1.75	3,552	3,553.85	3,557.28	3,553.75
24	2.32	3.27	1.36	3,228	3,230.32	3,231.27	3,229.36

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	7,129		0.0%
Start at 9 p.m.	7,319		0.0%
Uncontrolled	7,849		0.1%

MidAmerican Energy Company
Electric Vehicle Load Study

2030 Medium Penetration Scenario

Total Electric Vehicles: 137658

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	82.22	44.31	25.91	2,613	2,695.22	2,657.31	2,638.91
2	86.39	28.33	16.07	2,437	2,523.39	2,465.33	2,453.07
3	85.90	21.85	10.36	2,366	2,451.90	2,387.85	2,376.36
4	85.02	11.71	6.99	2,348	2,433.02	2,359.71	2,354.99
5	48.27	-	5.17	2,403	2,451.27	2,403.00	2,408.17
6	23.61	-	3.87	2,469	2,492.61	2,469.00	2,472.87
7	11.33	-	2.97	2,650	2,661.33	2,650.00	2,652.97
8	6.39	-	2.72	2,937	2,943.39	2,937.00	2,939.72
9	3.14	-	2.92	3,210	3,213.14	3,210.00	3,212.92
10	-	-	3.76	3,480	3,480.00	3,480.00	3,483.76
11	-	-	6.01	3,726	3,726.00	3,726.00	3,732.01
12	-	-	9.27	3,927	3,927.00	3,927.00	3,936.27
13	-	-	12.40	3,964	3,964.00	3,964.00	3,976.40
14	-	-	15.50	4,116	4,116.00	4,116.00	4,131.50
15	-	-	21.21	4,157	4,157.00	4,157.00	4,178.21
16	-	-	33.31	4,196	4,196.00	4,196.00	4,229.31
17	-	-	47.63	4,198	4,198.00	4,198.00	4,245.63
18	-	-	66.98	4,209	4,209.00	4,209.00	4,275.98
19	-	-	71.80	4,105	4,105.00	4,105.00	4,176.80
20	-	-	68.71	4,060	4,060.00	4,060.00	4,128.71
21	-	-	65.65	3,954	3,954.00	3,954.00	4,019.65
22	34.85	237.11	62.76	3,856	3,890.85	4,093.11	3,918.76
23	59.94	175.70	52.24	3,552	3,611.94	3,727.70	3,604.24
24	74.47	96.73	39.45	3,228	3,302.47	3,324.73	3,267.45

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	219,558		0.0%
Start at 9 p.m.	224,745		0.0%
Uncontrolled	238,587		1.6%

MidAmerican Energy Company
Electric Vehicle Load Study

2015 High Penetration Scenario

Total Electric Vehicles: 8839

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	5.95	3.84	2.14	2,613	2,618.95	2,616.84	2,615.14
2	6.31	2.53	1.40	2,437	2,443.31	2,439.53	2,438.40
3	6.34	1.99	0.94	2,366	2,372.34	2,367.99	2,366.94
4	6.28	1.07	0.64	2,348	2,354.28	2,349.07	2,348.64
5	3.70	-	0.47	2,403	2,406.70	2,403.00	2,403.47
6	2.04	-	0.36	2,469	2,471.04	2,469.00	2,469.36
7	1.04	-	0.27	2,650	2,651.04	2,650.00	2,650.27
8	0.58	-	0.24	2,937	2,937.58	2,937.00	2,937.24
9	0.29	-	0.24	3,210	3,210.29	3,210.00	3,210.24
10	-	-	0.28	3,480	3,480.00	3,480.00	3,480.28
11	-	-	0.42	3,726	3,726.00	3,726.00	3,726.42
12	-	-	0.63	3,927	3,927.00	3,927.00	3,927.63
13	-	-	0.86	3,964	3,964.00	3,964.00	3,964.86
14	-	-	1.07	4,116	4,116.00	4,116.00	4,117.07
15	-	-	1.50	4,157	4,157.00	4,157.00	4,158.50
16	-	-	2.37	4,196	4,196.00	4,196.00	4,198.37
17	-	-	3.37	4,198	4,198.00	4,198.00	4,201.37
18	-	-	4.82	4,209	4,209.00	4,209.00	4,213.82
19	-	-	5.19	4,105	4,105.00	4,105.00	4,110.19
20	-	-	5.07	4,060	4,060.00	4,060.00	4,065.07
21	-	-	4.91	3,954	3,954.00	3,954.00	3,958.91
22	2.48	16.81	4.72	3,856	3,858.48	3,872.81	3,860.72
23	4.19	11.96	3.99	3,552	3,556.19	3,563.96	3,555.99
24	5.28	7.46	3.11	3,228	3,233.28	3,235.46	3,231.11

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	16,234		0.0%
Start at 9 p.m.	16,671		0.0%
Uncontrolled	17,891		0.1%

MidAmerican Energy Company
Electric Vehicle Load Study

2030 High Penetration Scenario

Total Electric Vehicles: 258247

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	154.27	83.17	48.63	2,613	2,767.27	2,696.17	2,661.63
2	162.10	53.19	30.17	2,437	2,599.10	2,490.19	2,467.17
3	161.18	41.02	19.44	2,366	2,527.18	2,407.02	2,385.44
4	159.53	21.98	13.11	2,348	2,507.53	2,369.98	2,361.11
5	90.58	-	9.71	2,403	2,493.58	2,403.00	2,412.71
6	44.32	-	7.26	2,469	2,513.32	2,469.00	2,476.26
7	21.27	-	5.58	2,650	2,671.27	2,650.00	2,655.58
8	12.00	-	5.10	2,937	2,949.00	2,937.00	2,942.10
9	5.90	-	5.49	3,210	3,215.90	3,210.00	3,215.49
10	-	-	7.05	3,480	3,480.00	3,480.00	3,487.05
11	-	-	11.27	3,726	3,726.00	3,726.00	3,737.27
12	-	-	17.40	3,927	3,927.00	3,927.00	3,944.40
13	-	-	23.27	3,964	3,964.00	3,964.00	3,987.27
14	-	-	29.07	4,116	4,116.00	4,116.00	4,145.07
15	-	-	39.79	4,157	4,157.00	4,157.00	4,196.79
16	-	-	62.51	4,196	4,196.00	4,196.00	4,258.51
17	-	-	89.38	4,198	4,198.00	4,198.00	4,287.38
18	-	-	125.68	4,209	4,209.00	4,209.00	4,334.68
19	-	-	134.72	4,105	4,105.00	4,105.00	4,239.72
20	-	-	128.92	4,060	4,060.00	4,060.00	4,188.92
21	-	-	123.19	3,954	3,954.00	3,954.00	4,077.19
22	65.38	444.89	117.77	3,856	3,921.38	4,300.89	3,973.77
23	112.46	329.65	98.03	3,552	3,664.46	3,881.65	3,650.03
24	139.73	181.51	74.04	3,228	3,367.73	3,409.51	3,302.04

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	411,989		0.0%
Start at 9 p.m.	421,725		2.2%
Uncontrolled	447,707		3.0%

MidAmerican Energy Company
Electric Vehicle Load Study

2015 Low Penetration Scenario

Total Electric Vehicles: 2140

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	1.43	0.92	0.51	2,613	2,614.43	2,613.92	2,613.51
2	1.52	0.60	0.33	2,437	2,438.52	2,437.60	2,437.33
3	1.53	0.48	0.22	2,366	2,367.53	2,366.48	2,366.22
4	1.51	0.26	0.15	2,348	2,349.51	2,348.26	2,348.15
5	0.89	-	0.11	2,403	2,403.89	2,403.00	2,403.11
6	0.49	-	0.08	2,469	2,469.49	2,469.00	2,469.08
7	0.25	-	0.06	2,650	2,650.25	2,650.00	2,650.06
8	0.14	-	0.06	2,937	2,937.14	2,937.00	2,937.06
9	0.07	-	0.06	3,210	3,210.07	3,210.00	3,210.06
10	-	-	0.07	3,480	3,480.00	3,480.00	3,480.07
11	-	-	0.10	3,726	3,726.00	3,726.00	3,726.10
12	-	-	0.15	3,927	3,927.00	3,927.00	3,927.15
13	-	-	0.21	3,964	3,964.00	3,964.00	3,964.21
14	-	-	0.26	4,116	4,116.00	4,116.00	4,116.26
15	-	-	0.36	4,157	4,157.00	4,157.00	4,157.36
16	-	-	0.57	4,196	4,196.00	4,196.00	4,196.57
17	-	-	0.81	4,198	4,198.00	4,198.00	4,198.81
18	-	-	1.16	4,209	4,209.00	4,209.00	4,210.16
19	-	-	1.25	4,105	4,105.00	4,105.00	4,106.25
20	-	-	1.22	4,060	4,060.00	4,060.00	4,061.22
21	-	-	1.18	3,954	3,954.00	3,954.00	3,955.18
22	0.60	4.05	1.13	3,856	3,856.60	3,860.05	3,857.13
23	1.01	2.89	0.96	3,552	3,553.01	3,554.89	3,552.96
24	1.27	1.79	0.75	3,228	3,229.27	3,229.79	3,228.75

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	3,903		0.0%
Start at 9 p.m.	4,008		0.0%
Uncontrolled	4,299		0.0%

MidAmerican Energy Company
Electric Vehicle Load Study

2030 Low Penetration Scenario

Total Electric Vehicles: 58865

	---- Incremental Load ----				---- New System Peak Day ----		
Hour Ending	Simple Control	Start at 9 p.m.	Uncontrolled	Typical System Peak Day	Simple Control	Start at 9 p.m.	Uncontrolled
1	35.17	18.96	11.09	2,613	2,648.17	2,631.96	2,624.09
2	36.95	12.12	6.88	2,437	2,473.95	2,449.12	2,443.88
3	36.74	9.35	4.43	2,366	2,402.74	2,375.35	2,370.43
4	36.36	5.01	2.99	2,348	2,384.36	2,353.01	2,350.99
5	20.65	-	2.21	2,403	2,423.65	2,403.00	2,405.21
6	10.10	-	1.65	2,469	2,479.10	2,469.00	2,470.65
7	4.85	-	1.27	2,650	2,654.85	2,650.00	2,651.27
8	2.73	-	1.16	2,937	2,939.73	2,937.00	2,938.16
9	1.35	-	1.25	3,210	3,211.35	3,210.00	3,211.25
10	-	-	1.61	3,480	3,480.00	3,480.00	3,481.61
11	-	-	2.57	3,726	3,726.00	3,726.00	3,728.57
12	-	-	3.97	3,927	3,927.00	3,927.00	3,930.97
13	-	-	5.31	3,964	3,964.00	3,964.00	3,969.31
14	-	-	6.63	4,116	4,116.00	4,116.00	4,122.63
15	-	-	9.07	4,157	4,157.00	4,157.00	4,166.07
16	-	-	14.25	4,196	4,196.00	4,196.00	4,210.25
17	-	-	20.37	4,198	4,198.00	4,198.00	4,218.37
18	-	-	28.65	4,209	4,209.00	4,209.00	4,237.65
19	-	-	30.71	4,105	4,105.00	4,105.00	4,135.71
20	-	-	29.39	4,060	4,060.00	4,060.00	4,089.39
21	-	-	28.08	3,954	3,954.00	3,954.00	3,982.08
22	14.90	101.41	26.85	3,856	3,870.90	3,957.41	3,882.85
23	25.64	75.14	22.35	3,552	3,577.64	3,627.14	3,574.35
24	31.85	41.38	16.88	3,228	3,259.85	3,269.38	3,244.88

Summary	Annual MWh Sales	Percent of Total Sales	Percent Increase in System Peak
Simple Control	93,913		0.0%
Start at 9 p.m.	96,132		0.0%
Uncontrolled	102,055		0.7%