Electrify Heartland Plan

Section 3: EVSE Deployment Plan

Project title: Kansas – Missouri
Community Readiness for EV and EVSE

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By: Metropolitan Energy Center

and Kansas City Regional Clean Cities Coalition

With: Black & Veatch

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CFDA Number 81.086

Electrify Heartland Plan

Electrify Heartland Project Abstract

Electrify Heartland is an electric vehicle planning project managed by Metropolitan Energy Center. It is a product of the Greater Kansas City Plug-In Readiness Initiative, co-chaired by Kansas City Regional Clean Cities Coalition. Our goal is to produce a regional plan to prepare public resources and secure the economic and environmental benefits of plug-in vehicles within targeted metro areas with estimated 2.7M population. The targeted metro areas include Kansas City, MO & KS; Jefferson City, MO, Wichita, KS; Salina, KS; Lawrence, KS; and Topeka, KS. (14 Counties: Cass, Clay, Cole, Douglas, Jackson, Johnson, Leavenworth, Miami, Platte, Ray, Saline, Sedgwick, Shawnee, Wyandotte).

Electrify Heartland Steering Committee

Team	Organization	Name
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Training	National Electrical Contractors Association	Jim Cianciolo
Utility Grid	Black & Veatch	Sam Scupham
Vehicle & Fleet	University of Missouri at Kansas City	Henry Marsh

Exhibit i-i. Electrify Heartland Steering Committee Members

Section 3: EVSE Deployment Plan

Section Abstract

Our infrastructure (charging stations) team compiled data from many sources in order to answer questions about regional access to Electric Vehicle Supply Equipment (EVSE) at home, at work and at public locations. This section also briefly discusses how EVSE locations should be reported and mapped, how the utility grid can send and receive information regarding EVSE usage to mitigate barriers within utilities, barriers within multi-family dwellings and cost range for installation and hardware of charging stations.

Section Author:

Larry Kinder, LilyPad EV and Troy Carlson, Initiatives

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3 EVSE Deployment Plan

3.1 Estimate consumers with access to residential EVSE and forecast trends

The question is not who has access to residential charging stations, but rather, how many of those who purchase or are considering purchasing plug in electric vehicles have access to facilities that support overnight charging?

The locations where consumer vehicles are parked overnight have a major impact on who has accesses to residential charging stations. Consumer's purchasing decision for an EV will generally consider if they have the ability to charge their vehicle where they generally park overnight.

We use the Kansas City metropolitan area (KC metro) as an example for the planning area in the following exercise.

<u>We make the following assumptions:</u>

Consumers living in a single family dwelling with a garage are likely to be able to install a charging station in that garage. Consumers living in a single-family dwelling with no garage are not likely to be able to install a charging station.

Consumers living in apartment buildings or multifamily dwellings will typically have access to charging facilities only at the discretion of the management of the facilities.

<u>We draw the following conclusions:</u>

Level 1 Charging: We believe about 68% of the consumers in the KC Metro have access to standard 110V outlets overnight for slow Level 1 charging of their vehicles. We are using the 68% (from the table below) of all consumers in the KC Metro having access to garages as a proxy for the number of people that have access to Level 1, 110V charging. We believe level one charging will be adequate for most living in single-family dwellings with a garage.

Level 2 Charging: Faster Level 2 charging requires 240V electric service. Thus those same 68% would probably have to add 240V wiring and a charging station to their garage. Cost being a deciding factor for most families, we believe most aEV consumers living in single family homes will not opt for Level 2 charging if a 240V outlet does not already exist in or near the garage. Instead, Level 2 charging will likely be the choice for multi-family dwellings. Installation may be initiated by residents or building management, but should address concerns of electrical contractors, the utility provider for the property, building management and residents

Supporting Data:

We use US government reports to estimate the number of consumers in the KC Metro with access to garages.

From a 1997 US Census Document (http://www.census.gov/prod/99pubs/ahb-9901.pdf):

> "Garages or carports are common for households living in single-detached units-just over three in four of these homes (76 percent) have a covered shelter for vehicles. Townhouses or row houses, on the other hand, include a garage or carport less than half the time (46 percent). In both mobile homes and units in multiunit buildings, the proportion is 26 percent." -1997 U.S. census data

		Total	With Garage	
table 1.6	All Housing	766	521	68%
table 3.7	owner occupied	487	417	86%
table 4.7	renter occupied	210	76	36%

Source: American Housing Survey forthe Kansas City MetropolitanArea: 2002
http://www.census.gov/prod/2003pubs/h170-02-27.pdf

Exhibit 3-1 Kansas City residents with garages

3.2 Estimate consumers with access to workplace EVSE and forecast trends

Section 3.4 below describes the total number of charging ports in our area currently and projects the number out to mid-2014. There are currently about 30 workplace charging ports, which make up about 25% of the current 119 charging ports. With a projection of 475 charging ports by mid-2014 and assuming the 25% ratio holds steady, that would mean we could expect about 118 workplace charging ports by mid-2014.

3.3 Estimate of publically available EVSE and forecast trends

As of September 17, 2012 the AFDC website shows that Kansas and Missouri (excluding the St. Louis area) have a total of 119 commercial charging ports.

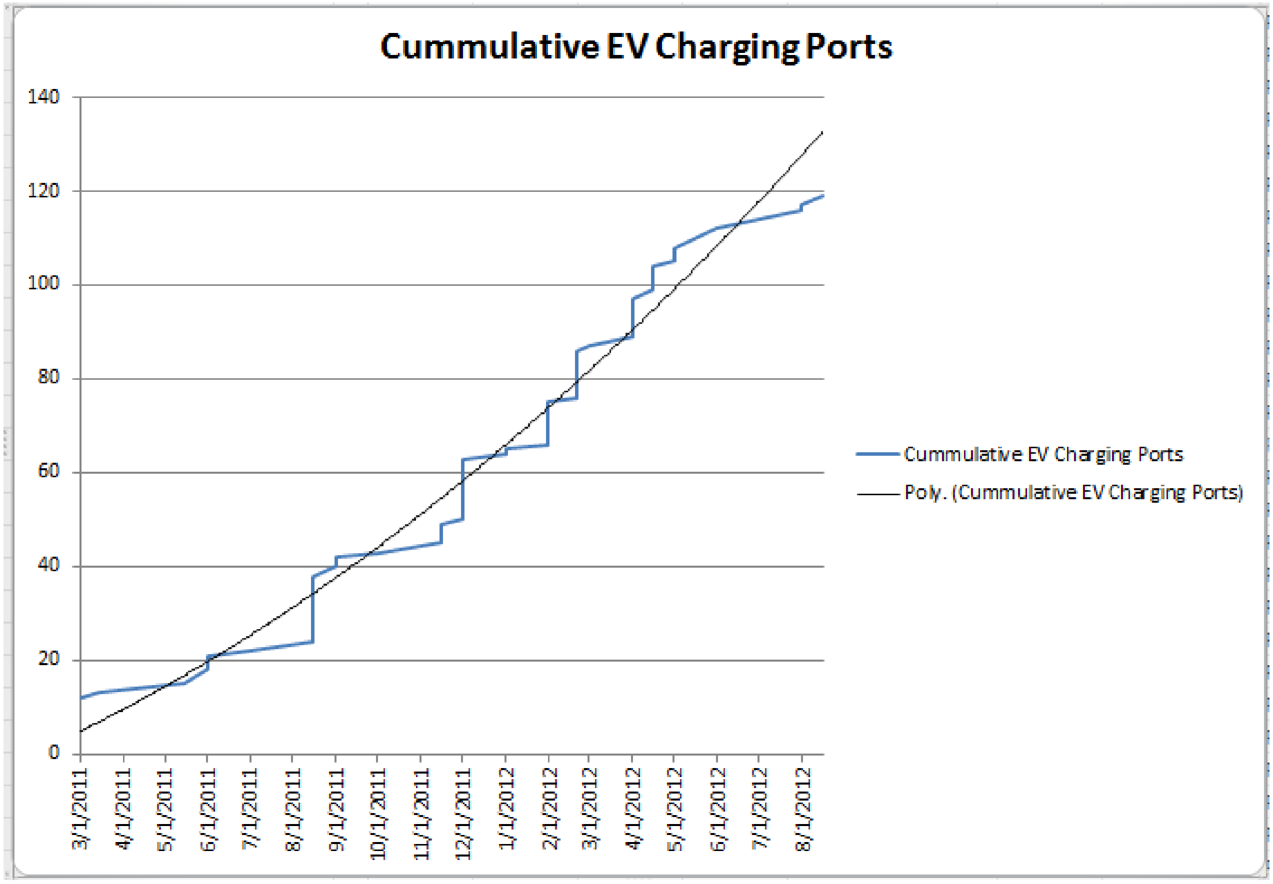


Exhibit 3-2 Number of charging station ports installed since March 2011.

The next graph shows the breakdown of currently installed charging stations by type of location:

30	Workplace
12	Gov Office
31	Auto Dealers
14	Higher Ed
4	Fleet
26	Retail
2	Demo

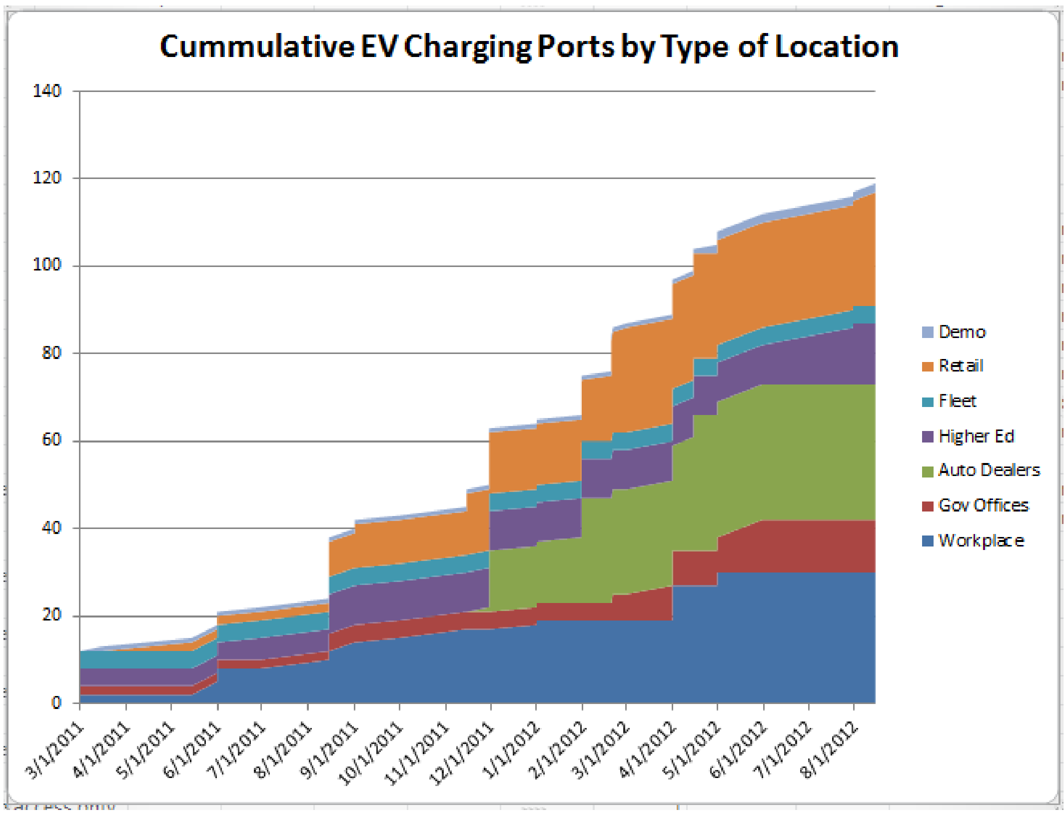


Exhibit 3-3 Number of EV charging ports shown by location type

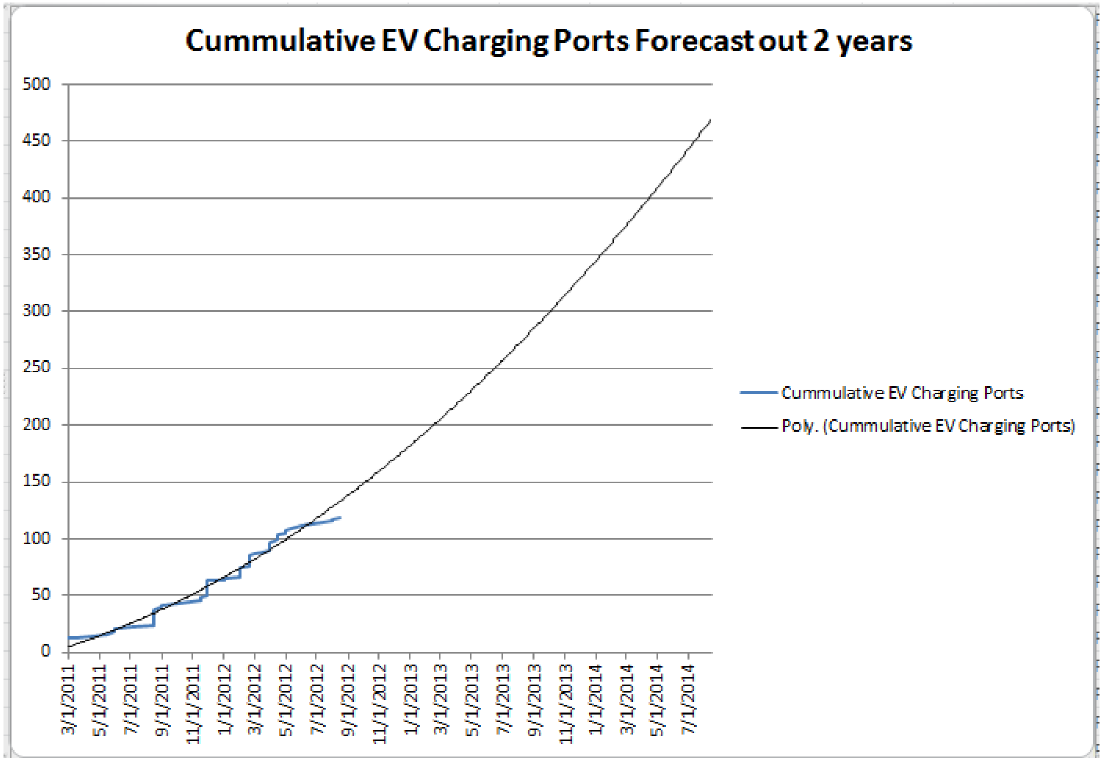


Exhibit 3-4: Projected charging ports in KS/MO (except St. Louis area) by July, 2014

3.4 Determine data flow and processes for updating maps of EVSE locations

We believe that the list of electric vehicle charging stations on the AFDC's Charging Station Locator www.afdc.energy.gov/fuels/electricity_locations.html is the most complete set of charging station locations available. We should encourage all installations of publically available commercial charging stations in the area to be reported to this database.

"…the list of electric vehicle charging stations on the AFDC's Charging Station Locator www.afdc.energy.gov/fuels/electricity_locations.html is the most complete set of charging station locations available."

After a charging station has been installed, the information about the station should be uploaded to the AFDC website. The basic flow of a project to install charging stations and upload information to the station could be described in the following steps:

1) Purchase
2) Permit
3) Installation
4) Inspection

5) Upload charging station info to AFDC's Charging Station Locator
6) AFDC Map

3.5 Analysis of EVSE/Grid send/receive information issues

Reference the City of Houston's "Recommended Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater Houston Area."[1]Please note that Kansas and Missouri are regulated states and Texas is not. However, the basic assumptions in this report remain applicable and are summarized here for information and future consideration by the regulatory bodies.

Background

Electric utilities are under significant pressure to maintain a dependable, clean, low-cost electrical supply to their customer base. In order to achieve these goals, utilities are evaluating, and in some cases implementing, smart grid technologies that allow utilities to control various electrical loads on their systems. Through these smart grid technologies, utilities can minimize new power plant and electrical distribution and transmission investment by shifting and controlling load while minimizing the impact to the customer.

Electrical transmission is the bulk transfer of electrical energy from generating power plants to substations located within populated areas. Transmission and distribution used to be owned by a single company, but numerous reforms have separated the transmission business from distribution. Power is transmitted through power lines at high voltages to reduce power loss. Energy transmission through underground means results in higher costs and causes greater operational limitations. Another limitation for distribution owners is that the energy cannot be stored, and therefore is generated on an as-needed basis.

Advanced Metering Infrastructure (AMI), also called *smart meters*, are being deployed to provide remote meter reading. Smart meters also have the ability to control various customer loads.

Electric vehicles are one of the better loads to control through smart meters, because EVs have an on-board storage system. This means that delaying the charge of the battery has no noticeable impact on the customer, unlike turning off a lighting or air-conditioning load, which can have an immediate impact on the customer.

Additionally, a neighborhood transformer may not be sized such that every EV-owning customer in an area can be charging at the same time. The ability to schedule the EV charging systems connected to a neighborhood transformer could significantly extend the

[1] City of Houston Texas, et al. "Recommended Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater Houston Area." *Green Houston TX*. Houston TX Gov, Oct. 2010. Web. 10 Dec. 2012. <http://www.greenhoustontx.gov/ev/pdf/evdeploymentguidelines.pdf>

life of that transformer, or delay and possibly eliminate the need to replace the transformer with a larger size. As the adoption of EVs increases, load control strategies for multi-family dwellings may allow the utility to control charge times to maximize the effectiveness and utilization of existing transformers.

During residential EVSE installations, the electrical contractor will evaluate the electrical service capabilities of the existing system. If inadequate power is available at the service entrance, an electrical service upgrade will be required.

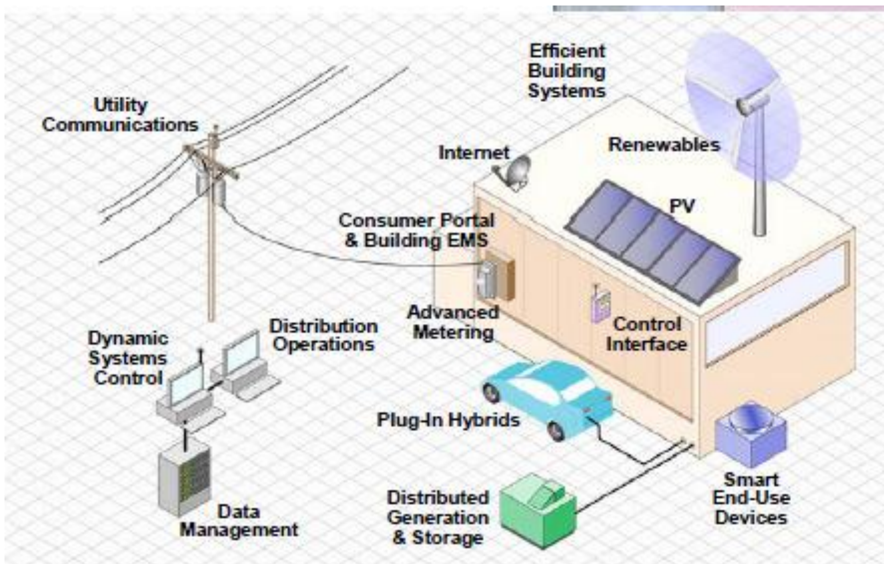


Exhibit 3-5: Smart Grid Infrastructure

Exhibit 3-5 above incorporates many design features of a smart grid/distributed energy storage system. Home use of photovoltaic or wind energy can supplement the utility power. A home area network (HAN) communicating with a smart meter can control lighting, heating, cooling, and other major appliances. Given the right incentives, a home owner may elect to have the utility control total home consumption or deliver power back to the utility through the storage capability of the EV. There are various mechanisms for utilities to control EV load, including:

Time-of-Use (TOU)
TOU is an incentive-based electrical rate that allows the EV owner to save money by charging during a designated “off-peak” timeframe established by the utility. Typically, these off-peak times are in the late evenings through early mornings and/or weekends, during a timeframe when demand on the utility electrical grid is at its lowest point. TOU is now being implemented by some utilities, but currently there is not a common approach. Discussion with local utility prior to installation of the charge station is recommended.

Dual Metering

Electric providers may provide a special rate for EV charging and require the installation of a second meter specifically for this purpose. This would require additional installation time, since the electrical contractor must install the meter before the EVSE is available for use. The use of a "revenue-grade" meter in the EVSE and a communications path to allow the utility control may obviate the need for the second meter.

Demand Response

Demand response is typically a voluntary program that allows a utility to send out a signal to customers (typically large commercial customers) to cut back on loads during times the utility is experiencing a high peak on their utility grid. These customers are compensated when they participate in this program. As deployment of smart meters becomes more prevalent, EV owners may participate in such programs. Utilities may enter into contracts with EV owners to allow the utility to maintain more control over EV charging.

Real-Time Pricing (RTP)

RTP is a concept that could be implemented in the future for EVs. In this model, pricing signals are sent to a customer through a number of communication mediums that allow the customer to charge their EV during the most cost-effective period. For example, the EVSE installed in the EV owner's garage could be pre-programmed to ensure the car is fully charged by 6:00 am, at the lowest cost possible. RTP signals from the utility would allow this to occur without customer intervention. In order to implement RTP, smart meters would need to be in place at the charging location and the technology built in to the EVSE. These programs are under development at the time of this writing.

Vehicle-to-Grid (V2G)

V2G is a concept that allows the energy storage in electric vehicles to be used to support the electrical grid during peak electrical loads, in times of emergency such as grid voltage support, or based on pricing economics. V2G could also support vehicle-to-home, where the energy stored in the vehicle battery could supplement the home's electrical requirements. V2G requires that the on-board vehicle charger is bi-directional (energy is able to flow both in and out of the system). The EVSE at the premises must also be bi-directional and able to accommodate all of the utility requirements related to flowing energy back into the electrical grid. Although there are various development efforts in V2G, for on-road EVs, this concept probably is several years away from implementation in any commercial sense.

Interconnection Requirements

Although vehicle-to-grid (V2G) connections may be in the future for most applications, some infrastructure will incorporate EVSE with solar parking structures or other renewable resources. Because these systems will connect to the local grid, it will be necessary to contact the local utility to determine whether there are any interconnection requirements. These requirements are in place to protect personnel and property while feeding electricity back into the utility grid. Most utility requirements typically are already in place for solar photovoltaic and wind systems that are grid-tied to the utility.

Commercial Electrical Supply/Metering

In the Houston area, there are typically two scenarios for connection to a commercial electrical supply. The first is utilizing the existing main service entrance section (SES) or an otherwise adequate supply panel at the commercial establishment, and the second is to obtain a new service drop from the utility.

The decision on which approach to take depends on a number of factors, including the ability to obtain permission from the property owner and/or tenant of the commercial business, and the location of the existing SES or adequate electrical supply from the proposed EV charging station site. If permission is granted by the property owner and/or tenant (as required), then a fairly simple analysis can be performed. Compare the cost of utilizing an existing supply vs. a new service drop to determine the best approach. A new utility service drop typically requires the establishment of a new customer account, which may include a credit evaluation of the entity applying for the meter, and a monthly meter charge in addition to the energy and demand charges. The local utility also may require an analysis of the anticipated energy consumption.

3.6 Analysis of barriers to EVSE for multifamily dwellings

Major Barriers Facing EVSE installations at Multi-Unit Dwellings

Barrier	Description
Cost	Installation costs can range anywhere from $2,000 to $10,000. A building that has sufficient panel capacity and an existing conduit running from the panel to the PEV parking space will likely only incur charging station, permit, and electrician installation/assessment costs, resulting in a lower cost installation. On the other hand, a building with limited panel capacity, no conduit, and a parking space located a significant distance from the electrical panel, will likely incur higher installation costs.[1]
Power Supply	The charging load of PEVs range from 3.3 kW, similar to a large household appliance or Nissan LEAF, up to 6.6 kW, similar to a Ford Focus Electric. Large scale adoption of PEVs will inevitably require increases in transformer capacity. Transformers supplying multifamily buildings typically have 10% to 15% excess capacity, or overhead, which is enough to sustain a few electric vehicles. However, as PEV adoption grows and vehicles are equipped with higher charging loads, these transformers may be insufficient to handle wide scale conversion to electric vehicles.[2]
Proximity to Metering Equipment	Service panels for MUDs can be located at substantial distances from where the charging station is to be installed.[3]
High Rise Units	In downtown San Diego, meter rooms are often located on the upper floors of high rise units and conduit space is limited. Challenges are faced in installing additional conduit and/or encountering physical limitations (e.g., drilling through concrete floors).[4]

Exhibit 3-6 Findings of the San Diego Regional Electric Vehicle Infrastructure Working Group. Continued on next page.

Parking	Parking is not standard across MUD building types. In some MUDs parking is bundled into the rent or sale price of the unit. In other buildings it is unbundled or paid for separately. Unbundled parking spaces can be assigned on a first-come first-serve basis, or they can be unassigned. A charging station tied to a bundled parking space could be added value to a future tenant; however, a charging station on an unbundled or unassigned spot may pose challenges for assigning costs to individual owners. Choice of spaces also must address issues with proximity to metering equipment as addressed above.[5]
Electricity Rates and Meters for Common Areas	Parking garages/lots are typically on a common meter. This means, electricity provided in parking garages and other common areas is paid by the property manager or homeowner association (HOA) and then billed to residents through HOA fees or rent. This creates a challenge in allocating charging costs to individual owners.[6]
Homeowner Associations (HOAs)	HOAs cannot prohibit or restrict the installation of a PEV charging station. Senate Bill 880 codified this and other provisions for charging installations in common areas. However, HOA boards may still resist installations. Lack of information regarding charging station installations remain a significant barrier.

[1] Peterson, David. Addressing Challenges to Electric Vehicle Charging in Multifamily Residential Buildings June 2011, UCLA Luskin School of Public Affairs.
[2] Ibid.
[3] Bianco, James S. Power Share System for Electric Vehicle Service Equipment, 2012.
[4] Pointon, Joel, SDG&E. Clean Cities US Department of Energy, Electric Vehicle Spring 2011 Quarterly Discussion webinar presented on March 28, 2011.

Exhibit 3-7 Findings of the San Diego Regional Electric Vehicle Infrastructure Working Group. Continued from previous page.

3.7 Analysis of Regulatory Treatment of Retail EV Charging

A logical result of the wide-spread adoption of EV in Kansas and Missouri will be demand for third parties to provide quick-charging refueling services along well-traveled corridors for drivers who are not confident that there is enough charge remaining in their battery to reach their desired destination. Such businesses could provide a valuable service, especially if they are fairly common and spread throughout the region, as the perception that a refueling station is always nearby would dramatically increase drivers' range confidence.

However, this business model presents some unique regulatory challenges that will have to be addressed before these businesses can be legally pursued in Missouri. Specifically, such businesses could potentially qualify as "public utilities" under Kansas and Missouri laws. As a result, such a business would potentially have to register as a public utility and take on numerous regulatory burdens.

Under Missouri law, public utilities are regulated by the Missouri Public Service Commission ("MPSC").[2] "Public utilities," as defined by statute[3], include "electrical corporations," which own, operate, control or manage any "electric plant".[4] Unfortunately, potential retail charging stations arguably fall under this umbrella, as the definition of "electric plants" includes "all real estate, fixtures and personal property operated, controlled, owned, used or to be used for or in connection with or to facilitate the generation, transmission, distribution, sale or furnishing of electricity for light, heat or power."[5] Therefore, because retail recharging stations would own, operate, control, and manage equipment used to sell electricity for power, they would arguably be required to register as public utilities. The resulting regulatory burden would severely impair the economics of the business.

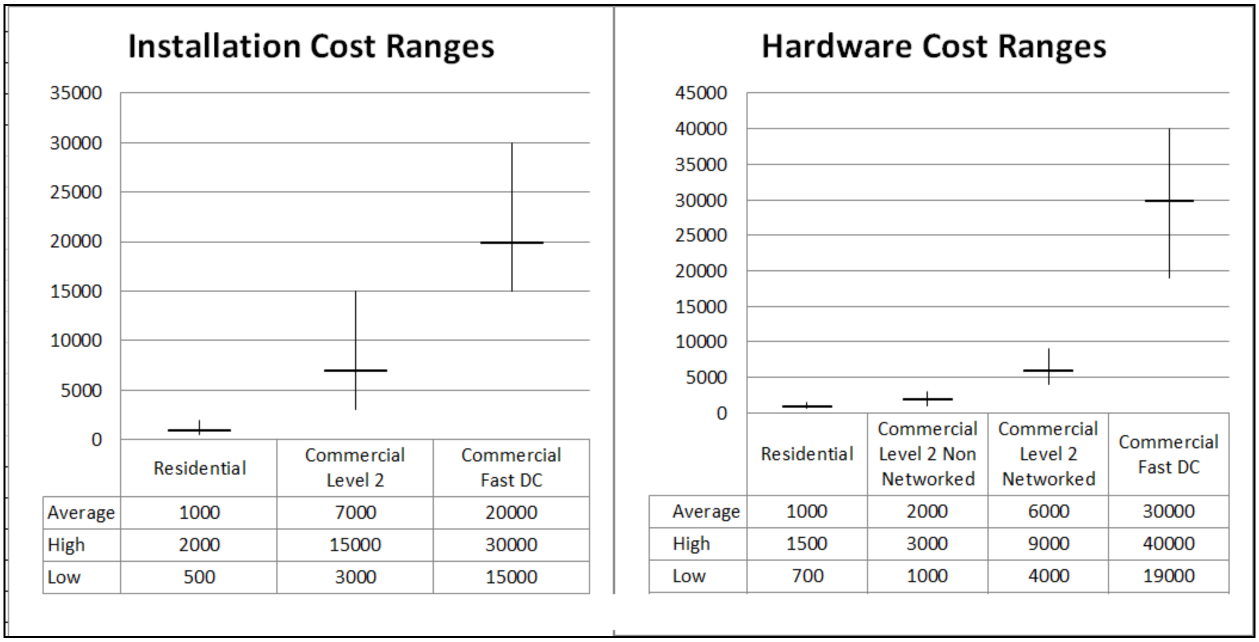
The only clear and definitive resolution of this issue would be a legislative change to the definition of a "public utility" that exempts third-party retail recharging stations. Fortunately, significant precedent for this type legislation exists in other states. For example, Maryland[6] and Virginia[7] have passed legislation exempting third-party retail charging stations from regulation as a "public utility."

3.8 Estimate of EVSE costs and potential funding

EVSE costs can range from $500 to over $30000, excluding installation. Installation can range similarly. The type of charging station and the capabilities drive the costs. It is important for the purchaser to understand the options and their charging needs before purchasing. See Exhibit 3-7 for more information.

Potential funding sources include but are not limited to: TIGER Grants, Ecotality, EV projects with the Department of Energy, Coulomb Charge Program, Stimulus and other federal grants, settlements such as State of California & Nevada Geothermal Power, U.S. military, state funds, municipal funds, venture funding and state rebates.

2Ogg v. Mediacom, L.L.C., 142 S.W.3d 801, 813 (Mo. App. W.D. 2004) (footnote omitted); see also R.S. Mo .§ 393.140.
3R.S.MO. § 386.020.
4R.S.MO. § 386.020(15).
5R.S.MO. § 386.020(14).
6"MD. Code 1-100(A) As Amended by S.B. 997." *State of Maryland*. N.p., n.d. Web. 10 Dec. 2012. <http://mlis.state.md.us/2012rs/chapters_noln/Ch_631_sb0997T.pdf>.
7Virginia Code § 56-232.2.



	Residential	Commercial Level 2	Commercial Fast DC
Average	1000	7000	20000
High	2000	15000	30000
Low	500	3000	15000

	Residential	Commercial Level 2 Non Networked	Commercial Level 2 Networked	Commercial Fast DC
Average	1000	2000	6000	30000
High	1500	3000	9000	40000
Low	700	1000	4000	19000

Exhibit 3-7 Cost ranges for Residential (Level 1), Commercial (Level 2) and Commercial Fast DC EVSE.

3.9 Fast DC Charging Standards

There are two competing fast DC charging standards. When purchasing and installing Fast DC charging stations be aware of the differences.

CHAdeMO is a Japanese standard currently used by the Nissan Leaf and the Mitsubishi MiEV. No US branded manufacturers currently support this standard.

SAE J1772 Combo Plug is a standard developed by the Society of Automotive Engineers in the US and supported by US branded auto manufactures and some European Manufacturers. No auto manufacturers are currently producing vehicles that utilize this plug.

In the US only the Leaf and the MiEV support fast DC charging and use the CHAdeMO standard. Remaining plug-in vehicles in the US have no fast charging port option on the vehicle today.

Some manufactures of CHAdeMO stations are stating that they will offer upgrades to their stations to either add an SAE port or replace the CHAdeMO port with an SAE port depending on how the market unfolds. Pricing is not known.

The dilemma is whether to install a CHAdeMO station now that can only charge a few cars or wait until a standard in the US emerges that can charge all cars.

Recommendations:

If you value providing the ability for some cars to fast charge now and can live with the uncertainty of possibly upgrading in the future, purchase/install a CHAdeMO station now. This option maximizes your community readiness efforts.

If you value certainty and ability to fast charge all vehicles rather than just a subset, then wait till a standard emerges in the US. This option minimizes your risk for upgrades, but minimizes your community readiness effort effectiveness.

3.10 About the Author

Troy Carlson is a business executive with 25 years of diverse business development and leadership experience. He has a proven track record for driving business growth and increasing market share in a competitive environment. Throughout his career, he has consistently taken various businesses to the next level through vision, strategic planning and execution. He led a business development project with a consortium of construction labor and management groups called the Kansas City Construction Partners (KCCP) where he received the Labor Management Cooperation Leadership Award. Mr. Carlson also led the establishment of the Kansas Logistics Park that now serves as the foundation for the wind energy manufacturing and logistics industry cluster. In 2009, he helped land its first client: a $66million wind energy manufacturing facility that will employ over 400 people. Mr. Carlson graduated Magna Cum Laude with a BA from Wichita State University. His professional affiliations include selection as a “40 under 40” business leader in 2001 by the Wichita Business Journal, 2000-2002 Past Chairman of the Wichita Area Outlook Team for the Center for Economic Development and Business Research, 1997 Past President for the Central Kansas Association of Health Underwriters, current member of KansasBio, MoBio, the Better Business Bureau of Greater Kansas City and a member of the Greater Kansas City Chamber of Commerce. Mr. Carlson understands the challenges and rewards of leading and managing a profitable business from both the top and bottom lines.

Larry Kinder is the CEO and founder of LilyPad EV, a provider of electric vehicle charging stations. Mr. Kinder is committed to a cleaner world with increased energy independence by using domestic electricity as a transportation fuel in a manner that makes solid business sense. He formed LilyPad EV to help create the charging infrastructure needed by drivers of plug-in electric vehicles that are arriving from almost all auto manufacturers.

He doesn’t just ‘talk the talk’; he ‘drives the drive’. Having driven over 14,000 electric miles, Mr. Kinder is a knowledgeable electric transportation advocate and entrepreneur striving to help communities, businesses, and individuals benefit from electric transportation.

The LilyPad EV team has worked with many customers, large and small, to purchase, install and maintain electric charging stations. Mr. Kinder regularly speaks to communities and organizations to educate and help prepare them for plug-in readiness, economic growth, and a cleaner, greener future.

Kansas City Regional Clean Cities Coalition Administered by Metropolitan Energy Center, the coalition is a public-private partnership among fleet managers and manufacturers, vendors and service providers in the alternative fuels and vehicle industries. It works in communities across Kansas and in western Missouri. Kansas City's coalition is a partner since 1998 with the U.S. Department of Energy's Clean Cities Program, whose mission is to advance the energy, economic, and environmental security of the United States by supporting local actions to reduce petroleum use in transportation. The coalition administers more than $40 million in clean transportation projects in Kansas, Missouri, Iowa and Nebraska. For more information visit www.metroenergy.org/kccleancities.aspx.About

Metropolitan Energy Center is a nonprofit organization with a threefold mission to create resource efficiency, environmental health, and economic vitality in the Kansas City region. Over the past three decades, MEC has grown to be a recognized catalyst for regional energy partnerships that satisfy the triple-bottom-line approach. Founded in 1980, MEC is a catalyst for community partnerships focused on energy conservation. It works through a variety of educational and training programs, including Kansas City Regional Clean Cities Coalition, Home Performance, Project Living Proof and EnergyWorks KC. Every energy dollar conserved through MEC's work remains available for investment in the local economy. MEC was awarded more than $17 million in federal funding for transportation projects in recent years and is a partner in other multi-million-dollar projects in Kansas and Missouri. MEC has been the recipient of many awards recognizing its contribution to energy conservation and was host of the national Affordable Comfort Conference in 2003 and 2009