Iowa Clean Cities Coalition

IOWA economic development

Advancing Iowa's Electric Vehicle Market

July 2016

Contents

Executive Summary

The Iowa Economic Development Authority (IEDA) commissioned a study on electric vehicle charging to assess the current electric vehicle (EV) market, forecast future market conditions and evaluate programs and policies that could potentially help the market meet these projections. The EV market in Iowa has grown to more than 1,000 EVs in the first half of 2016, compared to 3.4 million total registered vehicles in the state.[1] This growth can be attributed to an emerging number of charging stations, drivers who want to diversify their fuel options and leadership in both the public and private sectors working to expand the range of EVs in Iowa. The *Advancing Iowa's Electric Vehicle Market* report indicates that, despite it being early in the market adoption phase, EVs are poised to grow in the coming decades due to the declining costs of batteries and vehicles, an increasing percentage of renewable energy in the state's electricity mix, the expanding number of charging stations and automobile manufacturers' adherence to fuel economy standards. With this growth, there is ample opportunity to strategically advance the vehicle charging network through a combination of public and private investment, policies and programs.

To advance continued growth of EVs in Iowa, there are a number of market barriers that can be addressed through strategic policy and programmatic solutions. Some basic obstacles that the local EV market faces include vehicle range, cost of vehicles, cost of charging infrastructure and consumers' range anxiety. While the majority of EV charging takes place at home, publicly available charging stations are key to eliminating range anxiety for prospective EV owners. National studies have shown that consumers can be apprehensive about the availability of charging stations, including the number of publicly accessible locations, the availability of charging opportunities at their places of work and a lack of EV fast-charging stations that enable them to drive longer distances using interstate highways. To assist in the build-out of this network of charging stations, the Electric Vehicle Charging Station Ownership and Operational Responsibilities section of this report provides an overview of what can be expected in terms of planning, costs and management of these sites.

This report offers a general recommendation for the minimum level of charging types for specific location categories based on the current locations of EVs, existing charging stations, and the level of charging those stations provide. The study contains maps that show which areas need additional charging stations to serve local EV drivers. The maps also identify specific locations with longer dwell times in order to fill in the gaps in the existing network. The most common chargers today in Iowa are Level 1 chargers (which provide 2–5 miles of range per 1 hour of charging) and Level 2 chargers (which provide 10–20 miles of range per 1 hour of charging). A future priority is to establish a Level 3 (which offers 50–70 miles of range per 20 minutes of charging) charging network in the form of an Electric Highway program with stand-alone points on Iowa interstates and charging stations located no farther than 50 miles apart and no farther than 1 mile from the highway. This report investigates the types of business models that would allow this build-out of EV charging to occur. The recommended option for building a more robust EV charging network will help mitigate the concerns about access to EV charging and range anxiety.

[1] "Registered motor vehicles," Iowa Department of Motor Vehicles, accessed May 2016. http://www.iowadot.gov/about/registered.html.

The policy and program recommendations to advance the EV market in Iowa are intended as a menu of optional strategies geared to support the deployment of EVs and the development of a robust charging network. These include utility-sector efforts such as allowing owners and operators of charging stations to charge customers directly for electricity consumed during charging. Other examples include the development of incentives such as loans, rebates and unique financing to drive the EV and charging-infrastructure market. Low-cost options include exemptions and benefits for EV drivers, employer and workplace charging programs, as well as engagement and outreach to auto dealerships. Infrastructure-related policies include fuel corridors, multi-unit properties in both the residential and commercial sector, and aviation facilities.

To serve entities that wish to offer charging to employees and the general public, this report offers several recommendations toward a path forward. These studies include a sample survey for employers to gauge EV interest in their worker population and a methodology for aggregating the results of the employer survey, as well as several business cases with justification for companies to offer charging for patrons. These recommendations have the potential to expand access to convenient charging in Iowa. The creation of an EV Power Purchase program can give drivers deep discounts on EVs and spur a surge in sales. Potential outreach channels include social media, conducting trainings on EVs in conjunction with existing educational opportunities and assisting stakeholders in promoting their achievements in the EV market. Maintaining focus on these outreach opportunities will allow for key audiences to learn about ways to lower the cost of EV ownership, improve access to charging, and make EV ownership more convenient.

Key groups who participated in this study included state agencies, local municipalities, county government, utilities, nonprofits, the private sector, universities, EV owners, the general public, metro planning agencies, and EV station owners and operators. This study and resulting final report position IEDA and its partners to continue their role in facilitating the market growth of EVs in Iowa through updates to existing efforts, while pursuing new avenues to mitigate driver concerns related to vehicle range, convenience and access to charging, higher up-front cost, and performance.

Introduction

Plug-in electric vehicles (EVs) provide a variety of benefits to Iowans, including reduced emissions, energy-efficient and cost-efficient transportation, use of the state's growing renewable energy from the electrical grid and protection from volatile petroleum prices. EV charging stations can bring EV travelers from out of state into Iowa and contribute to the state's economic development. In addition, development of the EV market will help create jobs in Iowa with the infrastructure build-out, as well as in EV sales and maintenance. Finally, growth in the EV market will help reduce tailpipe emissions and provide other environmental benefits to the state.

In Iowa, the EV market is growing, but there are still challenges to lowering the cost of vehicles and building a network of charging stations that can meet drivers' needs. With the EV market poised for substantial growth through 2040, it is important that the EV stakeholders in Iowa undertake effective planning and implementation efforts, including the formulation of policies and programs that support this emerging transportation area. In this study, the term electric vehicle, or EV, will include both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

IEDA offers a variety of programs and services to individuals, communities and businesses to develop commerce and grow employment in Iowa. Developing sustainable, adaptable communities ready for this growth is also an essential part of the mission at IEDA—providing programs and resources that help communities reinvest, recover and revitalize themselves to make each community's vision a reality. For the state of Iowa, this vision is complementary with the use and deployment of EVs and their associated economic, environmental and energy benefits.

The purpose of the *Advancing Iowa's Electric Vehicle Market* report is to provide a framework for implementing effective policies and programs, as well as to identify other opportunities that stakeholders could pursue to facilitate EV adoption in Iowa. The intention of this study is for program managers, policymakers and other parties to use it as a tool to facilitate discussions on developing an effective statewide EV and charging infrastructure strategy. IEDA funded this study through the U.S. Department of Energy's (DOE) State Energy Program.

Assessment of Current EV Market

The following section analyzes the existing public EV charging infrastructure in Iowa and provides data on the current number of EVs on the road throughout the state.

Current Public EV Charging in Iowa

When looking at EV charging stations, it is important to understand the different types. Level 1 provides charging through a standard 120-volt (V) alternating current (AC) plug and will provide an EV around 2–5 miles of range for each hour of charging time. Level 2 charging equipment uses a 240-V or a 208-V plug and provides about 10–20 miles of range per hour of charging time. Direct current (DC) fast-charging equipment, also called Level 3, uses DC rather than AC to enable rapid charging, providing 50–70 miles of range per 20 minutes of charging time.[2]

As of March 2016, DOE's Alternative Fuels Data Center (AFDC) identified 76 public EV charging stations in Iowa.[3] AFDC's charging station locator is very useful and allows users to search for all types of alternative fuel stations. Adding stations to the AFDC website can take some time, however, and requires a level of responsiveness from the station owner; therefore, the data were cross-referenced with information from PlugShare.com, which allows EV drivers and users to upload station locations with accompanying information.[4] This effort identified an additional 20 public EV charging stations. This number combined with the AFDC list resulted in a total of 96 stations in Iowa. Of these 96 stations, there were 38 Level 1 charging outlets, 155 Level 2 outlets and 13 Level 3 outlets—the Level 3 outlets all appear to be Tesla superchargers. It is also notable that 20 of the 96 stations are located at car dealerships.

At least 26 of the 96 stations were identified as being ChargePoint, an EV infrastructure company that operates the world's largest EV charging network, offering both charging station equipment and a supporting network and mobile application.[5] Using these stations does require the EV driver to create, at no cost, an account with ChargePoint, and while the equipment is capable of charging customers an EV charging fee, the study found that all the ChargePoint charging stations in Iowa offer free charging.[6] In fact, this study only identified three charging stations in Iowa that charge customers a fee for charging their EVs, two of which were located at recreational vehicle (RV) campgrounds, and the other at a parking ramp in Des Moines, which offers charging at metered spots that cost $2.50 per hour. The decision to charge customers, in the case of the RV campgrounds, is likely due to the fact that these

[2] "Developing Infrastructure to Charge Plug-In Electric Vehicles," U.S. Department of Energy, Alternative Fuels Data Center, last modified January 11, 2016, accessed June 2016, http://www.afdc.energy.gov/fuels/electricity_infrastructure.html.

[3] "Alternative Fueling Station Locator," U.S. Department of Energy, Alternative Fuels Data Center, last modified June 21, 2016, accessed March 2016, http://www.afdc.energy.gov/locator/stations/.

[4] PlugShare, accessed March 2016, http://www.plugshare.com/.

[5] "Driving a Better Way," ChargePoint, accessed May 2016, http://www.chargepoint.com/about/.

[6] Research using information and user comments from the interactive maps on ChargePoint.com and PlugShare.com on whether stations were free or charged a fee, accessed May 2016.

campgrounds are already familiar and comfortable with imposing daily or hourly fees on vehicles for parking at their facilities and using their electrical outlets.

In addition, this project looked at public EV charging currently available in other states that share a greater metropolitan area with Iowa cities. These included Omaha, Nebraska, which borders Council Bluffs and Moline, and Rock Island, Illinois, which is part of the greater Quad Cities area. Using the AFDC data, ChargePoint data, and PlugShare data, the study found one public charging station located in

Figure 1: Locations of EV public charging stations in Iowa

[7] "Alternative Fueling Station Locator," U.S. Department of Energy, Alternative Fuels Data Center, search for "Electric" stations in Iowa, accessed March 2016, http://www.afdc.energy.gov/locator/stations/.

[8] PlugShare station locator, PlugShare, accessed June 2016, http://www.plugshare.com/.

[9] ChargePoint station locator, ChargePoint, accessed June 2016, https://na.chargepoint.com/charge_point.

[10] PlugShare station locator, PlugShare, accessed March 2016, http://www.plugshare.com/.

Rock Island, four public stations in Moline, and eight public stations in Omaha.[7,8,9] Almost all of these stations also offered free charging, with one station offering free charging within a pay-for-parking garage.[10]

Revenue Streams

Almost all public charging stations in Iowa offer free charging, most likely because non-utility entities are not legally allowed to charge directly for the sale of electricity—including electricity used to charge a car—in Iowa on a per-kilowatt-hour (kWh) basis. Although some alternative approaches are possible (for example, RV campgrounds impose an hourly or daily fee for parking and then offer charging as part of the fee), free charging also is influenced by the relatively small number of EVs that are currently on the road in Iowa. This small number of drivers implies that the actual cost of the electricity used by the charging stations is negligible to the business' overall operating costs and the value that it sees in offering the electricity for free. Assuming that an EV such as the Nissan LEAF would require 30 kWh to travel 100 miles, it would cost approximately $2.70 to fully charge the EV at the commercial electricity rates in Iowa. Many customers might not stay long enough for a full charge, too, depending on the type of business offering the charging and the typical dwell time. Businesses generally consider incurring this charge per customer, rather than imposing a fee for parking at the station, to be well worth the loyalty that they gain from customers in return.

Businesses that have paid to install a public charging station may also offer free charging because they are interested in strengthening their brand image and building a better relationship with their customers.[11] Offering EV charging shows a business' commitment to "green" or environmental issues, and some customers are more inclined to shop at businesses that share their environmental values.

It is unclear if, in the near future, businesses will plan to incorporate ways to reimburse the business for electricity costs from EV charging, which could include assessing flat fees or hourly fees to park at the station or through other means. It is also unclear if there is a tipping point where businesses will view the cost of offering free EV charging as greater than the benefit.

Current EV Registrations in Iowa

- 80 in Des Moines
- 70 in Ankeny
- 60 in West Des Moines
- 48 in Iowa City
- 47 in Cedar Rapids
- 41 in Urbandale
- 45 in Ames
- 32 in Dubuque
- 21 in Davenport
- 19 in Decorah
- 17 in Cedar Falls
- 17 in Marion
- 17 in Johnston
- 16 in Sioux City
- 16 in Bettendorf
- 15 in Clive
- 13 in Fairfield
- 13 in Waukee
- 12 in Council Bluffs
- 10 in Altoona
- 10 in De Witt
- 10 in Grinnell

[11] U.S. Department of Energy, *Plug-In Electric Vehicle Handbook: for Public Charging Station Hosts*, 2013, 9, http://www.afdc.energy.gov/pdfs/51227.pdf.

[12] Based on registration data received via personal communication from Iowa Department of Transportation as of June 2016.

As of June 2016, the Iowa Department of Transportation identified 163 BEVs and 854 PHEVs registered in the state, totaling 1,017 EVs in Iowa.[12] The following list highlights the cities in Iowa with more than 10 EVs:

Since there are approximately 1,000 zip codes in Iowa, breaking EV registration down by zip code rather than by city can provide a more granular picture. This analysis used the Jenks Natural Breaks classification method to establish EV ranges for analysis by zip code, which is a method that tries to minimize the variance within classes and maximize the variance between classes by looking at the standard deviations within and between the classes.[13] The results indicated that there are 190 zip codes in Iowa with 1–3 registered EVs, 49 zip codes in Iowa with 4–11 registered EVs, 19 zip codes in Iowa with 12–23 registered EVs and 3 zip codes in Iowa with 24–40 registered EVs.

Additionally, the Omaha-Council Bluffs Metropolitan Area Planning Agency provided EV registration data for the Omaha area by zip code, and 204 EVs were identified within the city of Omaha's zip codes, which especially impacts EV travel in western Iowa.[14] Despite being in different states, the economies and markets of Omaha and Council Bluffs are closely connected as they jointly make up the larger metropolitan area. Therefore, understanding the EV market in Omaha is important for having the full picture of Council Bluffs' EV market, and vice versa.

[13] Rick Jones, "GIS Data Classification in Cartographica," Cartographica, August 16, 2010, http://blog.cartographica.com/blog/2010/8/16/gis-data-classifications-in-cartographica.html.

[14] Omaha - Council Bluffs Metropolitan Area Planning Agency, data provided via personal communication in May 2016.

Figure 2: EV density by zip code

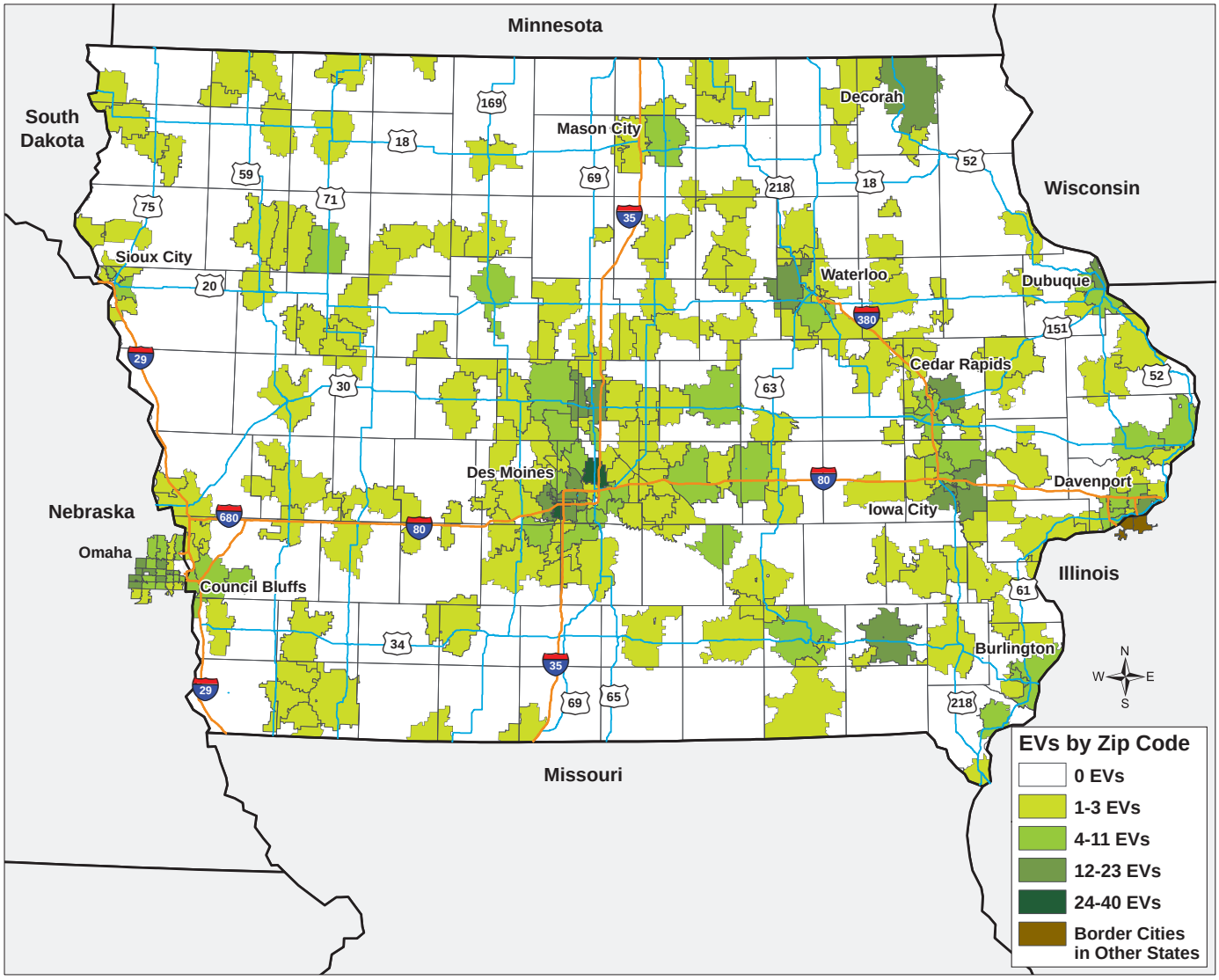
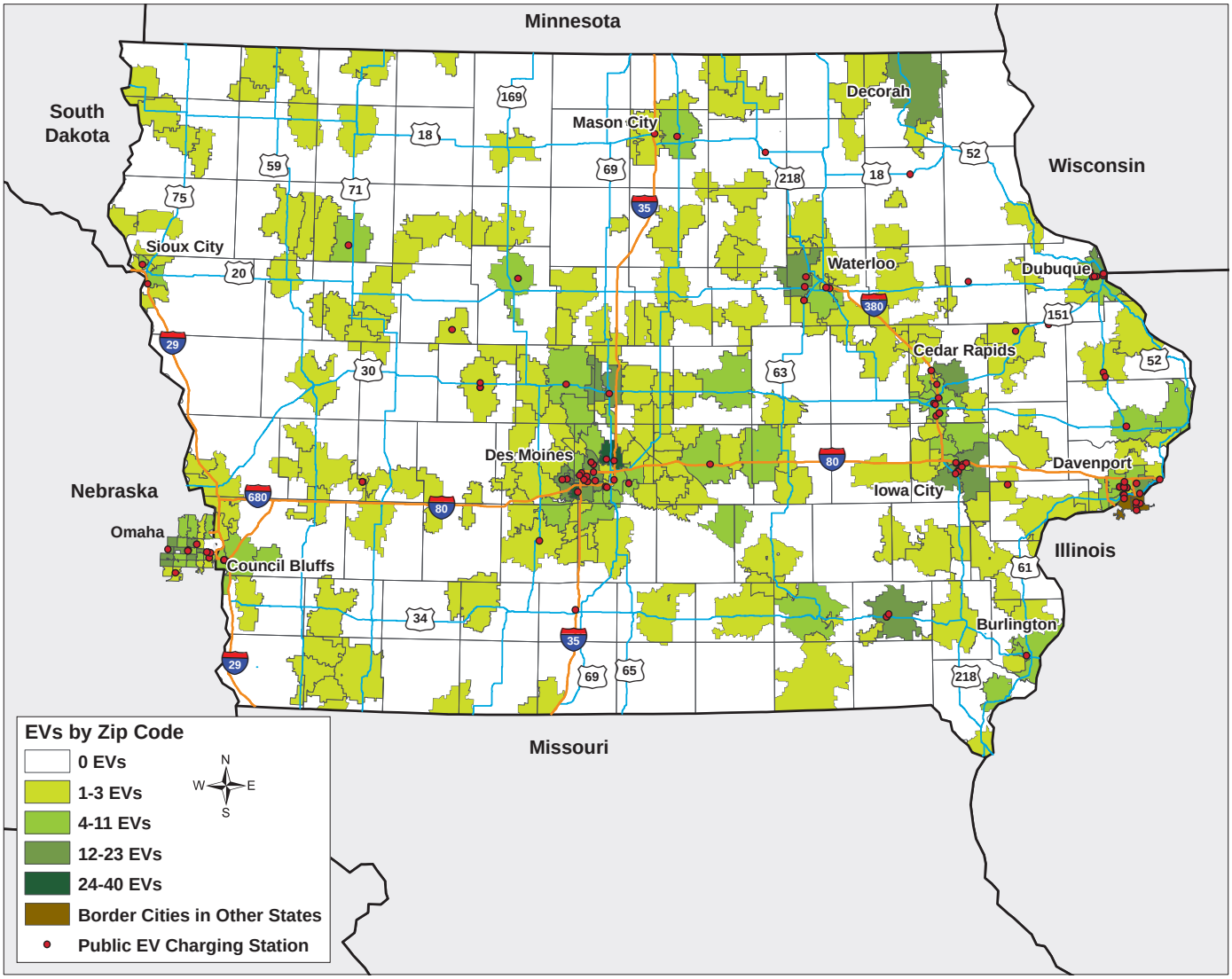


Figure 3: EV density by zip code with public EV-charging stations

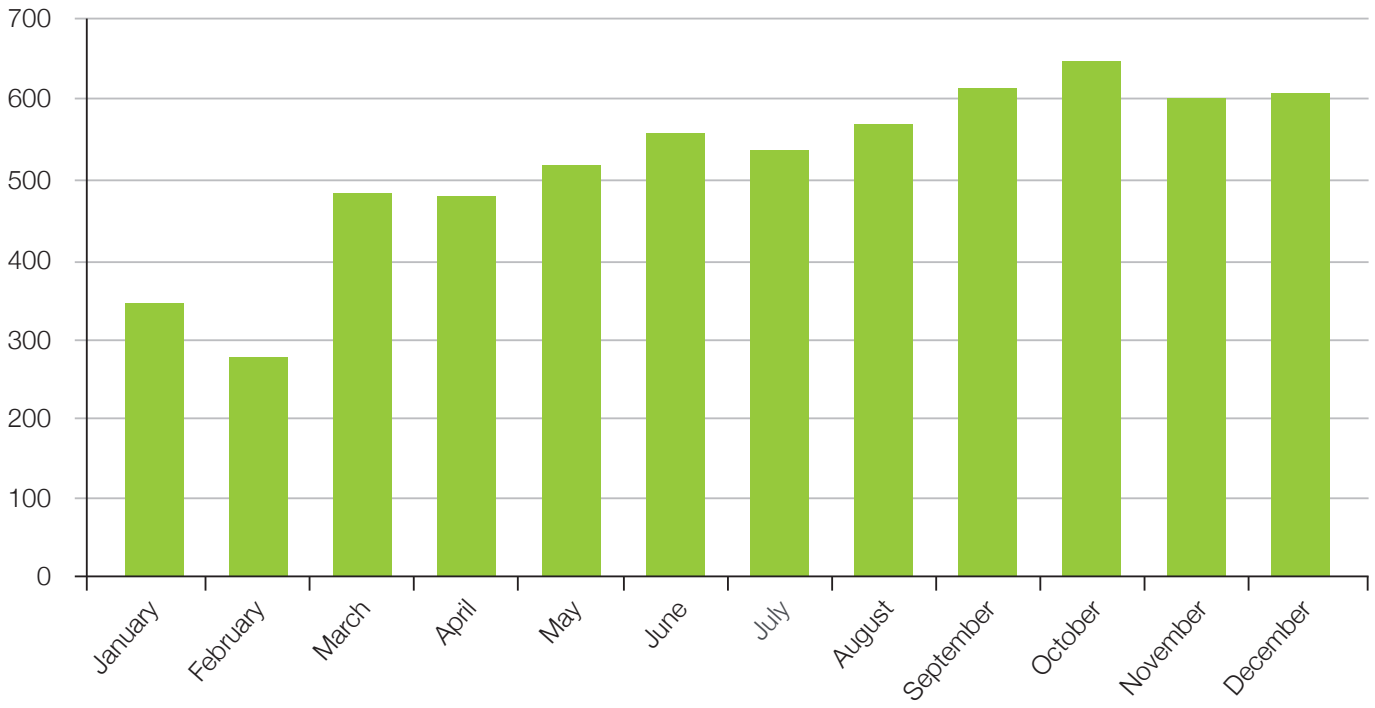


Iowa ChargePoint Station Analysis

As part of this study, ChargePoint provided anonymous state-level statistics on public charging at its stations.[15] This data showed that more than 99 percent of the charging events were Level 2-type charging (as opposed to Level 1). There were more than 6,200 charging sessions in 2015 in Iowa with an average of 113 unique visitors each month. The chart in Figure 4 shows the number of charging sessions per month for 2015.

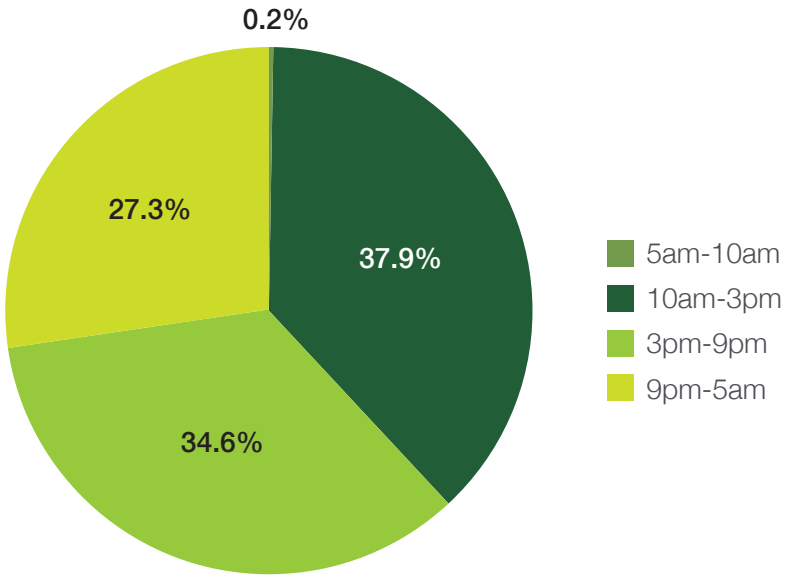
[15] This data was provided by ChargePoint via personal communication on May 27, 2016.

Figure 4: 2015 monthly ChargePoint sessions in Iowa



The ChargePoint data also shows that 37.9 percent of the sessions occurred between 10 a.m.–3 p.m., 34.6 percent of the sessions occurred between 3–9 p.m., and 27.3 percent of the sessions occurred between 9 p.m.–5 a.m. Only 0.2 percent of the sessions occurred between 5–10 a.m. This shows that nearly no public charging takes place in the morning, while just more than two-thirds takes place during the day and less than one-third takes place overnight. Figure 5 below shows this breakdown.

Figure 5: 2015 public charging by time of day in Iowa



The average time that an EV was connected to a ChargePoint station was 300 minutes (or 5 hours), while the average time that an EV was charging was 98 minutes (or 1 hour and 38 minutes), meaning that the EVs were only charging for 32.6 percent of the time that they were connected to the station.

In addition, ChargePoint data revealed that the EVs used an average of 5.5 kWh per session in 2015. At the average commercial rate of 9.05 cents/kWh, this means that each charging session would cost the business $0.50.[16]

[16] "Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through December 2015 and 2014 (Cents per Kilowatthour)," *Electric Power Monthly with Data for December 2015*, U.S. Energy Information Administration, accessed March 2016, page 126, https://www.eia.gov/electricity/monthly/current_year/february2016.pdf.

Electricity Rates and Impacts

In 2015, Iowa consumed 46,738 million kWh, with the residential sector specifically consuming 13,595 million kWh and the commercial sector consuming 12,072 million kWh.[17] Iowa's average retail price of electricity for the residential sector for 2015 was 10.61 cents/kWh and 9.05 cents/kWh for the commercial sector, ranking it 17th in the U.S. in terms of cheapest commercial electricity prices.[18]

As of 2014, Iowa had 182 utilities that provide service to 1.58 million customers. The Iowa Utilities Board (IUB) provides a clear picture of the number of utilities by type in Iowa, along with the number of customers and total sales, shown in Table 1 below.[19]

Table 1: Iowa Utility Information (2014)

Utility Type	# of Utilities	# of Customers	% Customers	MWh Sales	% Sales
Investor-Owned Utility (IOU)	2	1,142,515	72.26%	35,204,282	74.51%
Municipal Utility (Muni)	136	211,619	13.38%	5,376,386	11.38%
Rural Electric Cooperatives (REC)	44	227,023	14.36%	6,664,966	14.11%
Total	**182**	**1,581,157**	**100.00%**	**47,245,634**	**100.00%**

Time of Use Pricing

To understand the cost to drive an EV, it is important to look at the price of the electricity and how that price is delivered to the consumer. Some utilities offer pricing programs where the cost of electricity depends on the time of day when it is used. These are called "Time of Use" (TOU) pricing programs. TOU pricing programs allow customers to shift their usage to lower peak times and save money. This, in return, shifts the utilities' demand away from periods of peak demand, easing the need for expensive infrastructure upgrades.

A TOU program could help EV owners charge their EVs overnight at a lower electricity rate, but a full analysis of their individual electricity demand and usage throughout the day would be needed in order to determine if a TOU program will ultimately save money for EV owners or business offering EV charging. This is especially the case if a TOU program charges higher-than-normal rates for the electricity used during peak hours. This means that while charging an EV during off-peak hours could save money throughout the year, if the residence or business was also required to use significant amounts of

[17] "Electricity Sales (Consumption), Revenue, Prices & Customers," U.S. Energy Information Administration, accessed March 2016, http://www.eia.gov/electricity/data.cfm#sales.

[18] "Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through December 2015 and 2014 (Cents per Kilowatthour)," *Electric Power Monthly with Data for December 2015*, U.S. Energy Information Administration, accessed March 2016, page 126, https://www.eia.gov/electricity/monthly/current_year/february2016.pdf.

[19] "Iowa's Electric Profile (2014)," Iowa Utilities Board, accessed May 2016, https://iub.iowa.gov/electric-profile.

electricity during peak hours (for air conditioning for example), then any savings from the EV charging could be offset by the higher charges incurred from other appliances and equipment. TOU programs could be especially beneficial if utilities allowed customers to have separate meters for EV charging that could be enrolled in the TOU program without impacting the rate of the original meter.

In 2014, the U.S. Energy Information Administration (EIA) identified 12 electric utilities in Iowa that offer a TOU pricing program to residential or commercial customers—this was the only type of dynamic pricing program offered in Iowa (as opposed to real time pricing, variable peak pricing, etc.).[20] Table 2 shows these 12 utilities offering TOU programs in Iowa, as well as which type of utility they are, which type of customers are eligible to participate in each program, and the number of customers participating.

Table 2: Utilities with TOU Programs in Iowa

Utility Name	Type	Time of Use Pricing Program			
		Residential		Commercial	
		Availability?	Customers Enrolled	Availability?	Customers Enrolled
Chariton Valley Electricity Cooperative, Inc.	REC	N	0	Y	1
Eastern Iowa Light & Power Cooperative	REC	Y	112	Y	27
Harlan Municipal Utilities – Iowa	Muni	N	-	Y	12
Hawkeye Tri-County Electricity Cooperative, Inc.	REC	N	-	Y	8
Heartland Power Cooperative	REC	Y	6	Y	26
Indianola Municipal Utilities	Muni	Y	36	N	-
Interstate Power and Light Company	IOU	Y	16,290	Y	5,318
Linn County REC	REC	Y	41	Y	182
Consumers Energy	REC	Y	223	Y	21
MidAmerican Energy Company	IOU	Y	13	Y	738
Midland Power Cooperative	REC	N	-	Y	11
Waverly Municipal Electric Utility	Muni	N	-	Y	1

[20] "Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files: Final 2014 data," U.S. Energy Information Administration, released October 21, 2015, http://www.eia.gov/electricity/data/eia861/index.html.

As can be seen from the table, Interstate Power and Light Co., which is a public utility held by Alliant Energy Corporation, accounts for 97.4 percent of residential TOU pricing and for 83.8 percent of commercial TOU pricing in Iowa. Alliant and MidAmerican are the two investor-owned utilities (IOUs) that account for 72 percent of the electricity customers in Iowa.

With Alliant's TOU rate program, commercial customers are billed at 40 percent of the energy charges (50 percent for residential customers) during off-peak times, while peak times are billed at 140 percent of the energy charges. A small additional service charge is billed per meter, and a minimum term of 1 year is required.[21]

In other parts of the country, some utilities, such as San Diego Gas and Electric in California, have started offering specific TOU programs for EV charging. This program, which was launched in 2015, allows customers to install a separate meter for EVs, and this electricity is tracked separately and charged according to the EV-TOU program.[22]

Cost of Charging EVs in Iowa

Assuming 12,500 miles per year of travel (based on Iowa's average vehicle miles traveled [VMT])[23] and EV efficiency of 0.34 kWh/mile,[24] an EV would use 4,250 kWh per year on average in Iowa. Iowa's average commercial electricity rate was 9.05 cents/kWh in 2015.[25] Therefore, the cost to charge an EV would be $385 per year at this average commercial rate. Since Iowa's average residential rate was 10.61 cents/kWh, this means it would cost $451 per year to charge an EV at this residential rate. Assuming that a typical gasoline vehicle gets 23 miles per gallon and that gasoline costs $2.50 per gallon, it would cost an average of $1,272 per year for an Iowa driver to fill up his or her car with gasoline.[26]

Figure 6 highlights these potential average costs of driving in Iowa by comparing the average historical cost of gasoline in Iowa (6-year average from 2010–2015) with the cost of charging an EV at the average residential rate in Iowa for 2015, as well as the average commercial rate in Iowa for 2015.

---

[21] Interstate Power and Light Electric Tariff, Alliant Energy, February 15, 2016, http://www.alliantenergy.com/wcm/groups/wcm_internet/@int/@tariff/documents/document/mdaw/mde1/~edisp/015421.pdf.

[22] "EV Rates," San Diego Gas and Electric, accessed March 2016, http://www.sdge.com/clean-energy/ev-rates.

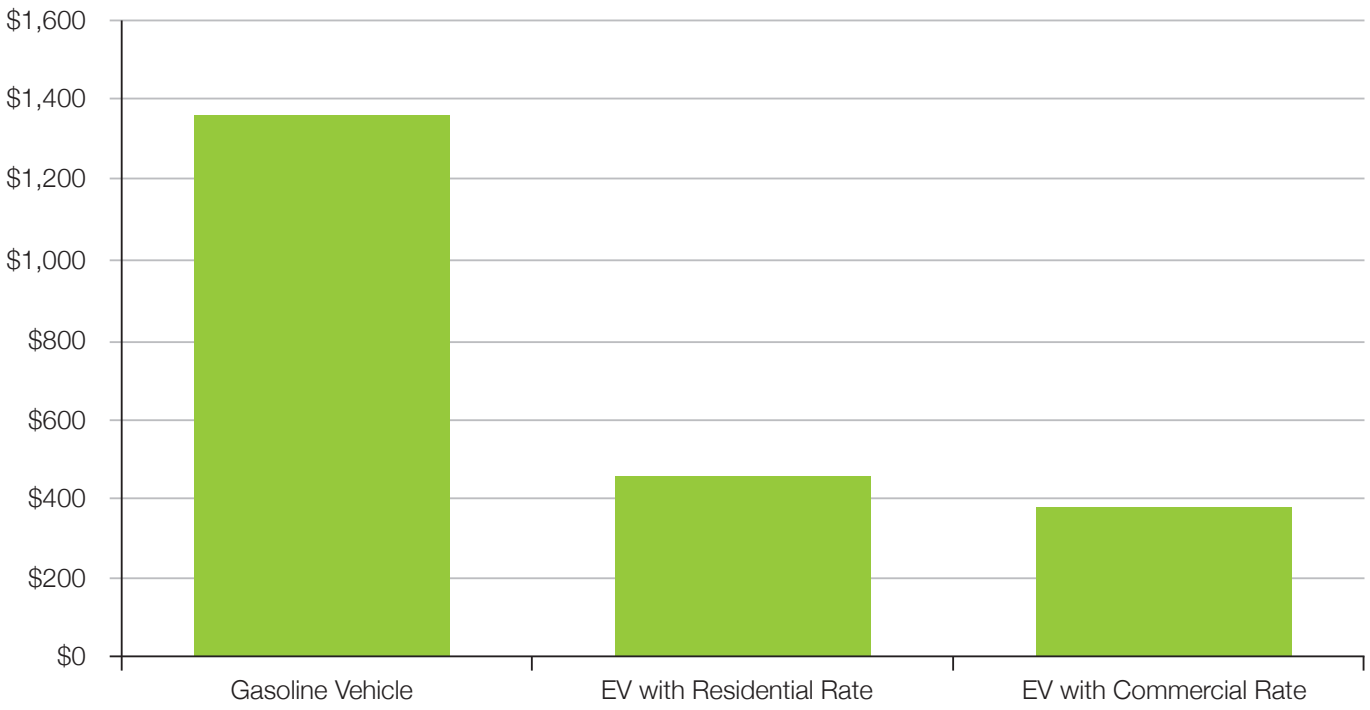
[23] "Iowa 2014 Annual Vehicle Miles of Travel," Iowa Department of Transportation, revised June 2015, http://www.iowadot.gov/maps/msp/vmt/clvmt14.pdf. The Iowa Department of Transportation's 2014 statistics show 28,020,000,000 Annual VMT for cars, pickup trucks and vans and 2,241,393 licensed drivers in 2014, which averages to 12,501 annual VMT for cars, pickup trucks and vans per driver in Iowa.

[24] Don Anair and Amine Mahmassani, *State of Charge: Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States*, Union of Concerned Scientists, June 2012, http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/electric-car-global-warming-emissions-report.pdf.

[25] "Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through December 2015 and 2014 (Cents per Kilowatthour)," *Electric Power Monthly with Data for December 2015*, U.S. Energy Information Administration, accessed March 2016, page 126, https://www.eia.gov/electricity/monthly/current_year/february2016.pdf.

[26] "Petroleum and Other Liquids: Refiner Gasoline Prices by Grade and Sales Type," U.S. Energy Information Administration, accessed June 2016, https://www.eia.gov/dnav/pet/pet_pri_refmg_dcu_SIA_a.htm. This number is assuming that the driver drives 12,500 miles in the year with the gasoline price based on a 6-year average of gasoline prices in Iowa from 2010–2015.

Figure 6: Average annual cost of driving in Iowa



Environmental Impact of EVs in Iowa

EIA's preliminary data for 2015 show that Iowa generated 57,171,989 (megawatt-hours) MWh of electricity.[27] Iowa's wind energy accounted for nearly 18 million MWh in 2015, or 31 percent of the state's electricity generation. This makes Iowa the only state to pass the 30 percent mark for wind generation and ranks Iowa as second only to Texas in terms of total wind power generation in the nation.[28] Additionally, MidAmerican Energy, which is headquartered in Des Moines and is one of Iowa's two IOUs, announced in April 2016 that it is planning a project called Wind XI which will add up to 2,000 (megawatts) MW of wind generation in Iowa.[29] This $3.6 billion project will be MidAmerican's largest wind project as well as the largest economic development project in Iowa's history. Adding renewable energy sources like wind to the state's electricity generation profile only helps to further improve EVs' life cycle emissions and environmental impacts when compared to their gasoline counterparts.

[27] "Form EIA-923 Detailed State Data," *Electric Power Monthly*, U.S. Energy Information Administration, revised January 13, 2016, accessed May 2016, http://www.eia.gov/electricity/data/state/.

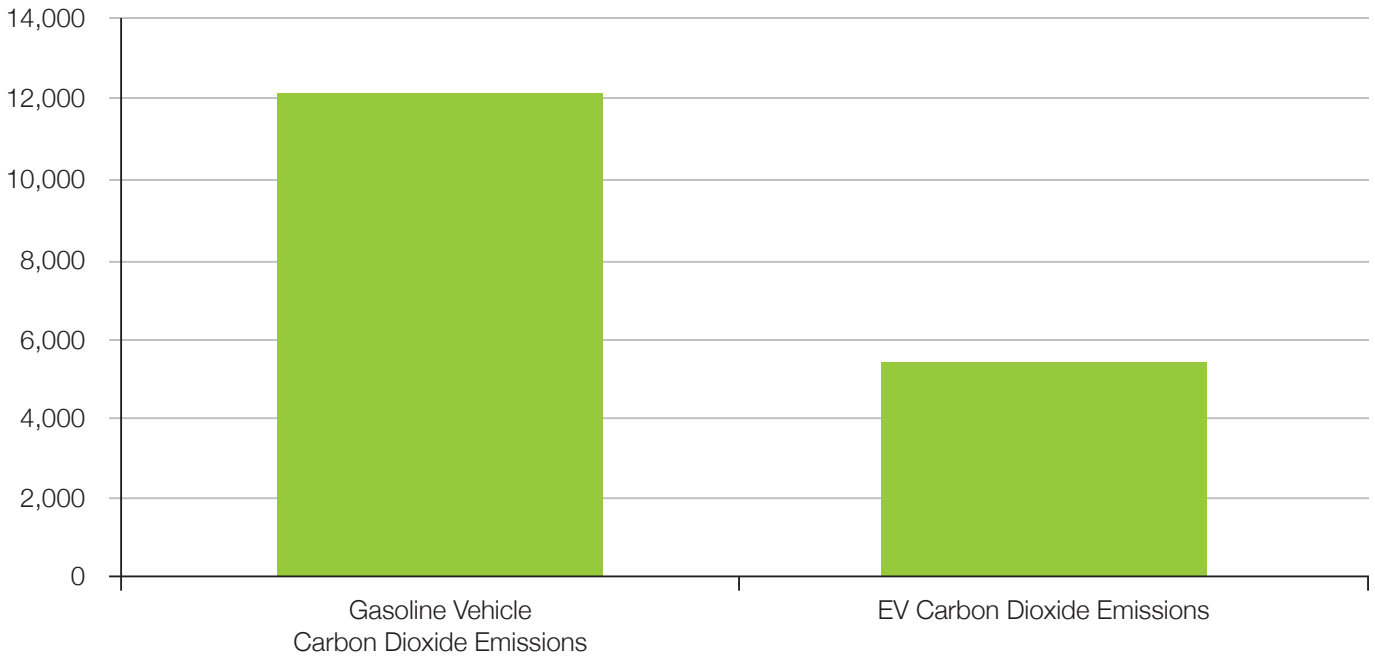
[28] "Form EIA-923 Detailed State Data," *Electric Power Monthly*, U.S. Energy Information Administration, revised January 13, 2016, accessed May 2016, http://www.eia.gov/electricity/data/state/.

[29] "Wind Energy," MidAmerican Energy, accessed June 2016, https://www.midamericanenergy.com/wind-energy.aspx.

Iowa's electricity generation in 2014 (2015 data is not yet available) produced 33,653,635 metric tons of carbon dioxide (CO_2) equivalent or 74.19 billion pounds.[30] Given this, Iowa's average emissions rate is 1.30 pounds of CO_2 per kWh of electricity. Assuming each EV in Iowa uses approximately 4,250 kWh per year, this means that each EV contributes to 5,525 pounds of CO_2 emissions.

Assuming the average gasoline vehicle produces 440 grams or 0.97 pounds of CO_2 per mile and the average Iowa driver will drive 12,500 miles each year, this would result in 12,125 pounds of CO_2 emissions.[31] An EV driver in Iowa, therefore, reduces their vehicle's CO_2 emissions by more than 50 percent when compared to the average gasoline vehicle.

Figure 7: Average annual pounds of CO_2 emissions by vehicle type



[30] "2014 Greenhouse Gas Emissions from Large Facilities," U.S. Environmental Protection Agency, FLIGHT (Facility Level Information on GreenHouse gases Tool), last updated August 16, 2015, accessed May 2016, http://ghgdata.epa.gov/ghgp/main.do.

[31] "Beyond Tailpipe Emissions: Greenhouse Gas Emissions for Electric and Plug-In Hybrid Electric Vehicles," U.S. Department of Energy, Alternative Fuels Data Center, accessed May 2016, http://www.fueleconomy.gov/feg/Find.do?zipCode=50301&year=2014&vehicleId=35207&action=bt3.

The Future of the EV Market

How EV sales will unfold in the nation and in Iowa in both the near- and long-term future depends on a number of factors, such as the pace and cost of technology development, as well as the policy and programs created to overcome existing barriers. There are informational barriers such as customers' knowledge of EV ranges and maintenance costs. There are policy barriers such as laws and regulations about reselling electricity. Additionally, Iowa dealership laws such as requirements for insurance coverage, a physical location for repairs, bonds through the state and franchises that impact the auto manufacturer Tesla.[32] (More information on these dealership laws and their impacts are discussed in the Dealerships section of this report.) There are also infrastructure barriers, including the lack of public charging stations, which prevents EV drivers from being able to go long distances in Iowa with confidence. Finally, there are significant cost barriers as the average EV costs 58 percent more compared to the average automobile.[33,34] As these barriers are overcome or eliminated however, the rate of EV adoption will accelerate.

While many advocacy groups, nonprofits, and government agencies are addressing the information and policy barriers, there are technology groups and auto manufacturers who are also working to address the cost issue. While recent EV models have had ranges around 100 miles or less and a manufacturer's suggested retail price (MSRP) between $30,000–$80,000, multiple auto manufacturers anticipate offering EVs with longer ranges in the next 1–3 years with a MSRP closer to $30,000.[35] GM's 200-mile-range Chevrolet Bolt will be available in late 2016 with an approximate $30,000 MSRP.[36] The Tesla Model 3 alone, which has a base MSRP of $35,000 and a range of more than 200 miles, received an estimated 2,000 reservations just from the state of Iowa only 4 weeks after it was revealed on April 1, 2016.[37] The U.S. as a whole has placed nearly 250,000 reservations for the Model 3, for which deliveries could begin in late 2017.[38] Additionally, many auto manufacturers anticipate delivering additional EVs to the U.S. in

---

[32] Iowa Code 2016, Section 322.2, The Iowa Legislature, accessed June 2016, http://coolice.legis.iowa.gov/Cool-ICE/default.asp?category=billinfo&service=IowaCode&input=322.2.

[33] James Healey, "Average new car price zips 2.6% to $33,560,"USA Today, May 4, 2015, http://www.usatoday.com/story/money/cars/2015/05/04/new-car-transaction-price-3-kbb-kelley-blue-book/26690191/.

[34] Stephen Edelstein, "Electric Car Price Guide: Every 2015-2016 Plug-In Car, With Specs: UPDATED," Green Car Reports, January 27, 2016, http://www.greencarreports.com/news/1080871_electric-car-price-guide-every-2015-2016-plug-in-car-with-specs-updated. The calculated current average cost of available new 2015/2016 EVs is at $53,000.

[35] "Cars," Plugincars, accessed May, 2016, http://www.plugincars.com/cars?field_isphev_value_many_to_one=pure+electric.

[36] Roland Hwang, "Future of Electric Vehicles is Bright," Natural Resources Defense Council, March 8, 2016, https://www.nrdc.org/experts/roland-hwang/future-electric-vehicles-bright.

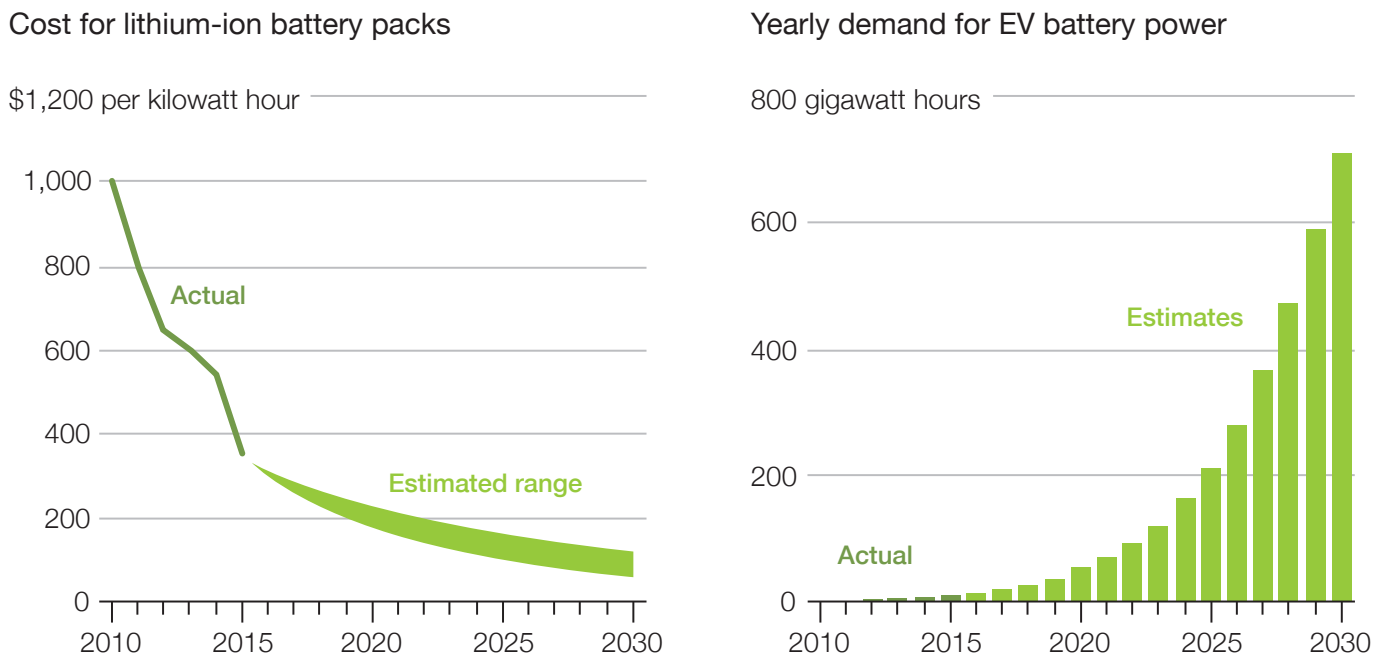
[37] Tesla Model 3 Worldwide Reservations, Ocasual, last updated May 12, 2016, accessed May 2016, http://model3.ocasual.com/#. This site uses sample data about global Model 3 reservations to estimate reservations by country and state.

[38] "Model 3," Tesla Motors, accessed May 2016, https://www.teslamotors.com/model3.

the coming years. Ford will add 13 EVs and hybrids by 2020, expecting 40 percent of its models to be electrified at that point, while Honda expects two-thirds of its models to be electrified by 2020.[39] Similarly, Audi anticipates 25 percent of its U.S. car sales to be EVs by 2025.[40]

One of the biggest challenges to date in making EVs more affordable has been the prohibitive cost of the batteries, which make up a third of the cost of manufacturing an EV.[41] The high cost of batteries is due to the research and development involved, the types of metals used, the processing and purification of the metals needed, and the advanced manufacturing required.[42] In 2015, though, battery prices fell by 35 percent, and Bloomberg anticipates the trajectory to continue to a point where EVs will be as affordable as their gas-powered equivalents by 2022.[43]

Figure 8: Historical EV battery costs and demand[44]



[39] Roland Hwang, "Future of Electric Vehicles is Bright," Natural Resources Defense Council, March 8, 2016, https://www.nrdc.org/experts/roland-hwang/future-electric-vehicles-bright.

[40] Roland Hwang, "Future of Electric Vehicles is Bright," Natural Resources Defense Council, March 8, 2016, https://www.nrdc.org/experts/roland-hwang/future-electric-vehicles-bright.

[41] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

[42] Entrepreneurship Review, "The Cost Dilemma: Why Are Batteries So Expensive?" March 14, 2011, http://miter.mit.edu/articlecost-dilemma-why-are-batteries-so-expensive/.

[43] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

[44] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

The rise of self-driving cars also brings up questions around the future growth of the EV market. While it may be too soon to fully understand how these autonomous vehicles could affect the EV market, some see the two concepts evolving in tandem. This scenario anticipates ride-sharing companies like Lyft and Uber utilizing self-driving cars, which would only strengthen the case for EVs since the lower maintenance costs of EVs would be a better fit for high-mileage (more than 20,000 miles annually) city driving.[45] In this case, the onset of self-driving cars would help to increase EV demand, bolstering the supply and reducing the costs, thereby making EVs more affordable for the public.[46] This will potentially lead to increased demand for publicly accessible charging stations.

Bloomberg New Energy Finance released a report in 2016 estimating that global EV sales could account for 35 percent of all car sales by 2040.[47] This does not mean that 35 percent of all car sales in the U.S. will be EVs because countries throughout Scandinavia and Europe, as well as China and India, could account for a bulk of the new EV sales. While the U.S. accounted for 39 percent of global EV stock in 2014, its sales in 2014 only accounted for 1.5 percent of all global EV sales, indicating how EV sales in other countries around the world are beginning to eclipse the U.S.[48]

The Future of EVs in Iowa

DOE's EIA provides regional projections for EVs in its *Annual Energy Outlook* (AEO) 2016. Iowa falls into its "West North Central" region, which also includes Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota. Overall Iowa car sales from 2012 to 2015 accounted for approximately 14.5–16.5 percent of the West North Central region's total car sales.[49] Car sales in Iowa were approximately 143,000 in 2015; if Iowa retains a 15 percent share of the region's estimated car sales, Iowa's new car sales would grow to 152,211 by 2040.

In terms of EVs, EIA's reference case for the West North Central region projects a 9.0 percent average annual growth in EV sales from 2015 until 2040, resulting in 40,663 new EV sales in 2040 for the region.[50] EIA forecasts strong growth in EV sales until 2025 (an average annual growth of 13.3 percent), before plateauing through 2028. Slower, yet steady, growth resumes in 2029 and continues through 2040 (an average annual growth of 1.7 percent).[51] This leveling off of EV sales aligns with the 2025

---

[45] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

[46] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

[47] "Electric Vehicles To Be 35% of Global New Car Sales by 2040," Bloomberg New Energy Finance, February 25, 2016, http://about.bnef.com/press-releases/electric-vehicles-to-be-35-of-global-new-car-sales-by-2040/.

[48] "Global EV Outlook 2015," International Energy Agency, 2015, http://www.iea.org/evi/Global-EV-Outlook-2015-Update_1page.pdf.

[49] "Light-Duty Vehicle Sales by Technology Type," *Annual Energy Outlook 2016*, U.S. Energy Information Administration, accessed June 2016, http://www.eia.gov/forecasts/aeo/data/browser/#/?id=48-AEO2016&cases=ref2016&sourcekey=0.

[50] "Light-Duty Vehicle Sales by Technology Type," *Annual Energy Outlook 2016*, U.S. Energy Information Administration, accessed June 2016, http://www.eia.gov/forecasts/aeo/data/browser/#/?id=48-AEO2016&cases=ref2016&sourcekey=0.

[51] "Light-Duty Vehicle Sales by Technology Type," *Annual Energy Outlook 2016*, U.S. Energy Information Administration, accessed June 2016, http://www.eia.gov/forecasts/aeo/data/browser/#/?id=48-AEO2016&cases=ref2016&sourcekey=0.

expiration of current zero-emissions vehicle (ZEV) requirements under California's Advanced Clean Car Program, which nine other states have also adopted.[52] Even though only a handful of states have adopted this program, the vehicle market of these states alone is large enough to impact the entire auto industry and its future production, which is why this effect is also seen in the EIA's forecasts for the West North Central region.[53]

One factor that is not accounted for in the EIA's forecast is the recent climate agreement coming out of the United Nations Climate Change Conference in Paris (COP21) that was signed by 174 countries in April 2016.[54] The Paris Agreement calls for more than 100 million EVs on the road globally by 2030, up from 1 million EVs on the road today.[55] To achieve the agreement's target of limiting global temperature increase to less than 2 degrees Celsius, the International Energy Agency (IEA) has projected that 140 million EVs must actually be on the road in 2030, which would account for 10 percent of global vehicles on the road in 2030.[56] In terms of U.S. country-specific contributions, the IEA set its target at 1.2 million EVs on the road by 2020, which is estimated to be 6% of all vehicles sold between 2016 and 2020.[57] While these global efforts are not guarantees, they can be beneficial to keep in mind when trying to understand the future of EVs within Iowa specifically.

Another factor that may not be fully captured in the EIA forecasts is the potential impact of Tesla launching its Model 3—since it began accepting reservations for the vehicle a mere 6 weeks before the EIA published its AEO 2016 early-release numbers. As mentioned previously, it is estimated that approximately 2,000 reservations were placed in Iowa for the Model 3.[58] Production is expected to begin at the end of 2017, with deliveries spanning 2018 and beyond.[59] Tesla's facilities have the capacity of producing 3,000 units per week, or 156,000 per year, which means deliveries of pre-reserved Model 3s will most likely extend through 2019.[60] These reservations, which required a $1,000 down payment, are refundable and can be cancelled, though, which means that they are not a perfect indicator of the future EV market.

---

[52] Email communication with John Maples, U.S. Energy Information Administration, May 24, 2016.

[53] John O'Dell, "Will California's Zero-Emissions Mandate Alter the Car Landscape?" Edmunds, May 27, 2015, http://www.edmunds.com/fuel-economy/will-californias-zero-emissions-mandate-alter-the-car-landscape.html.

[54] Pamela Falk, "U.S. joins 174 nations to sign hard-won climate pact," CBS News, April 22, 2016, http://www.cbsnews.com/news/us-climate-pact-un-signing-ceremony-paris-agreement-cop21/.

[55] United Nations Climate Change Conference, "Paris Declaration on Electro-Mobility and Climate Change & Call to Action," December 2, 2015, http://newsroom.unfccc.int/media/521376/paris-electro-mobility-declaration.pdf.

[56] "Table 3: Electric car stock targets to 2020 based on country commitments," Global EV Outlook 2016, International Energy Agency, 2016, 20, https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf.

[57] *Global EV Outlook 2016*, International Energy Agency, May 26, 2016, 20, https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf.

[58] Tesla Model 3 Worldwide Reservations, accessed May 2016, http://model3.ocasual.com/#.

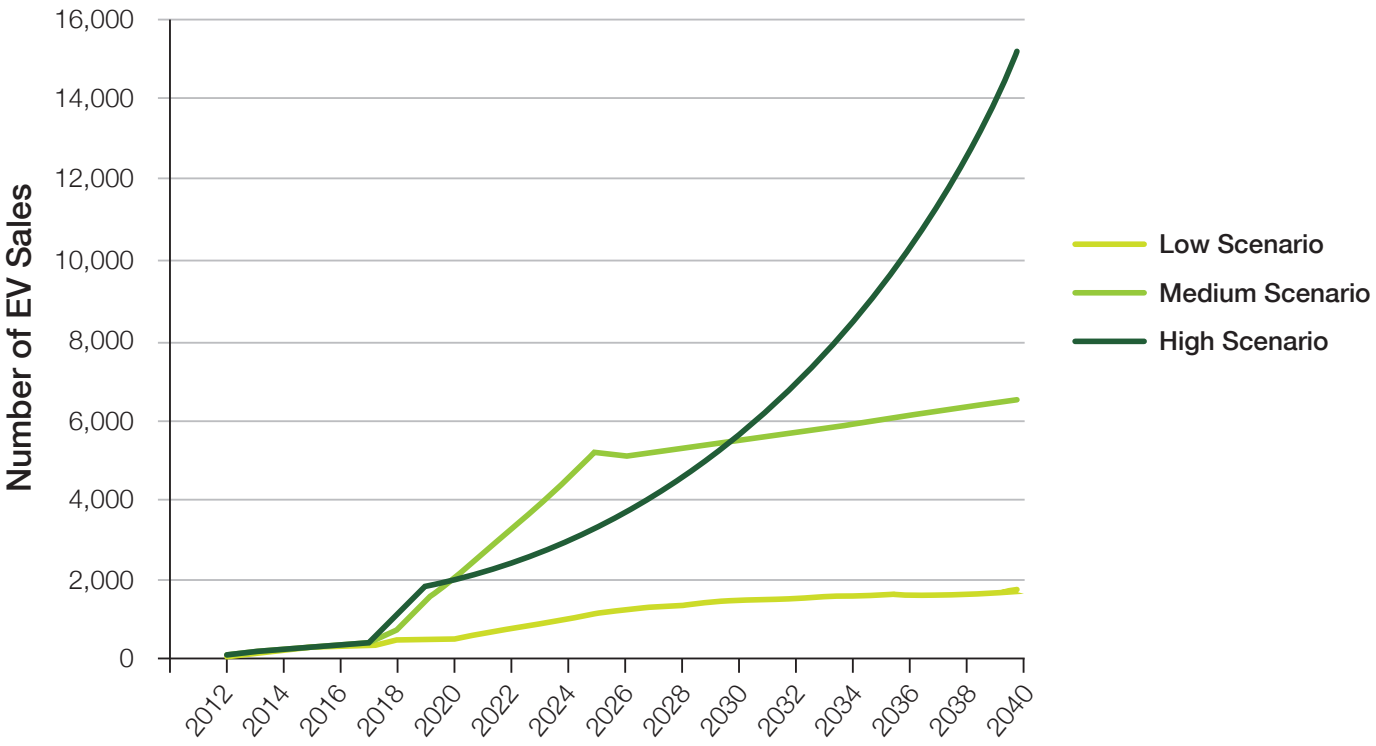
[59] Alan Boyle, "Elon Musk's Tesla Motors accelerates its production plan for Model 3 electric cars," Geek Wire, May 4, 2016, http://www.geekwire.com/2016/elon-musks-tesla-motors-speeds-production-plan-model-3-electric-cars-boosting-stock/.

[60] Fred Lambert, "Tesla confirms 'increasing its production plans to minimize the wait for Model 3'," electrek, April 7, 2016, http://electrek.co/2016/04/07/tesla-model-3-production-plans/.

Nonetheless, the implications for the Iowa EV market are quite large. Even if only 25 percent of the 2,000 reservations follow through, this would mean 500 new EVs would come online from 2018 through 2019. If the first 250 of these Model 3's are delivered to Iowa in 2018 (with the remainder being delivered in 2019), this would result in an increase in sales of more than 100 percent from 2017, where Iowa's EV sales are estimated to be around 231. Just from this one conservative scenario of only 25 percent of the anticipated Iowa Model 3 reservations being fulfilled, it is possible to see just how disruptive the Model 3 sales could be to the market.

For the purposes of this study, three different scenarios have been developed to forecast the growth of the EV market in Iowa through 2040, which are shown in Figure 9 below. All EV projections assume that an EV will be retired from the current stock after 10 years.

Figure 9: Projected EV sales in Iowa to 2040



The low scenario utilizes EIA's regional EV annual sales growth rates for Iowa and assumes that only 25 percent of the Tesla Model 3 reservations will be fulfilled in Iowa, with deliveries split between 2018 and 2019. This scenario assumes the Model 3 sales are more of an anomaly, with EV sales returning to EIA reference-case level in 2020 through 2040. In this scenario, EV sales will experience 7.9 percent average annual growth, and EVs in 2040 will account for 1.2 percent of all car sales in Iowa. The low scenario would result in more than 16,974 EVs on the road in Iowa in 2040.

The medium scenario also utilizes EIA's regional EV annual sales growth rates for Iowa, but this scenario assumes that 50.0 percent of the Model 3 reservations will materialize. It also assumes that the EV sales trend will continue after 2019, using the EIA's regional EV growth rates coupled with the higher-than-expected Model 3 sales in 2018–2019. In this scenario, EV sales will experience 15.7 percent average annual growth, and EVs in 2040 will account for 4.3 percent of all car sales in Iowa. The medium scenario would result in more than 61,935 EVs on the road in Iowa in 2040.

The high scenario assumes that EV sales will account for 10 percent of all car sales in 2040, with a steady annual average growth rate in EV sales. While seemingly high, reaching 10 percent of sales would still be far below the currently anticipated global average of 35 percent in 2040.[61] This scenario also assumes that 70 percent of the Model 3 reservations in Iowa will be delivered. In this scenario, EV sales will experience 20.0 percent average annual growth, and EVs in 2040 will account for 10 percent of all car sales in Iowa. The high scenario would result in more than 101,905 EVs on the road in Iowa in 2040.

Table 3 provides the specific number of EV sales in these scenarios over the years along with EV sales as a percent of all car sales.

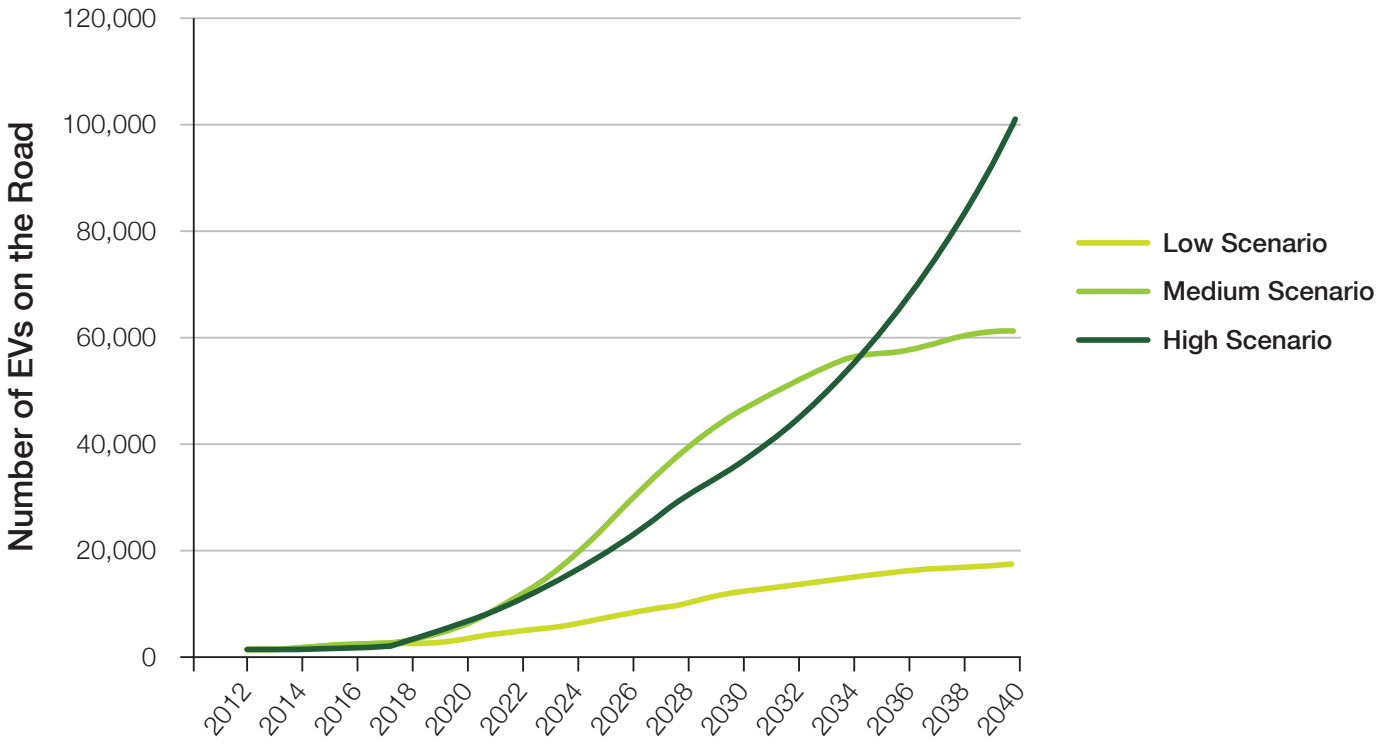
Table 3: Projected EV Sales in Iowa

		2020	2025	2030	2035	2040
Low Scenario	EV Sales	659	1,398	1,526	1,677	1,794
	Percent of All Car Sales	0.5%	1.0%	1.1%	1.1%	1.2%
Medium Scenario	EV Sales	2,137	5,266	5,661	6,157	6,552
	Percent of All Car Sales	1.5%	3.7%	3.9%	4.2%	4.3%
High Scenario	EV Sales	2,141	3,496	5,707	9,318	15,212
	Percent of All Car Sales	1.5%	2.4%	3.9%	6.3%	10.0%

[61] Tom Randall, "Here's How Electric Cars Will Cause the Next Oil Crisis," Bloomberg, February 25, 2016, http://www.bloomberg.com/features/2016-ev-oil-crisis/.

Figure 10 below shows how each of the three scenarios compare in terms of ongoing EV stock through 2040.

Figure 10: Projected EV stock in Iowa to 2040



In addition, Table 4 highlights the specific numbers for EV stock growth in these scenarios through 2040. This table also provides an estimate of the EV stock on the road as a percent of all vehicles on the road in Iowa.[62] As mentioned before, this assumes that EVs are retired from stock after 10 years.

Table 4: Projected EVs on the Road in Iowa

		2020	2025	2030	2035	2040
Low Scenario	EVs on the Road	3,562	8,282	12,960	15,573	16,974
	Percent of All Cars on Road	0.1%	0.3%	0.5%	0.6%	0.6%
Medium Scenario	EVs on the Road	6,275	25,697	47,450	57,184	61,935
	Percent of All Cars on Road	0.3%	1.0%	1.8%	2.1%	2.2%
High Scenario	EVs on the Road	6,876	20,572	38,310	62,467	101,905
	Percent of All Cars on Road	0.3%	0.8%	1.4%	2.3%	3.7%

[62] Calendar Year 2015 Vehicle Registrations Summary," Iowa Department of Transportation, accessed May 2016, http://www.iowadot.gov/mvd/stats/regis2015.pdf. EIA does not provide projections for vehicle stock at the state or regional level. This report used Iowa DOT numbers for all cars and sport utility vehicles registered in Iowa for 2015and applied EIA's national-level projection for vehicle stock growth to 2040.

Recommended Public Charging Station Locations

In order to identify areas where additional public EV charging stations are needed in the near future, it is important to identify the current gaps in the existing charging infrastructure. There can be different strategies in building out the public EV charging network, with issues similar to a "chicken and egg" type situation. One strategy could be to build EV charging stations in areas where future need is expected, regardless of whether any EVs are there now. This strategy anticipates that the charging station will encourage more people (often "early adopters") to buy EVs. Another strategy is to ensure that the areas where EVs currently exist are fully supported and have the appropriate charging infrastructure. This strategy also anticipates that others, beyond "early adopters," will purchase an EV after they see there are charging network available.

This analysis focuses on the latter strategy, and identifies 14 zip codes with 12 or more EVs but either no public charging or only one public charging station. Industry reports have estimated that for every 100 EVs on the road, there should be 20–40 public charging ports (a single charging station can have more than one port).[63,64] A general guideline would be to have at least one public charging port for every two and a half to five EVs on the road in a particular area.

Table 5 below displays the five zip codes that have 12 or more EVs and zero public charging stations. These are labeled as Tier 1 zip codes, since it might be more critical to install a public charging station in these areas.

Table 5: Tier 1 Zip Codes

Zip Code	City	County	Total EVs	Charging Stations	Utility Service in Zip Code
50014	Ames	Story	22	0	Ames Municipal
50265	West Des Moines	Polk	20	0	MidAmerican
52101	Decorah	Winneshiek	19	0	Alliant & Hawkeye REC
50312	Des Moines	Polk	14	0	MidAmerican
50311	Des Moines	Polk	12	0	MidAmerican

[63] "Charging Station Analysis," iCast, Appendix 6 of the *Colorado Project FEVER Report*, July 27, 2012, page 3 http://www.electricridecolorado.com/uploads/files/6._Charging_Station_Analysis_.pdf.

[64] "Charging Stations Keep Electric Vehicles Moving Ahead," Intel Corporation and PEP Stations, 2012, http://www.intel.com/content/dam/doc/case-study/energy-atom-pep-stations-study.pdf.

Similarly, Table 6 below displays the nine zip codes that have more than 12 EVs and only one public charging station. These are labeled as Tier 2 zip codes, since these areas might already have at least one charging station to serve the area. In many cases, though, there is a need for additional public charging based on the number of EVs in the area. Additionally, the existing public charging station is not always convenient or ideal. For example, the numbers in the table below include charging stations available at car dealerships. While this does serve as a public charging station, EV drivers may utilize a station at a grocery store, shopping center, or parking ramp more often during their weekly routine.

Table 6: Tier 2 Zip Codes

Zip Code	City	County	Total EVs	Charging Stations	Utility Service in Zip Code
50266	West Des Moines	Dallas	40	1	MidAmerican
50023	Ankeny	Polk	38	1	MidAmerican
50021	Ankeny	Polk	32	1	MidAmerican & Consumers Energy
50010	Ames	Story	23	1	Ames Municipal
50323	Urbandale	Polk	20	1	MidAmerican & Consumers Energy
52240	Iowa City	Johnson	20	1	MidAmerican
52302	Marion	Linn	17	1	Alliant & Linn County REC
50325	Clive	Polk	15	1	MidAmerican
50310	Des Moines	Polk	14	1	MidAmerican

Idaho National Laboratory (INL) finished a study in 2015 that analyzed EV driving and charging habits across 22 regions in the U.S. for three years. This project "demonstrated that charging infrastructure should be focused at home, workplaces and in public 'hot spots' where demand for Level 2 or DC fast-charging stations is high."[65] INL described these public hot spots as being locations where cars were parked for longer periods of time, such as shopping malls, airports, commuter lots and downtown parking ramps with close access to a number of different venues.[66]

[65] "Plugged In: How Americans Charge Their Electric Vehicles," Idaho National Laboratory, September 2015, 5, https://avt.inl.gov/sites/default/files/pdf/arra/SummaryReport.pdf.

[66] "Plugged In: How Americans Charge Their Electric Vehicles," Idaho National Laboratory, September 2015, 4, https://avt.inl.gov/sites/default/files/pdf/arra/SummaryReport.pdf.

Both tables provide the city and county along with the zip code. Additionally, the tables identify which utilities provide electricity to those zip codes. A full map of all electrical service area boundaries is available from the IUB.[67]

In looking at the zip codes above, this report has identified seven areas of focus with maps showing current EV ownership, existing public EV charging, nearby points of interest, and average annual daily traffic. This more qualitative approach was taken since myopically focusing on a zip code in the tables above might not tell the whole story if there are other charging stations nearby but just on the other side of the zip code boundary. The seven areas for which maps were developed and are shown below include:

1. Des Moines
2. West Des Moines/Urbandale
3. Ankeny/Polk City
4. Ames
5. Iowa City/Coralville
6. Marion/Cedar Rapids
7. Decorah.

[67] "Statewide Electrical Boundary Map," Iowa Utilities Board, March 2013, http://www.iowadot.gov/maps/msp/electrical/StatewideElectricalBoundaryMap.pdf.

Figure 11: Des Moines – Recommended charging station locations based on existing conditions

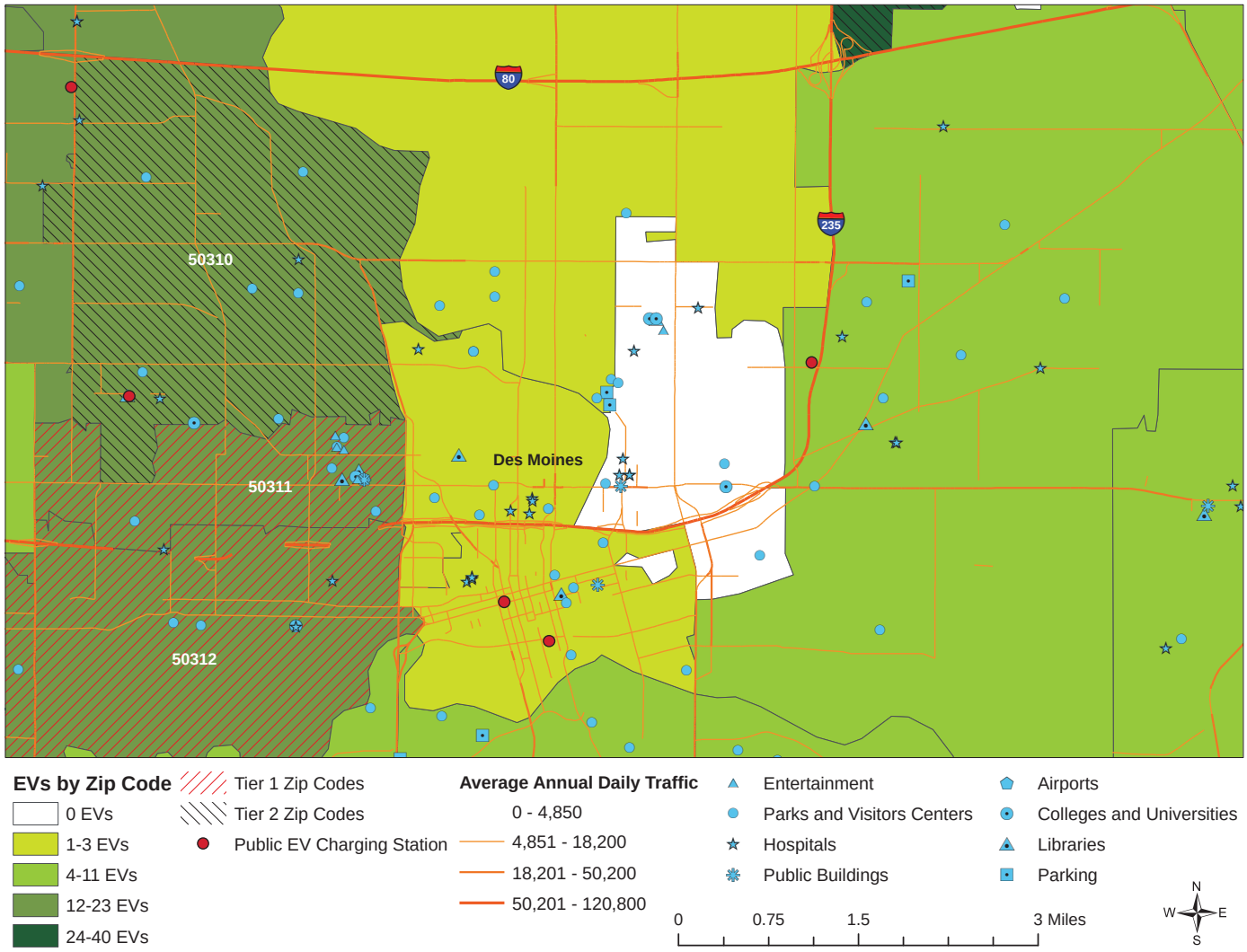


Figure 12: West Des Moines/Urbandale – Recommended charging station locations based on existing conditions

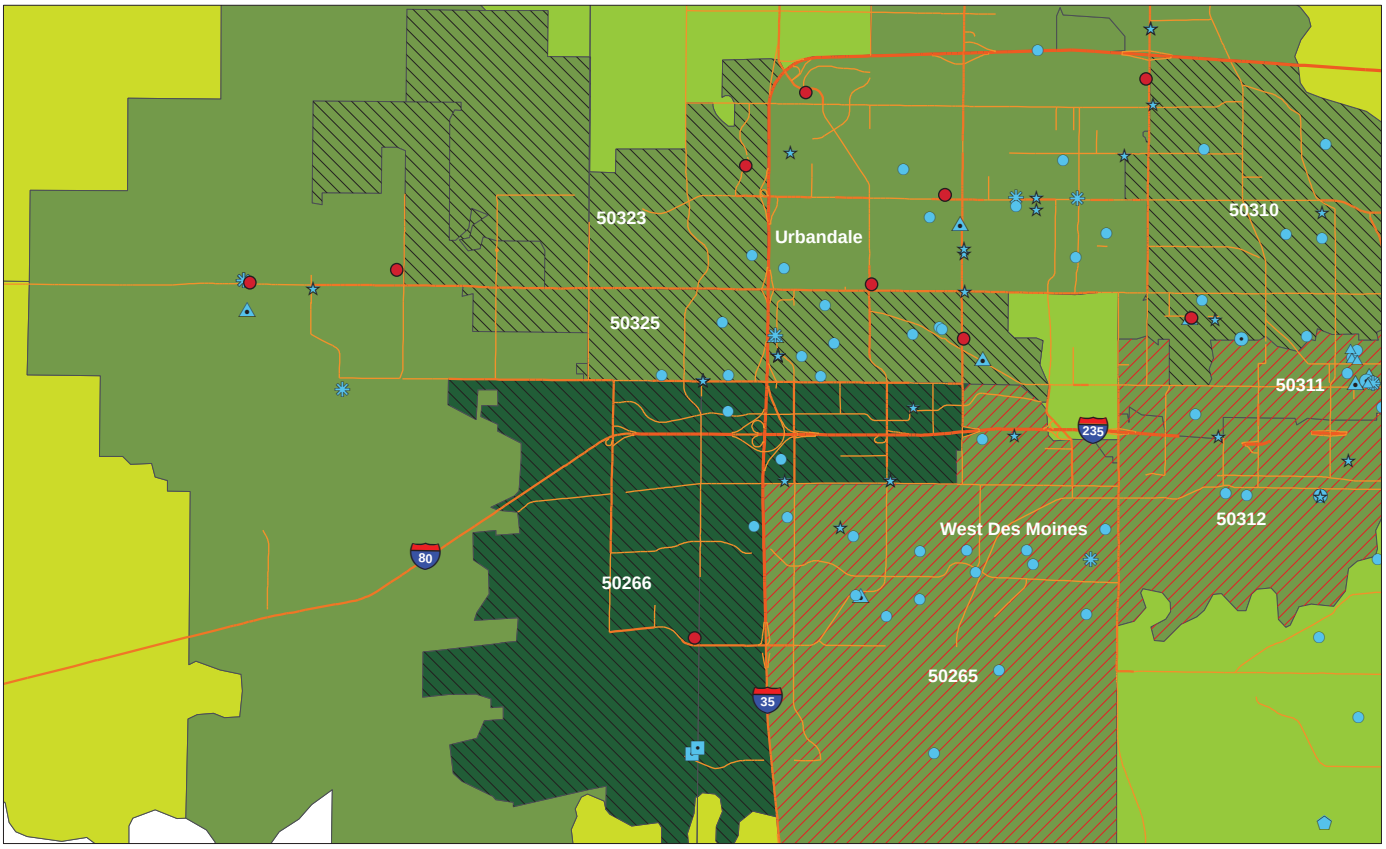


Figure 13: Ankeny/Polk City – Recommended charging station locations based on existing conditions

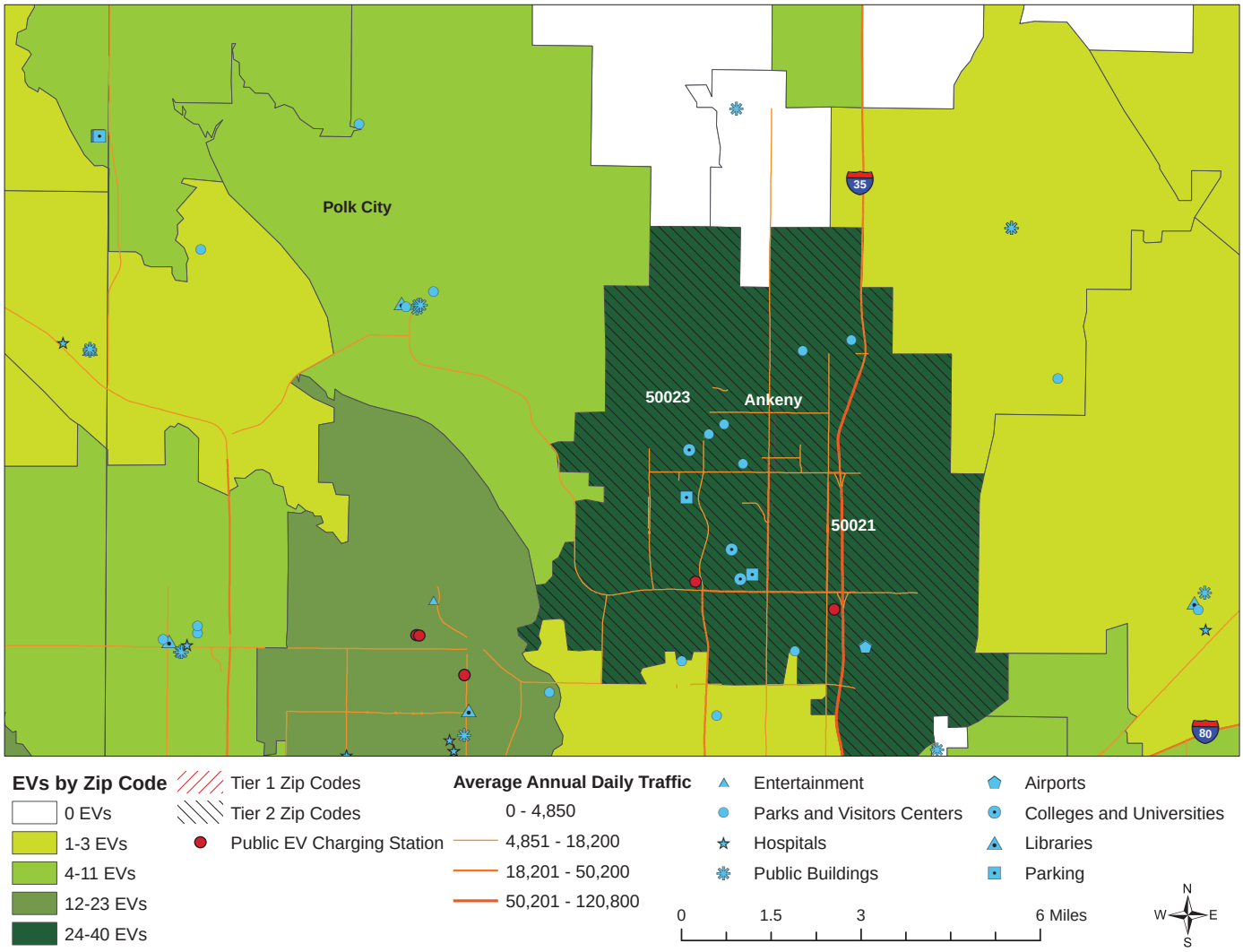


Figure 14: Ames – Recommended charging station locations based on existing conditions

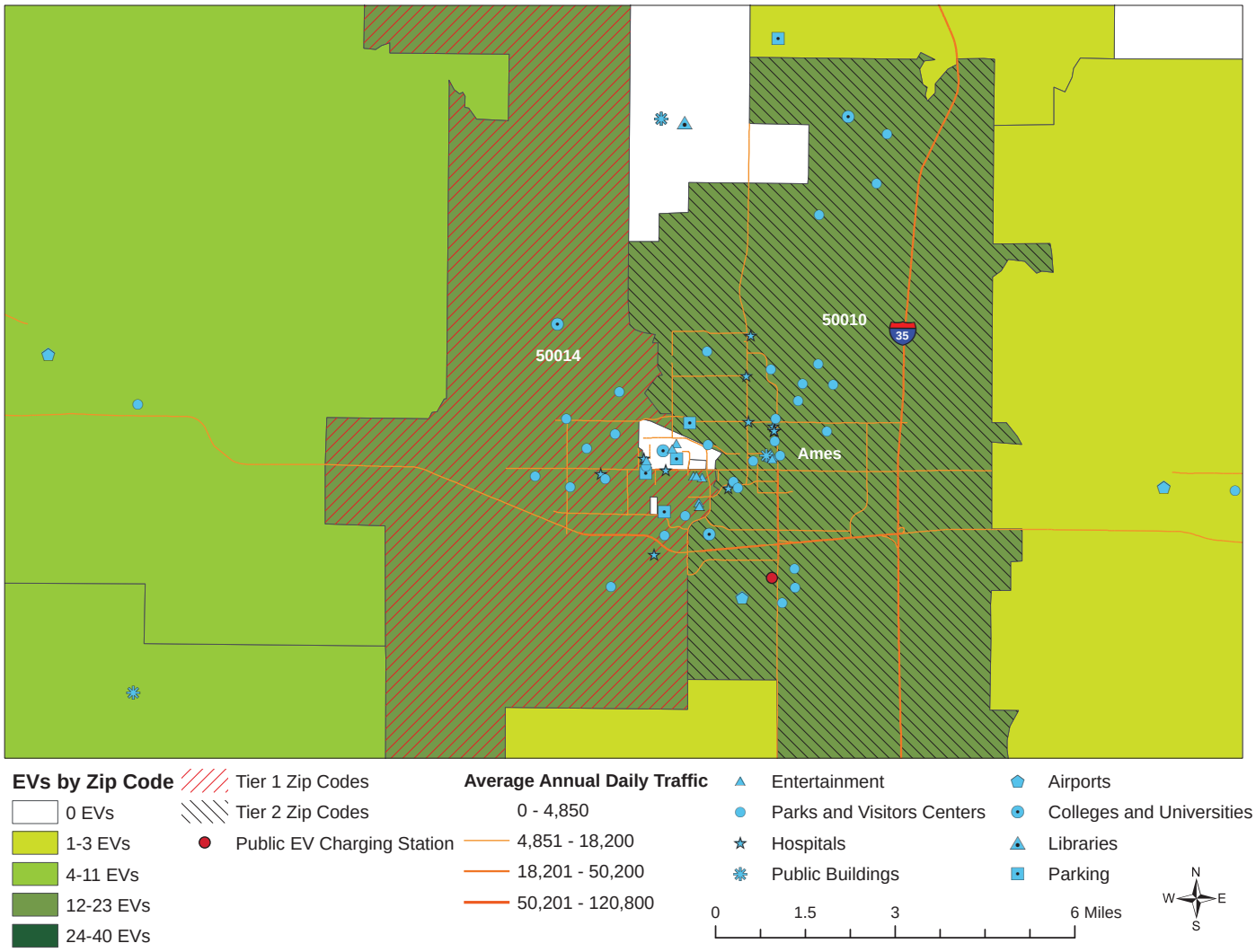


Figure 15: Iowa City/Coralville – Recommended charging station locations based on existing conditions

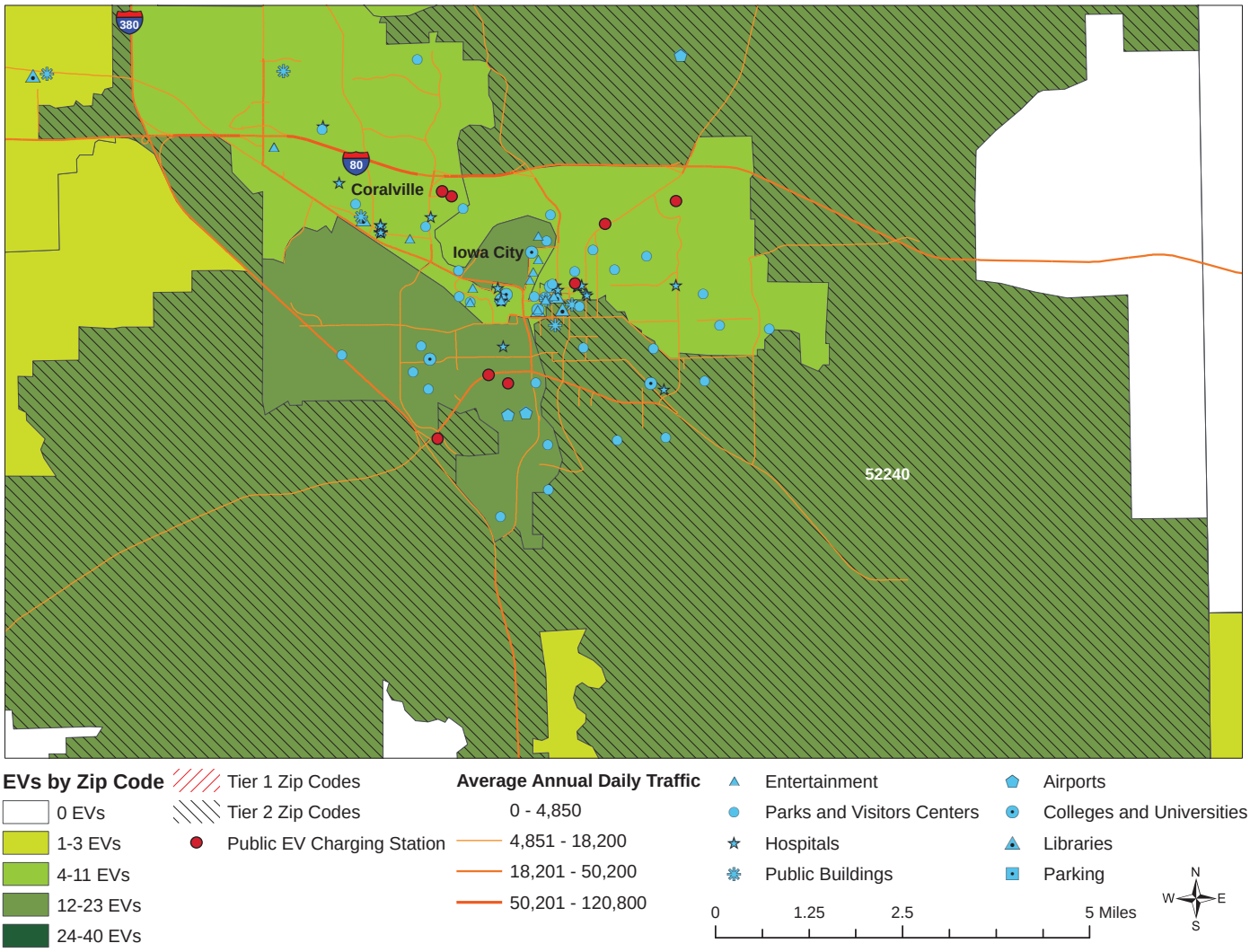


Figure 16: Marion/Cedar Rapids – Recommended charging station locations based on existing conditions

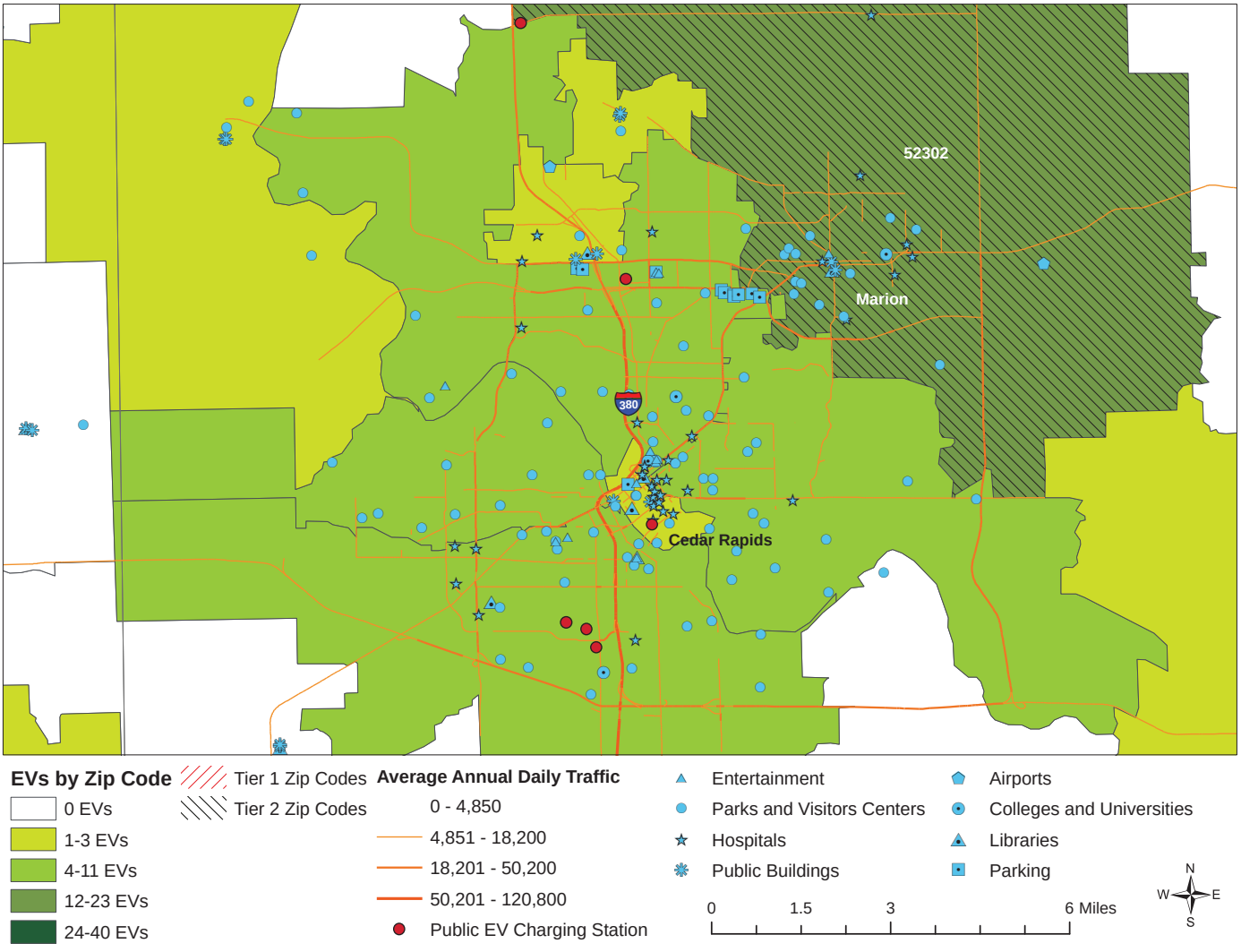
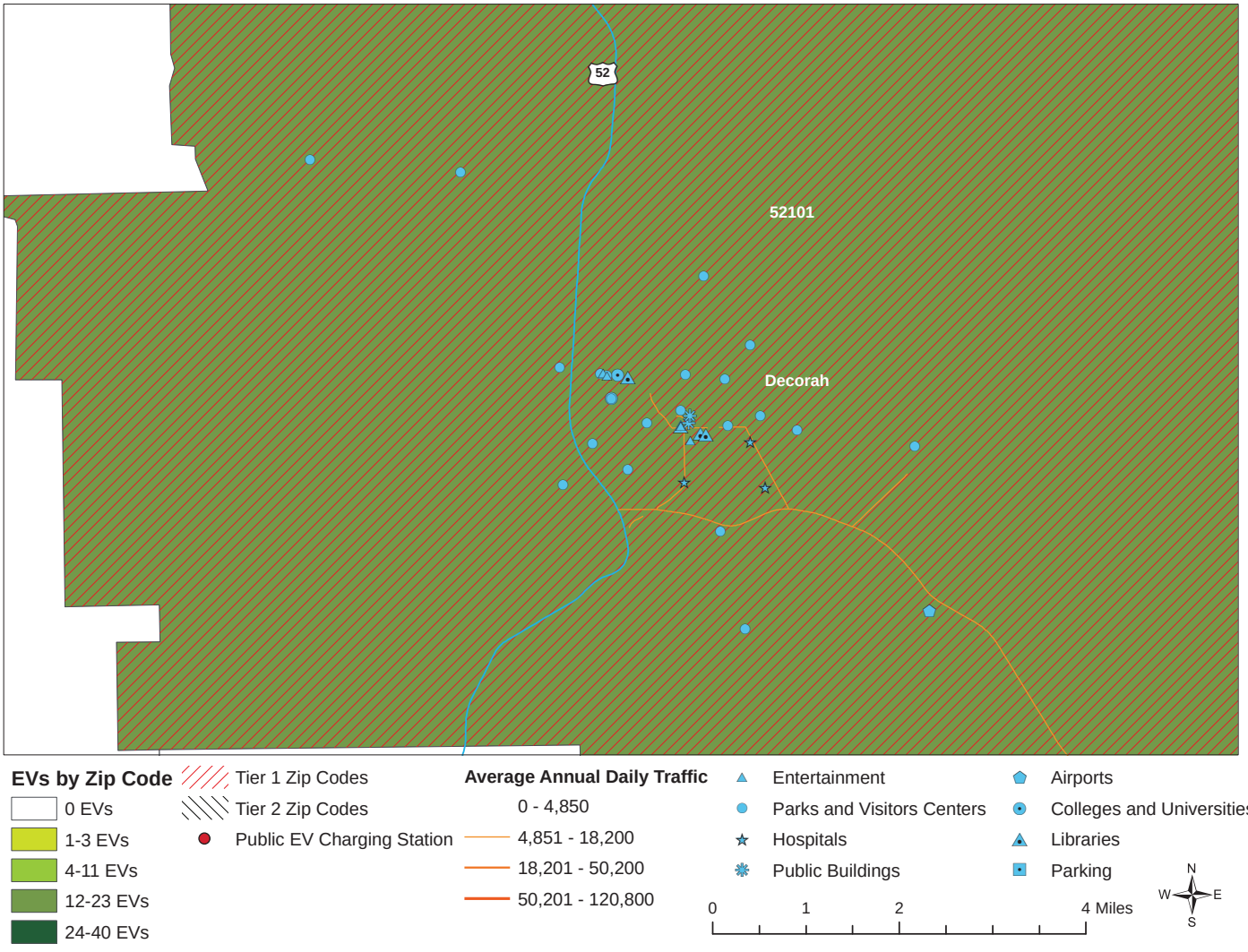


Figure 17: Decorah – Recommended charging station locations based on existing conditions



Recommendations for an Iowa Electric Highway

In addition to targeting the gaps identified in the previous section, there are other strategies that Iowa can implement in pursuing its build out of an EV-charging network. One of these strategies is to build an EV network of Level 3 charging stations along interstates or major highways in order to serve the travel corridors with the highest vehicle counts. This strategy allows EV drivers to confidently and comfortably travel long distances and between communities without the range anxiety that many potential EV owners can face.

One option is for the state to implement a concept that is similar to the "West Coast Electric Highway," which is a network of Level 3 EV charging stations along Interstate 5 (I-5) from Baja, California, through the Pacific Northwest, to British Columbia. This project involved coordination among the Washington State Department of Transportation, the Oregon Department of Transportation, and a Governor's Office inter-agency group in California.[68] The West Coast Electric Highway established criteria for its DC fast-charging station locations to establish a consistent EV driving experience along the entire highway. The criteria included the following:[69]

- A station located every 25–50 miles
- All stations within ½ mile of the highway
- Safe and convenient access
- Parking spaces
- Restrooms and drinking water
- Shelter and lighting
- 480V three-phase electric power supply
- Amenities (e.g., food and traveler information).

Focusing specifically on Iowa, this study looked into the potential of developing an Electric Highway on interstates (I-80, I-35, I-380 and I-29) across the state, as well as where EV charging stations could be located based on an established set of criteria. Given the rural nature of many sections of interstate travel through Iowa, it may not be feasible to include all of the same criteria as those for I-5 above. The criteria set for an Iowa Electric Highway included the following:

- Level 3 EV charging station
- Charging stations located no further than approximately 50 miles apart
- Charging stations located no further than 1 mile from the interstate.

---

[68] "West Coast Electric Highway," West Coast Green Highway, accessed December 30, 2014, http://www.westcoastgreenhighway.com/electrichighway.htm.

[69] Jeff Doyle, "Pacific NW Collaboration to Develop the West Coast Electric Highway," Washington State Department of Transportation, September 19, 2012, 13, http://wstc.wa.gov/Meetings/AgendasMinutes/agendas/2012/September19/documents/2012_0919_BPI_WSDOTEV.pdf.

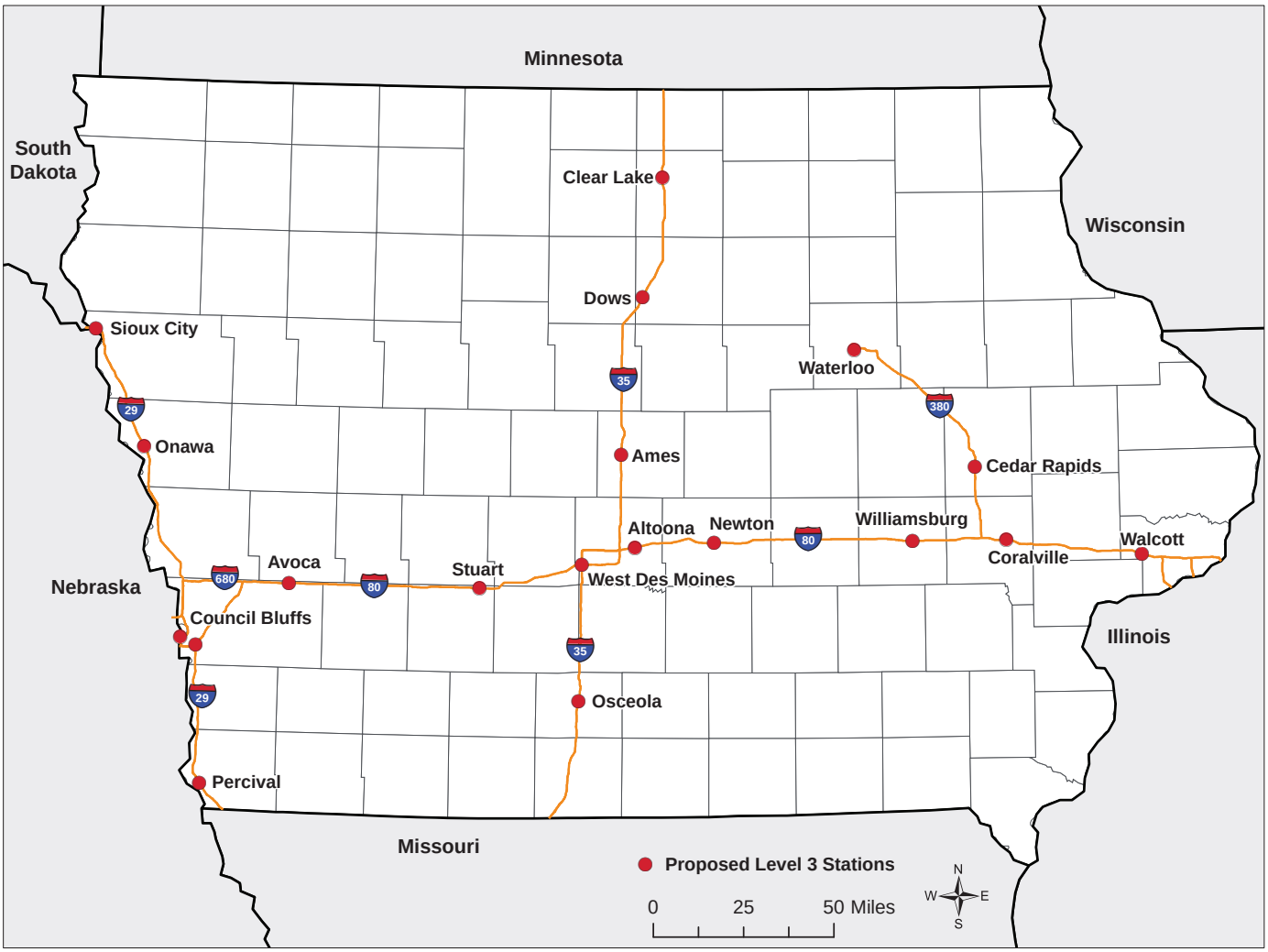
An Electric Highway plan in Iowa could include I-80, running West-East across the state for approximately 306 miles; I-35, running North-South across the state for a distance of approximately 219 miles; I-29, running North-South along the western edge of the state approximately 151 miles in length; and I-380, running from Coralville to Waterloo and approximately 73 miles in length.

Using the above criteria and analyzing interstate exits with existing services and amenities, this analysis identified an initial set of proposed station locations for consideration. The stations required to establish a full Electric Highway on both interstates resulted in the following:

- Proposing nine Level-3 charging stations along I-80
- Proposing five Level-3 charging stations along I-35
- Proposing three Level-3 charging stations along I-380
- Proposing four Level-3 charging stations along I-29.

The map in Figure 18 below provides recommended locations, including the city name, for all Level 3 charging stations across the state.

Figure 18: Recommended Level 3 EV-charging station locations for an electric highway



Tables 7–10 provide the location/exit number, distance from the previous station, the electric utilities that service the area, and types of businesses within that same 1-mile radius of the interstate exit.[70] At some exits where there is only one company that falls into a business type, or if there is a business that is a primary attraction at that exit, the actual name of the business or attraction was provided. The recommended stations for both interstates have been numbered 1–19 to facilitate discussions about specific stations. It should be noted that station 4 is used in both the I-80 route and the I-35 route, and station 8 is used in both the I-80 route and the I-380 route.

These station locations were selected through an analysis identifying exits that have existing amenities within 1 mile of the interstate and within the 50-mile range of a station within either direction. If more than one location met the criteria, then the analysis looked into the locations that had more amenities and nearby attractions that could make for an optimal charging environment.

This means that there are 19 stations needed to develop a full Electric Highway through the main interstate corridors of Iowa. Assuming each Level 3 charging station would cost $50,000,[71] it is implied that it could cost approximately $950,000 for full implementation. It could cost around $450,000 to develop the stations along the I-80 route, while it could cost around $200,000 more to develop the four additional stations along I-35 in order to complete both routes. If a phased approach is needed due to funding or other constraints, it would be important to make a concerted effort to develop these electric highways in a coordinated and timely manner in order to optimize use between destinations and reduce range anxiety. For example, a phased approach could focus on completing a series of stations between two destinations on a highway, as opposed to building a number of unconnected stations along different routes and interstates. Additionally, some locations could be temporarily served by Level 2 stations at destinations or lodging establishments until a Level 3 station is established.

[70] "Iowa Utilities Board Electrical Service Area Reference Map," Iowa Utilites Board, March 2013, http://www.iowadot.gov/maps/msp/electrical/StatewideElectricalBoundaryMap.pdf.

[71] Josh Agenboard and Ben Holland, "Pulling Back the Veil on EV Charging Station Costs," Rocky Mountain Institute, April 29, 2014, http://blog.rmi.org/blog_2014_04_29_pulling_back_the_veil_on_ev_charging_station_costs.

Table 7: Recommended Electric Highway EV-Charging Station Locations along I-80 from West to East

Station	Exit/Location	Distance from Previous Station	Electric Utility Service Area	Notable Businesses within 1-Mile Radius
Station 1	Exit 5 at Council Bluffs	About 5 miles from the Nebraska border	MidAmerican	• Shopping (Mall of the Bluffs) • Multiple restaurants • Grocery store • Hotels • Bowling alley
Station 2	Exit 40 at Avoca	35 miles from Station 1	MidAmerican and Nishnabotna Valley REC	• Restaurants • Hotels • Golf course • Travel center
Station 3	Exit 93 at Stuart	53 miles from Station 2	Stuart Municipal and Farmers Electric Coop	• Restaurants • Hotels • City park • Gas stations
Station 4 (station also used in I-35 route)	Exit 123B at West Des Moines	30 miles from Station 3	MidAmerican	• Shopping • Grocery store • Book store • Restaurants • Hotels • Gas stations
Station 5	Exit 142 at Altoona	19 miles from Station 4	MidAmerican	• Adventureland • Casino (Prairie Meadows) • Restaurants • Shopping
Station 6	Exit 164 at Newton	22 miles from Station 5	Alliant	• Restaurants • Hotels
Station 7	Exit 220 at Williamsburg	56 miles from Station 6	Alliant and T.I.P. REC	• Shopping (Tanger Outlets) • Restaurants • Hotels
Station 8 (station also used in I-380 route)	Exit 240 at Coralville	20 miles from Station 7	MidAmerican	• Shopping (Coral Ridge Mall) • Restaurants • Hotels • Clear Creek Trail
Station 9	Exit 284 at Walcott	44 miles from Station 8 and 22 miles from the border of Illinois	Alliant	• Restaurants • Iowa 80 Truckstop (world's largest truckstop) • Iowa 80 Trucking Museum • Shopping/souvenirs

Table 8: Recommended Electric Highway EV-Charging Station Locations along I-35 from North to South

Station	Exit/ Location	Distance from Previous Station	Electric Utility Service Area	Notable Businesses within 1-Mile Radius
Station 10	Exit 194 at Clear Lake	About 36 miles from Albert Lea, Minnesota and 25 miles from the Minnesota border	Alliant	• Restaurants • Hotels • Gas stations • City park
Station 11	Exit 159 at Dows	29 miles from Station 10	Alliant and Franklin REC	• Fast food (Arby's) • State rest area • Wildlife area and park (2 miles from exit)
Station 12	Exit 113 at Ames	46 miles from Station 11	Ames Municipal	• Restaurants • Hotels • Gas stations • City park
Station 4 (same station from I-80 route)	Exit 124 (on I-80 / I-35) at West Des Moines	43 miles from Station 12	MidAmerican	• Shopping • Grocery store • Book store • Restaurants • Hotels • Gas stations
Station 13	Exit 33 at Osceola	40 miles from Station 13. 34 miles from the border of Missouri and 55 miles from Bethany, Missouri.	Alliant and Clark Electric Coop	• Restaurants • Shopping (Walmart) • Hotels • Gas stations • City park • Lakeside Hotel Casino (at exit 34)

Table 9: Recommended Electric Highway EV-Charging Station Locations along I-380 from North to South

Station	Exit / Location	Distance from Previous Station	Electric Utility Service Area	Notable Businesses within 1-Mile Radius
Station 8 (same station from I-80 route)	Exit 0B on I-380 and then exit 240 on I-80 at Coralville	N/A	MidAmerican	2 miles from I-380: • Shopping (Coral Ridge Mall) • Restaurants • Hotels • Clear Creek Trail
Station 14	Exit 20A at Cedar Rapids	20 miles from Station 15	Alliant & Linn County REC	• Museum of Art • Public library • Park • Restaurants • Hotels
Station 15	Exit 71A at Waterloo	51 miles from Station 11	MidAmerican	• Shopping (Crossroads Mall) • Book store • Grocery Store • Coffee Shop • Restaurants • Hotels • Isle Casino

Table 10: Recommended Electric Highway EV-Charging Station Locations along I-29 from North to South

Station	Exit / Location	Distance from Previous Station	Electric Utility Service Area	Notable Businesses within 1-Mile Radius
Station 16	Exit 149 at Sioux City	43 miles from Station 12	MidAmerican	• Marina • City park • Museums (Sargent Floyd River Museum, Sioux City Public Museum and Lewis and Clark Interpretive Center) • Art center • Restaurants • Hard Rock Casino
Station 17	Exit 112 at Onawa	36 miles from Station 18	Onawa Municipal and Western Iowa Power Coop	• Fast food (McDonald's, Subway and Dairy Queen) • Hotel (Super 8)
Station 18	Exit 53B at Council Bluffs	59 miles from Station 19	MidAmerican	• City parks • Restaurants • Golf course • Pharmacy • Coffee shop • Hotel (Quality Inn)
Station 19	Exit 10 at Percival	43 miles from Station 20 and 10 miles from the Missouri border	Atchison-Holt Electric Coop	• Travel centers • Fast food (Wendy's) • Hotels • Antique mall • Gas station

Business Models

There are many different potential business models for public EV charging stations, and which model will work best in a given location will depend heavily on certain factors such as demand, the partners involved, the capital available, the income/return on investment (ROI) expectations, local electricity regulations, price of electricity and the anticipated utilization. As the EV market in Iowa evolves, it may also be necessary for the business models for EV charging stations to evolve in order to address the new needs, concerns, policies and goals of the partners involved.

For instance, Iowa has not made any distinction between the retail sale of power, which only utilities can perform, and providing the service of public EV charging.[72] This limits how businesses with public EV charging can compensate themselves for the electricity used. Rather than charge for electricity used, businesses would be required to charge for time spent at the charging station or a flat fee for parking at the charging station. Almost all businesses in Iowa currently offer EV charging free of charge, with only a handful of business, such as RV parks, charging by the time spent at the station.[73]

One could consider the EV market in Iowa to be in its initial phase as EV saturation is low and public charging is not heavily utilized. As previously noted, the price of electricity in Iowa is relatively affordable, with the commercial retail rate ranking as the 17th cheapest in the nation at 9.05 cents/kWh.[74] In a market like this, a business interested in installing EV charging might not mind providing customers with free electricity due to the lower price of electricity and the relatively small size of the EV population utilizing it.

Also, the lower number of EVs in the state and the scarcity of public EV charging means that electric utilities may be willing to support the growth of the EV charging network by helping an interested private business pay for the installation of a charging station or by covering the cost of electricity used by the station.

Given the nature of EV-charging stations, there are a few stakeholders with natural involvement, including the regulator (or IUB in this case), the utility providing electricity, the property owner and, if applicable, the equipment owner/operator. Often, building out a robust charging network might also be the goal of local or state agencies and nonprofits, which could mean there is an opportunity for these entities to have a role as well.

Given the fact that non-utility businesses in Iowa cannot currently charge for the sale of electricity, one might think that this would put Iowa businesses at a disadvantage in terms of developing successful business models. This is not the case, though, since a recent study by the Center for Climate and Energy Solutions (C2ES) found that “business models that rely solely on direct revenue from EV charging

---

[72] Kendrick Vonderschmitt, The Council of State Governments, “State Utilities Law and Electric Vehicle Charging Stations,” October 9, 2013, http://knowledgecenter.csg.org/kc/content/state-utilities-law-and-electric-vehicle-charging-stations.

[73] Plugshare, analyzing costs and fees of public charging stations in Iowa, accessed May 2016, http://www.plugshare.com/.

[74] U.S. Energy Information Administration, Electric Power Monthly, Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector, accessed March 2016, https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_b.

services currently are not financially feasible."[75] When attempting to recoup costs only through the resale of electricity, the study found that a Level 3 charging station would result in a net loss of $44,000 over 10 years and a Level 2 station would result in a net loss of $26,000 over 10 years. While this might make the prospect of installing charging stations appear to be unattractive, the study ultimately found that there is a promising opportunity to improve the financial performance of charging stations. This improvement is possible with the development of business models involving partnerships that gain benefits beyond profits from selling electricity, such as capturing market share of EVs or electric vehicle supply equipment (EVSE), increasing customer satisfaction, strengthening brand awareness, and meeting targets or goals.[76] Additionally, it notes that diverse businesses may be increasingly willing to help fund the installation of charging stations because of the indirect benefits, detailed in Table 11, that they would receive.[77]

Specifically, the C2ES study looked at three business models. The first was a business model where a large business subsidized $7,000 toward the cost of a Level 3 charging station. This large business would most likely be an auto manufacturer with interest in expanding the EV market, a battery producer looking to encourage greater adoption of EVs, or a charging equipment manufacturer looking to establish or capture significant market share of the EV charging network in an area.

The second was a business model where a group of local businesses in a localized area shared the cost of an EV charging station. The businesses then split any revenues from the station and all assumed to benefit from customers patronizing their shops while charging. The third model was a combination of the first two.[78] The findings on these models were modest, stating that they could potentially be beneficial in reducing cost and risk among partners when pursuing the development of an EV charging station.

These models, along with other combinations of partnerships, could also help encourage businesses to install EV charging stations in Iowa. Table 11 captures some of the primary benefits that each potential partner would experience by being involved in co-funding the installation of an EV charging station.

---

[75] Nick Nigro and Matt Frades, *Business Models for Financially Sustainable EV Charging Networks*, Center for Climate and Energy Solutions, March 2015, xiii, www.c2es.org/docUploads/business-models-ev-charging-infrastructure-03-15.pdf.

[76] Nick Nigro and Matt Frades, *Business Models for Financially Sustainable EV Charging Networks*, Center for Climate and Energy Solutions, March 2015, xiii, www.c2es.org/docUploads/business-models-ev-charging-infrastructure-03-15.pdf.

[77] Nick Nigro and Matt Frades, *Business Models for Financially Sustainable EV Charging Networks*, Center for Climate and Energy Solutions, March 2015, xvii, www.c2es.org/docUploads/business-models-ev-charging-infrastructure-03-15.pdf.

[78] Nick Nigro and Matt Frades, *Business Models for Financially Sustainable EV Charging Networks*, Center for Climate and Energy Solutions, March 2015, xiv, www.c2es.org/docUploads/business-models-ev-charging-infrastructure-03-15.pdf.

Table 11: Benefits for Potential Partners in Investing in an EV-Charging Station

Potential Partner	Benefits of EVSE Investment
Business / Property Owner	• Image branding ("green") • Increase customers satisfaction and loyalty • Potential revenue from charging
Electric Utility	• Image branding ("green") • Increasing demand for product (electricity) • Increased awareness of EVs in general, in which adoption would encourage charging at home, too
EVSE Equipment Producer / Operator	• Increased visibility • Increased market share of equipment in use in area
Auto Manufacturer / EV Battery Manufacturer	• Image branding ("green") • Increased visibility • Help increase awareness availability of EVs and ultimately market share of their EVs on road
State / Local Agencies	• Help meet environmental goals / targets • Increased visibility of agency in market space • Increase resident satisfaction with agency's efforts

Potential Business Models for Installing an EV Charging Station

Kansas City Power and Light's (KCP&L's) Clean Charge Network Initiative is an example of utility investment in EV charging stations. Through this program, KCP&L achieved the ambitious goal of installing 1,000 EV charging stations in the Kansas City area, more than any other U.S. city, in the span of just a few months in 2015. The effort utilized stations manufactured by ChargePoint, which provided a bulk discount on the equipment and reached out to local businesses and cities as partners.[79] In a program like this, the electric utility covers the cost to install, maintain and operate the EV charging station, while the property owner, whether it is the city or a private business, covers the cost of electricity used for the first 2 years. After 2 years, KCP&L will work to change Kansas' regulations to allow these businesses to sell electricity for EV charging to the customer.

[79] "KCP&L Clean Charge Network," Kansas City Power and Light, accessed June 2016, http://www.kcpl.com/about-kcpl/environmental-focus/clean-charge-network.

Another model, similar to what was described by the second model in the C2ES study, involves a group of businesses in close proximity pooling their money to fund the EVSE installation costs as a group. This is a good prospect for businesses with shared parking areas, such as parking ramps in metro locations or strip mall-type locations. It could also work in tourist or destination locations, where, even if the businesses do not share a parking area, they could work with a public parking lot nearby to install EV charging in order to drive pedestrian traffic. The number of ways to involve partners in funding EV charging is nearly limitless. Any interested potential partner can reach out to other potential partners, gauge their interest, and leverage how the installation would benefit them, as shown in Table 11.

A business model for Level 3 charging stations, as part of the Iowa electric highway concept, can involve partners such as auto manufacturers, EV battery producers, EVSE equipment operators or state agencies to help fund the more expensive charging stations. By having partners fund as little as $5,000, this will help mitigate the upfront costs to the business and alleviate the net losses described by the C2ES study. In return, each partner will capture the benefits unique to them highlighted in Table 11.

Policy/Program Descriptions and Impacts

The state of Iowa has many opportunities to pursue policies and programs that will lead and facilitate the development of an EV market. Options range from educating stakeholders about available programs and funding at the federal level, to enabling low-cost, private-market decisions, to implementing market drivers that will result in a fiscal cost to the State. For the purposes of this project, a wide-ranging policy table was developed and is presented as Appendix 1. Although many states are taking an active role in EV deployment, Iowa should carefully consider which options will truly benefit its unique market, geography, population and political climate. As a result of this mix of considerations, the main policy areas that Iowa should consider (in no particular order) include utilities, incentives, loans and financing, consumer engagement and education, indirect incentives, employer and workplace charging programs, fees, fuel corridors, multi-unit properties, airports and aviation, and dealerships. Appendix 1 includes a variety of examples, possible action items, and their impacts to help stakeholders and decision makers carefully weigh the options about how to most effectively address the EV market in the state.

Utilities

As utilities are providing electricity for EVs, they can have a prominent role in the market. Many utilities across the U.S. are embracing this opportunity and leading the transformation from internal combustion engines to electric-powered transportation. This role can range from transitioning their own fleets to EVs, offering free EV charging to employees and visitors, providing TOU rates that incentivize off-peak EV charging, and offering rebates to switch to EVs or install charging stations. One limitation that is of particular interest in Iowa is that any charging station that charges drivers directly for electricity is considered a utility and therefore must be regulated accordingly. This rule applies regardless of the electricity's source—be it from the utility grid or a solar canopy that powers the charging station.

Examples

Many states in the U.S. have enacted laws that exempt EV charging station owners and operators from functioning as a utility when recouping the costs of electricity from their units. The basic language in these statutes declares, "An entity that owns, controls, operates, or manages a facility that supplies electricity to the public solely for the purposes of charging an electric vehicle is not defined as a public utility."[80] According to the AFDC State Laws and Incentives section, states that have passed this type of law include California, Colorado, Florida, Hawaii, Idaho, Illinois, Maine, Maryland, Minnesota, Oregon, Utah and Virginia. Specific language from bills passed at the state level can be found in Appendix 2.

Action

Reviewing the examples from other states that have passed this legislation could help local stakeholders consider options for Iowa. Additionally, consulting with energy offices in other states that have enacted these laws can help inform the stakeholder engagement process and understand outcomes of these policy changes in other states. Developing a policy specific to Iowa would require consultation and collaboration with state agencies, utilities, and EV stakeholders. The timeframe of considering this policy should complement the pursuit of Level 3 charging and electric highway development.

Impact

Allowing EV owners and operators to charge directly for electricity at charging stations opens up a completely new business model for Iowa. This type of payment structure would result in the acceleration of Level 3 charging, as charging station operators would have a mechanism to recoup the costs of providing electric fuel. As the market grows, demand will rise, and the station owners will face increasing costs of offering electricity to customers. The only existing option for station owners and operators who wish to recoup the costs associated with EV charging are to charge users a flat or time-based fee for using the spot. By implementing a model that sells electricity on a watt-for-watt basis, there is more transparency and a perception of fairness that will allow consumers to see exactly what they are paying for when using these charging stations, similarly to how the average consumer pays a per-gallon price at the pump to fill their cars.

---

[80] "State Laws and Incentives," U.S. Department of Energy, Alternative Fuels Data Center, last modified June 4, 2014, accessed April 1, 2016, http://www.afdc.energy.gov/laws/state.

Incentives, Loans and Financing

Different states in the U.S. offer varying packages of incentives and rebates to help spur deployment of EVs and/or EV charging stations. The federal government offers a tax credit of up to $7,500 for EVs and a 30 percent infrastructure tax credit for charging stations, not to exceed $30,000.[81] For some states, this type of financing also extends to conversions. These kinds of financial packages are designed to eliminate the barrier of incremental cost difference between EVs and gasoline vehicles. The National Renewable Energy Laboratory (NREL) recently conducted a consumer survey across the U.S. The findings showed that even with the subtraction of the federal tax credits, the Nissan LEAF ($21,510 with federal incentives) is affordable to only 46 percent respondents, and the Chevrolet Volt ($25,670 with federal incentives) is affordable to only 33 percent of respondents.[82] Furthermore, 26 percent of respondents would not pay any incremental cost, regardless if they felt the vehicle was affordable.[83]

Examples

Research indicated that more than half of all states in the U.S. had some sort of financial policy in place to help offset the costs of either EVs or charging stations. These states include California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa (utility rebates for residential charging), Maryland, Massachusetts, Michigan, Mississippi, Montana, New Hampshire, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont and Washington. Incentives range from tax credits, point-of-sale discounts, rebates, grants, bulk purchasing programs (mentioned in greater detail in the Dealership section) and loans. These funding mechanisms are administered by all types of entities, including state agencies, air quality districts, nonprofits and utilities. Many of these policies were signed into legislation with a sunset end date or a tiered structure where the benefits decrease in size over time.

---

[81] "Federal Laws and Incentives," U.S. Department of Energy, Alternative Fuels Data Center, last modified June 4, 2014, accessed April 1, 2016 http://www.afdc.energy.gov/laws/fed_summary.

[82] Mark Singer, *Consumer Views on Plug-in Electric Vehicles – National Benchmark Report*, National Renewable Energy Laboratory, January 2016, http://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

[83] Mark Singer, Consumer Views on Plug-in Electric Vehicles – National Benchmark Report, National Renewable Energy Laboratory, January 2016, http://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

Action

If incentives will help spur the EV market, the IEDA and stakeholders could determine the best funding mechanism and the right agency to lead the effort. In other states, air quality planning organizations are using Congestion Mitigation and Air Quality (CMAQ) funds from the U.S. Department of Transportation Federal Highway Administration for grants. CMAQ was recently reauthorized by the Fixing America's Surface Transportation Act in 2015,[84] and this would be a viable option, without using state funds, to cover the incremental costs associated with EVs and a portion of the funds needed to purchase and install EV chargers. Other states have found success using DOE's State Energy Program as a smaller funding source, which provides leadership to maximize the benefits of energy efficiency and renewable energy in each state through communications and outreach activities, technology deployment, and access to new partnerships and resources. Periodically, there are also competitive funding opportunities through federal agencies to which the state could apply, such as those available through DOE's Clean Cities program. By running a grant or rebate program, the State would have more control in ensuring that it can build a strategic and connected charging infrastructure network.

Impact

As previously noted, subsidies are shown to be the single largest driver of EV purchasing behavior.[85] The International Council of Clean Transportation (ICCT) study states that:

> *Some of the states with the largest electric vehicle incentives—California, Georgia, Hawaii, Oregon, and Washington—have electric vehicle sales shares that are approximately 2–4 times the national average. A statistical regression was performed, revealing that the total monetary benefit to consumers from state incentives significantly positively correlates with BEV sales when all 50 states and the District of Columbia are included. These findings suggest that future state efforts to incentivize BEV sales through incentives that substantially drive down the total cost of owning and operating electric vehicles are likely to be effective.*[86]

Although this study has proven incentives to be effective, they should be considered as one of many options in a suite of programs and policies to drive EV adoption in Iowa. Adding a sunset clause or an exit strategy ensures that incentives are used to support an emerging market but do not exist in perpetuity.

---

[84] "Congestion Mitigation and Air Quality (CMAQ) Improvement Program," U.S. Department of Transportation, Federal Highway Administration, last modified June 21, 2016, accessed May 31, 2016, http://www.fhwa.dot.gov/environment/air_quality/cmaq/.

[85] Lingzhi Jin, Stephanie Searle and Nic Lutsey, *Evaluation of State-Level U.S. Electric Vehicle Incentive*, The International Council on Clean Transportation, October 2014, http://www.theicct.org/sites/default/files/publications/ICCT_state-EV-incentives_20141030.pdf.

[86] Lingzhi Jin, Stephanie Searle and Nic Lutsey, *Evaluation of State Level U.S. Electric Vehicle Incentives*, The International Council on Clean Transportation, October 2014, http://www.theicct.org/sites/default/files/publications/ICCT_state-EV-incentives_20141030.pdf.

Consumer Engagement and Education

A key way to develop the EV and charging infrastructure network is to raise awareness and foster a greater understanding of EVs' capabilities and their associated benefits through a targeted education and outreach effort. Iowa, through its DOE-funded Clean Cities Coalition at IEDA, conducts outreach and provides tools and materials to make sure that this knowledge is shared with stakeholders and the general public.

Examples

Specific outreach and educational efforts happening across the U.S. are designed to get drivers inside of EVs, as the experience of being behind the wheel is different from reading about them on the internet. The National Drive Electric Week is a nationwide celebration intended to heighten awareness of today's widespread availability of EVs and to highlight their benefits. This event takes place in the fall, and it continues to grow year after year. In 2015, 196 allied events in 187 cities were hosted with more than 130,000 people attending events across the U.S.[87] Additionally, Canada, Hong Kong and New Zealand hosted events as well. In 2016, an event for National Drive Electric Week is already scheduled to take place in West Des Moines at the Valley Junction Farmers Market on September 15.

Blue Indy is an all-electric car-sharing service that has been implemented in Indianapolis, Indiana. By joining this program, citizens have the option to rent an EV and pay for the time used. A number of payment plans are also available to fit the needs of the individual driver. EV owners can also join the Blue Indy network for $20/year and $2/hour and have access to the charging stations owned and operated by this program.

It is important to make sure that consumers know about resources available to help them in making an EV purchase. The resources on www.fueleconomy.gov, which is a U.S. DOE web page dedicated to providing fuel economy information, are for the general public. On this site, drivers can compare fuel economy, learn more about incentives, and calculate the price of fuel based on type and distance of trip. The Alternative Fuels Data Center, www.afdc.energy.gov, is a resource that provides information about incentives and programs in each state; it can help locate an EV charging station, and it alerts drivers to benefits and considerations for their vehicle. The PlugShare website, www.plugshare.com, is a crowd-sourced website where various users can post information about commercial and residential charging stations; users can even see which stations are currently in use.

Action

The resources and outreach types above are helpful to both prospective and current EV drivers; however, if the public does not know about their existence, then they are likely to go underutilized. One way to promote these events and tools would be to utilize social media. Websites and mobile applications such as Facebook, Twitter, Snapchat, YouTube, NextDoor and LinkedIn are community forums where connections happen online. These are resources that could be leveraged to start a

[87] "National Drive Electric Week 2015 Breaks Attendance for Second Consecutive Year," Plug In America, September 29, 2015, http://www.pluginamerica.org/press-release/national-drive-electric-week-2015-breaks-attendance-record-2nd-consecutive-year.

discussion and reach new audiences. EV stakeholders in Iowa could also utilize more traditional forms of media, such as sending out a news advisory ahead of a major event, like a station ribbon-cutting or a Ride and Drive, so that media can plan to attend. Issuing a press release the day before an event can prompt media coverage as well. Coordinating media outreach and social media messages across the EV stakeholder network is a good way to make sure that consistent messaging is getting out there and that all available outlets are being utilized.

Impact

Outreach and education help eliminate the uncertainties that surround a new technology. Many people fear what they do not know. Range anxiety can occur when people overestimate the distance that they drive their automobile, and they mistakenly believe that an EV cannot accommodate their daily travel. Others may believe that EVs are "glorified golf carts" and need to actually have the driving experience in order to understand that these are advanced technology vehicles. In order to be transformative, EV stakeholders need to shift the reality of prospective owners to advance the market.

Indirect Incentives

More than 20 states, not including Iowa, have passed some sort of law that provides either a privilege or an exemption that benefits EV drivers. These indirect incentives are designed to have little or no financial impact on the issuing entity, but they will reward early EV adopters with benefits that make driving more convenient, though this figure can be challenging to put into a monetary value. By incentivizing electric transportation without a fiscal award, stakeholders have the opportunity to be truly innovative and design packages that fit the needs of drivers in their geographic region. Analysis by the ICCT shows that the most effective EV incentives are subsidies, high-occupancy vehicle (HOV) lane access, and emission-testing exemption initiatives.[88] Due to Iowa's relatively good air quality and smaller population, HOV lanes and emissions testing are not available. Customizing these policies to benefit Iowa EV drivers could have a positive impact on the EV market.

Examples

A number of states have provided EV drivers a waiver so that they do not need to participate in vehicle emissions testing.[89] Since emissions testing fees are usually low, this does not provide a noteworthy financial incentive. However, the intangible benefits of avoiding the emissions testing inspection centers and completing the necessary paperwork is attractive to EV owners.

California and Hawaii both have legislated parking lot regulations that call for all parking lots with a minimum number of spots (50 and 100, respectively) to have a percentage of spots designated for EV charging. This ensures that all future planning efforts are growing with the EV market and will be able to accommodate the charging needs of drivers.

---

[88] Lingzhi Jin, Stephanie Searle and Nic Lutsey, *Evaluation of State Level U.S. Electric Vehicle Incentives*, The International Council on Clean Transportation, October 2014, http://www.theicct.org/sites/default/files/publications/ICCT_state-EV-incentives_20141030.pdf.

[89] "State Laws and Incentives," U.S. Department of Energy, Alternative Fuels Data Center, last modified June 4, 2014, accessed April 1, 2016, http://www.afdc.energy.gov/laws/state.

Florida has adopted state statutes that prohibit a vehicle that is not capable of charging from stopping, standing or parking in a designated EV spot. This provides EVSE owners and operators with an enforcement mechanism to ensure that EV drivers are able to access designated spaces and charging stations. It also means that municipalities and other local governments do not need to formulate and regulate their own policies and can follow state law.

Action

With a great deal of redevelopment happening especially in downtown areas, one opportunity is for public employees, developers, elected officials and decision makers to work together to offer charging in new parking lots and in new parking ramps. Stakeholders should be advised that this is a long-term effort and that the payoffs to expanding the available EVSE may not be immediate—it may take some time for drivers to frequent new EV stations.

Although Iowa does not require vehicle emissions testing, this could be modified slightly to fit the Iowa climate. For example, all new initial vehicle registrations are required to be done in-person in Iowa at the local treasurer's office. To add convenience for EV owners, perhaps this paperwork could be completed online or by mail as an exception. Currently, new vehicles must be registered within 30 days of purchase. One way to add a convenience factor for EV owners would be to extend this deadline to 60 days.

Although Iowa does not have any HOV or toll roads, there are a series of bridges that charge tolls. An option to integrate these bridges into the EV exemptions plan would be to have the State of Iowa underwrite or offset these tolls for all EVs.

Impact

An analysis undertaken in a recent state-level U.S. electric vehicle incentives project showed that subsidies, carpool lane access, and emissions exemptions had the greatest influence on EV sales.[90] If the State of Iowa and stakeholders work together to implement some of these low-cost policies in the unique manner described above, the impact of just two or three of these drivers could be more significant than a more comprehensive suite of policies.

Employer and Workplace Charging Programs

One method to reach mass quantities of people is to approach them at their place of work to educate them on EVs. The ability for EV owners to charge at work potentially doubles the electric range of their vehicle.[91] Some of the benefits of offering EV charging to staff include employee recruitment and retention, furthering of sustainability goals, public image and employee satisfaction. While it can be difficult to determine the amount of staff time required to run such a program, an EV group-buy program in Colorado required $7,000 of staff time to manage.[92]

---

[90] Lingzhi Jin, Stephanie Searle and Nic Lutsey, *Evaluation of State Level U.S. Electric Vehicle Incentives*, The International Council on Clean Transportation, October 2014, http://www.theicct.org/sites/default/files/publications/ICCT_state-EV-incentives_20141030.pdf.

[91] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, 2013, http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf.

Examples

DOE has created the EV Everywhere Grand Challenge, in which the Workplace Charging Challenge aims to have 500 U.S. employers join the initiative as partners by 2018. Partners set a minimum goal of providing charging for a portion of EV-driving employees and a best practice goal of meeting all employee demand. As of January 2016, more than 250 employers have joined as Challenge partners, and the installation of workplace charging as a sustainable business practice is growing across the country. Partner efforts have resulted in more than 600 workplaces with more than 5,500 charging stations accessible to nearly 1 million employees.[93]

In Colorado, Rhode Island and Wisconsin, State agencies and departments are statutorily mandated to evaluate opportunities for commuting options, including workplace charging. While this does not mean that the state agency must implement a program, it does mean that a cost-benefit analysis and feasibility study can help agencies determine if workplace charging is a viable option for their organization.

Action

EV stakeholders in Iowa could examine legislation that will require state agencies to conduct an analysis to determine the likelihood of employers offering an EV charging program to their employees. Some references that can assist state agencies in this study include the Ownership and Operational Guidelines, DOE's *Plug-In Electric Vehicle Handbook for Workplace Charging Hosts, DOE's Costs Associated with Non-Residential Electric Vehicle Supply Equipment, and NREL's Consumer Views on Plug-In Electric Vehicles – National Benchmark Report*. Appendix 3 includes a sample survey that IEDA can share with potential workplace charging partners. A business can disseminate this survey to its workforce to determine the need for charging or how to plan for future demand of charging stations.

Impact

Participants in DOE's Workplace Charging Challenge are six times more likely to drive a PEV than the average worker.[94] Also, as a result of this program, 90 percent of partner employees expressed satisfaction with the workplace charging program, and the number of planned and installed partner charging stations increased by 70 percent between June 2014 and December 2015.

---

[92] "The EV and PV Power Purchase Handbook," Colorado Energy Office, Refuel Colorado Program, http://www.refuelcolorado.com/Power_Purchase_Handbook.pdf.

[93] "Workplace Charging Challenge: Join the Challenge," U.S. Department of Energy, Accessed May 2016, http://energy.gov/eere/vehicles/workplace-charging-challenge-join-challenge.

[94] *Workplace Charging Challenge Mid-Program Review: Employees Plug In*, U.S. Department of Energy, EV Everywhere, December 2015, http://www.energy.gov/sites/prod/files/2015/12/f27/105313-5400-BR-0-EERE%20Charging%20Challenge-FINAL_0.pdf.

Fees

A number of transportation stakeholders have voiced concerns over the growing EV market and what the impacts will be on fuel use nationwide. Since the gasoline tax is used for funding road and bridge repair, and EVs (both PEVs and PHEVs) use little to no fuel, there could potentially be a shortfall in the transportation budget. For this reason, several states have enacted laws that require EV owners to pay additional registration fees to help make up for lost revenue as well as to plant seed funding for the region's EV network.

Examples

The states of Colorado, Georgia, Idaho, Michigan, Missouri, Nebraska, North Carolina, Oregon, Virginia, Washington and Wyoming are among those who are charging a higher fee for EV registrations. The idea is that EV drivers should pay their "fair share" of road-user fees. Supporters of this legislation feel that instituting this fee early on in the EV-adoption process helps prepare the market for accelerated deployment. While EV sales are low now and gasoline taxes have not yet taken a noticeable decline, the EV market will grow, and this fee will ensure that roads and bridges continue to be funded at current levels. In addition, the higher registration fee for EVs is relatively low, and, in many cases, directly funds charging infrastructure that the payees use. However, recent studies suggest that annual EV-specific fees actually have a negative impact on EV sales.[95] The benefits of this policy must be carefully weighed with the risks of stifling an emerging EV market in Iowa.

Action

Deciding to pursue this issue is a decision that the State of Iowa, decision makers and EV stakeholders must carefully evaluate. There are both benefits and disadvantages to pursuing this type of fee-based policy. Consulting with energy offices from across the U.S. would be the best way to assess the positive and negative outcomes of this legislation now that many of these policies have been in place for several years.

Impact

There are two main impacts that can arise from the implementation of this type of policy. On the positive side, the fee structure can be split so that roads are in the appropriate state of repair for all drivers and that fees are collected from all users. Additionally, many are in favor of EV drivers self-funding the expansion of the charging network of which they will be the exclusive users. On the other hand, there is always the chance that a fee structure, which is perceived to penalize EV owners, will discourage adoption and stunt market growth.

---

[95] Lingzhi Jin, Stephanie Searle, and Nic Lutsey, *Evaluation of State Level U.S. Electric Vehicle Incentives*, The International Council on Clean Transportation, October 2014, http://www.theicct.org/sites/default/files/publications/ICCT_state-EV-incentives_20141030.pdf.

Electric Highways

Strategic siting of charging stations is a key endeavor that will ensure high charging rates, extend vehicle range, and soothe range anxiety, as well as encourage more electrified miles traveled across the United States. Identifying the right distance between charging stations, the proximity to major thoroughfares, and the amenities needed to encourage drivers is essential for establishing this network.

Examples

To meet this goal, efforts are taking place at both the federal and state level. The U.S. Department of Transportation must designate a national network of EV charging stations on highways, among other alternative fueling stations. In addition, in Illinois the Department of Transportation must construct and maintain at least one EV charging station at every location along toll highways where an entity is already providing fuel, facilities, garages, stores or restaurants.

Action

The state can take the electrified highway concept in Figure 18 and use this to begin planning efforts for a fueling corridor. By strategizing and dividing the highways into sections, stakeholders can target the mostly frequently traveled corridors with the highest vehicle counts. EV advocates can also compare the electrified highway concept against clusters of EV registrations in certain zip codes, as shown in Figure 18, to determine where EV drivers are likely to travel. These resources can serve as a guidebook to EV leaders to begin a strategic build-out of the charging network that will support the future market.

Impact

The main impact of a robust fueling corridor for EVs is that it will eliminate range anxiety, which is a main barrier to implementation, as evidenced by the fact that a majority of respondents (56 percent) to a recent NREL survey stated that they would not purchase an EV unless the vehicle could travel at least 300 miles on a single charge.[96] In Iowa, where hundreds of miles may separate many metropolitan areas along highways, the development of this network is essential to creating a market where driving across the state is not a challenge. In addition, the development of an electrified highway is also likely to attract out-of-state drivers, resulting in more visitors and revenues coming to the state.

Multi-Unit Properties: Residential and Commercial

Multi-unit properties present unique challenges in installing EV charging stations. In the residential sector, homeowner associations (HOAs) and property management companies have often rejected proposals to install EVSE. Often, decision makers do not have the proper knowledge or training to determine that these projects are safe and can attract business and/or residents.

[96] Mark Singer, *Consumer Views on Plug-in Electric Vehicles – National Benchmark Report*, National Renewable Energy Laboratory, January 2016, http://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

Examples

In California, Oregon and Colorado, laws are in place to make sure that property managers across sectors cannot apply a system of blanket denials for EV charging stations. However, many of these laws also carry a heavy responsibility for the party who is pursing the installation. The laws in these three states mandate that a lessor of a dwelling or commercial property must approve written requests from a lessee to install EVSE in a parking space, provided the lessee cover the costs of installation, the equipment and removal, as well as carry an insurance policy naming the development as additional insured.

The New York State Energy Resource and Development Authority (NYSERDA) published a study that named best practices zoning in Vancouver, British Columbia and Los Angeles, California:[97]

> *In Vancouver, a municipality created a collaborative working group to develop EV-readiness strategies with the intent of meeting long-range GHG [greenhouse gas] reduction goals, and it became the first North American municipality to mandate EVSE-ready electrical installation in all new residential and commercial construction. In the Los Angeles metropolitan area, high statewide standards required by CALGreen, the nation's first mandatory green building code, and local amendments work in concert with utility-led efforts to plan for EV readiness across complex jurisdictional boundaries.*

Action

Pursuing this type of policy action requires buy-in from multiple parties who have an active interest in the process. HOAs, property developer interest groups, and property management companies will all have concerns that need to be addressed in crafting this type of legislation. However, as the EV market expands and the safety of the units and the vehicle charging process is better understood, there will be less of a need for properties that legislate these types of agreements.

Stakeholders could help with local permitting and zoning efforts by educating installers who obtain permits for charging stations to easily understand the applicable requirements and codes. In addition, other recommendations made by the NYSERDA study include reducing consumer costs by lowering fees for residential installations. This can be done by classifying residential EVSE installations as minor label work and by incentivizing and encouraging the incorporation of EVSE by modifying building codes (when economically appropriate) so that they require that a percentage of new accessory parking be pre-wired for EVSE, providing flexibility for future capacity.[98]

---

[97] *EV-Ready Codes for the Built Environment: Electric Vehicle Supply Equipment Support Study*, New York State Energy Research and Development Authority, November 2012. http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EV-Ready-Codes-for-the-Built-Environment.pdf.

[98] *EV-Ready Codes for the Built Environment: Electric Vehicle Supply Equipment Support Study*, New York State Energy Research and DA, November 2012, http://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EV-Ready-Codes-for-the-Built-Environment.pdf.

[99] Paul Menser, "Charging Behavior Revealed: Large National Studies Analyze EV Charging Infrastructure Needs," Idaho National Laboratory, Accessed May 2016, https://www.inl.gov/article/charging-behavior-revealed-large-national-studies-analyze-ev-infrastructure-needs/.

Impact

Opening up public, shared spaces overcomes a major barrier in the EV market. According to INL, between 57 and 65 percent of all charging events takes place at home.[99] If a driver who lives in an apartment building or an HOA finds that he or she is unlikely to charge an EV on his or her property, it is reasonable to assume that he or she will not choose to drive one. In addition, the build-out of an electrified highway depends on commercial businesses installing and operating EVSE. If a lessee finds that it is not allowed to do so, a robust network of EV charging will never thrive.

Airport and Aviation

Airports represent a key opportunity for EV charging on two levels. First, airport visitors who drive EVs will need to charge their car while on-site—either as travelers themselves or while providing transportation for other guests. Second, ground vehicles which operate exclusively on the airport property represent a significant opportunity for EV charging as they drive many miles within a short radius. While no EV airport policies exist yet at the state level in Iowa, there are federal programs that the aviation sector can take advantage of.

Examples

The Zero Emissions Airport Vehicle and Infrastructure Pilot Program[100] covers 50 percent of the costs for ZEVs and provides additional funds for fueling stations. The Federal Aviation Administration manages this effort. In 2015, $42.4 million in environmental grants were given to airports.[101] Public-use airports in Environmental Protection Agency-designated nonattainment and maintenance areas for air quality standards are eligible for this funding. In Iowa, Muscatine County is out of attainment for the sulfur dioxide standard, and Pottawattamie County is in noncompliance for lead.[102] In these areas, the Muscatine Municipal Airport in Muscatine County, as well as the Council Bluffs Municipal Airport, would be eligible for funding in Pottawattamie County, respectively. Applications are due by January 1 each year, and the agency will give funding priority to applications that demonstrate the greatest air quality benefits measured by the amount of emissions reduced per dollar of funds expended.[103] Another consideration is public access to charging—90 percent should be for dedicated on-airport vehicle use with 10 percent available for public use.[104]

---

[100] "Zero Emissions Airport Vehicle and Infrastructure Pilot Program," U.S. Department of Transportation, Federal Aviation Administration, last modified February 24, 2016, accessed May 26, 2016, http://www.faa.gov/airports/environmental/zero_emissions_vehicles/.

[101] "Zero Emissions Airport Vehicle and Infrastructure Pilot Program," U.S. Department of Transportation, Federal Aviation Administration, last modified February 24, 2016, accessed May 26, 2016, http://www.faa.gov/airports/environmental/zero_emissions_vehicles/.

[102] "Current Nonattainment Counties for All Criteria Pollutants," U.S. Environmental Protection Agency, last modified June 17, 2016, accessed May 31, 2016, https://www3.epa.gov/airquality/greenbook/ancl.html.

[103] *Zero Emissions Airport Vehicle and Infrastructure Pilot Program Technical Guidance*, U.S. Department of Transportation, Federal Aviation Administration, http://www.faa.gov/airports/environmental/zero_emissions_vehicles/media/Zero-Emissions-Vehicles-Tech-Guidance.pdf.

[104] *Zero Emissions Airport Vehicle and Infrastructure Pilot Program Technical Guidance*, U.S. Department of Transportation, Federal Aviation Administration, http://www.faa.gov/airports/environmental/zero_emissions_vehicles/media/Zero-Emissions-Vehicles-Tech-Guidance.pdf.

Action

According to the AFDC, publicly available charging stations are not yet available at either of these airports. The stakeholders in Iowa's EV Charging Study could help the eligible airports formulate a plan for EVs by sharing information about Electric Vehicle Charging Station Ownership and Operational Responsibilities, creating a budget and estimate costs for EV charging stations, and using the maps in the Current Public EV Charging in Iowa section to determine how airport EV charging will fit into a larger statewide plan.

Impact

Each airport will need to carefully assess the habits of its fleet to identify the proper duty cycle for EV implementation. The optimal application for EVs part of an airport fleet would be light-duty vehicles that drive cyclical routes or short distances at a time and have an opportunity for charging every 75–100 miles. If a vehicle is returning to a home-base each night, a Level 1 charge can get the vehicle battery back to capacity in time before the morning shift begins.

In addition, the types of passenger vehicle trips occurring at airports should be evaluated. For longer dwell times taken by airline passengers, Level 1 charging should accommodate those who will be leaving their vehicle in a parking spot for more than 4 hours. For those who will be spending a short time on-site, Level 2 and DC fast charging can allow visitors to get their battery back to a state of full charge more rapidly.

If EVs and publicly available charging are introduced at airports, a net positive air quality impact could occur. Data from the AFDC suggest that in Iowa all EVs placed into service could potentially cut CO_2 emissions in half by replacing its gasoline counterpart.

Table 12: Annual Emissions per Vehicle[107]

Vehicle Type	Pounds of CO_2 Equivalent
Gasoline	11,435
Plug-In Hybrid	6,731
Hybrid	6,285
All-Electric	5,440

[106] U.S. Department of Transportation, Federal Aviation Administration, Office of Airports Planning and Environmental Division, *VALE Brochure*, http://www.faa.gov/airports/environmental/vale/media/VALE-brochure-2016.pdf, Accessed May 26, 2016.

[107] U.S. Department of Energy, Alternative Fuels Data Center, Emissions from Hybrid and Plug-In Electric Vehicles, http://www.afdc.energy.gov/vehicles/electric_emissions.php, search for Iowa conducted on May 31, 2016.

Dealerships

Currently, Tesla Motors does not have the authority to sell vehicles in-person to consumers in the state of Iowa. Under state law, dealerships have to be insured, have a physical location to conduct vehicle repairs, be bonded through the state, and be franchised, as opposed to having automakers selling directly to consumers.[108] This means that Tesla cannot open a showroom for the general public as they do not meet these criteria.

In addition, dealership programs are a great way to drive the EV market by reducing the price of EVs even lower than subsidies and incentives can. A "power purchase" program ideally pairs EVs with rooftop solar—although either can be done on a stand-alone basis. A group purchase program can serve as a very effective tool to help constituents understand that EVs available today are affordable, comfortable, and able to meet consumers' needs for many types of trips. These programs can also inform constituents that home solar systems can reduce emissions and save consumers money. Thus, starting a group purchase program may be an effective method for spurring local EV and solar markets for those who feel these systems are just outside of their price range.

Examples

In both Nevada and New Jersey, a vehicle manufacturer is not explicitly required to sell cars through a franchised dealership if the car is powered by an electric motor and only sells new or used cars that it manufactures. This type of law is also called the "Tesla Exemption." This allows for Tesla to have a presence in more states and impact sales of EVs. Other states that allow Tesla to have a showroom include Washington, Oregon, California, Utah, Colorado, Nevada, Arizona, Minnesota, Missouri, Texas, Illinois, Indiana, Ohio, Tennessee, Georgia, Florida, North Carolina, Maryland, Pennsylvania, New York and Massachusetts.[109]

The EV Power Purchase Program has been implemented in Colorado and Minnesota with Nissan and is a mechanism for local community groups to work with dealerships to provide deep discounts on EVs. These programs are modeled after successful solar power group purchase programs, which dozens of communities have adopted since the first program was pioneered in Portland, Oregon, in 2010.

Action

The State of Iowa and various EV stakeholders could work together with groups such as the Iowa Automobile Dealers Association to craft legislation that allows Tesla to sell directly to Iowans, yet still meet the regulations that franchised dealerships are subject to in the interests of fairness. Alternatively, if this legislation is not possible due to political interests, perhaps a compromise could be reached that allowed Tesla to conduct test drives of their vehicle in Iowa. A 2009 U.S. Department of Justice advocacy report recommends "eliminating state bans on direct manufacturer sales in order to provide automakers with an opportunity to reduce inventories and distribution costs by better matching production with consumer preferences."[110]

---

[108] The Iowa Legislature, Iowa Code 2016, Section 322.2 http://coolice.legis.iowa.gov/Cool-ICE/default.asp?category=billinfo&service=IowaCode&input=322.2, Accessed June 1, 2016.

[109] Tesla Motors, https://www.teslamotors.com/findus, Accessed May 31 ,2016.

[110] The U.S. Department of Justice, *Economic Effects of State Bans on Direct Manufacturer Sales to Car Buyers*, May 2009, https://www.justice.gov/atr/economic-effects-state-bans-direct-manufacturer-sales-car-buyers.

The optimal model for an EV Power Purchase program would be to have the effort spearheaded by one single entity, with multiple market champions acting on the local level to cultivate dealership relationships, identify potential solar partners, and market the program. There are three basic elements to an EV group power purchase program: competitive selection process by a local government or nonprofit to choose one or more EV dealers; outreach effort led by local government or community organizations; and a limited-time offer to drive people to act quickly.[111]

Impact

According to the Clean Technica Blog, 1,730 pre-orders for the Tesla Model 3 have been placed in the state of Iowa.[112] This figure shows a high level of interest—nearly twice as high as the current number of available EVs in Iowa. By allowing Tesla to sell, or at least offer test drives to prospective customers in-state, Iowa could directly facilitate additional sales of EVs for those who are not willing to drive to another state to purchase.

The state of Colorado has seen significant impacts from the EV power purchase program, and there is every reason to expect that Iowa would see improved results as well. The group purchase program allows auto dealers to reduce customer acquisition costs by bringing in more customers than usual with minimum additional outreach needed. The value of these reduced acquisition costs offsets the discount on EVs offered to program participants. The impacts of this program have been between a four- and six-fold increase in sales from their usual EV baseline for these dealerships.[113]

---

[110] The U.S. Department of Justice, *Economic Effects of State Bans on Direct Manufacturer Sales to Car Buyers*, May 2009, https://www.justice.gov/atr/economic-effects-state-bans-direct-manufacturer-sales-car-buyers.

[111] *The Electric Vehicle and Photovoltaic Power Purchase Handbook*, State of Colorado Energy Office, Refuel Colorado, http://www.refuelcolorado.com/Power_Purchase_Handbook.pdf.

[112] Kyle Field, "New Map Estimates Tesla Model 3 Reservation Locations," Clean Technica, April 26, 2016, http://cleantechnica.com/2016/04/28/new-map-estimates-tesla-model-3-reservation-locations/.

[113] The Electric Vehicle Power Purchase Handbook, State of Colorado Energy Office, Refuel Colorado, 2016, http://www.refuelcolorado.com/Power_Purchase_Handbook.pdf.

Electric Vehicle Charging Station Ownership and Operational Responsibilities

There are many factors that influence the decision to install and maintain EV charging infrastructure on available property, including the case for business, environmental reasons, or a role in reducing petroleum consumption in the transportation sector. No matter the reason, the financial responsibilities of owning and operating an EV charging station can be complex and numerous, including equipment, labor and installation, electricity charges, as well as networking and software fees. This section outlines the costs, requirements and considerations that all property managers should weigh when implementing an EV charging station or EVSE.

Deploying an EV Charging Station

Charging station owners will need to carefully match their location type and potential needs with the right type of EVSE to ensure that they can power the unit effectively and offer drivers the right level of charging for the range of their vehicle. In addition, the proper pairing of location type with appropriate level of charging can attract EV drivers to a place of business, which could result in increased revenues for the business, and employers can use EV charging as a way to recruit new employees and meet their corporate greening goals. This is further discussed in the Business Case section of this study.

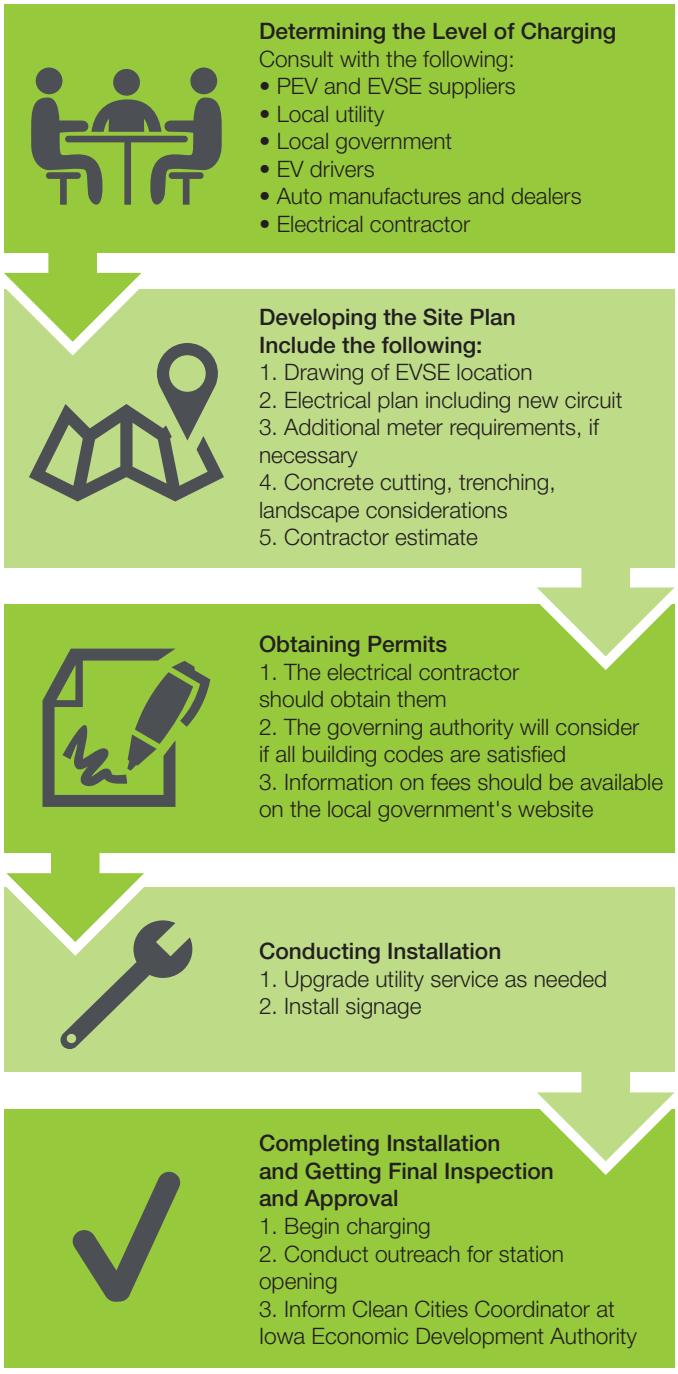
Table 13: Summary of EV Charging[114]

	AC Level 1	AC Level 2	Level 3/DC Fast-Charging
Voltage	120V	• 240V (typical in residential applications) • 208V (typical in commercial applications)	208/480V AC three-phase input
Range	2–5 miles of range per 1 hour of charging	10–20 miles of range per 1 hour of charging	50–70 miles of range per 20 minutes of charging
Equipment needed	SAE J1772 standard connector for vehicle	SAE J1772 standard connector for vehicle	• J1772 combo • CHAdeMO • Tesla Supercharger
Ideal locations	• Airports • Home • Hotels	• Libraries • Museums • Public buildings/ courthouses • Recreation centers • Restaurants • Shopping centers • Stadiums • Public parks	• Banks • Fast food restaurants • Gas stations • Grocery stores • Pharmacies • Rest stops • Stand-alone points on heavy traffic corridors (e.g. stations at strategic intervals as part of an "Electric Highway")

[114] Alternative Fuels Data Center- http://www.afdc.energy.gov/fuels/electricity_infrastructure.html. Accessed on 4/20/16.

While there is no prescriptive way to move from the concept of a charging station to the official opening of one, there are several steps that stakeholders should consider. The flow chart and tables below offer some high-level guidance on what steps should be followed and the viewpoints that should be taken into account for each type of stakeholder.

Figure 19: Process flow chart[115]



[115] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, 2012, http://www.afdc.energy.gov/pdfs/51227.pdf.

EV Stakeholder Engagement

Cultivating the right mix of stakeholders and considering their diverse viewpoints is crucial to developing a viable charging network across Iowa. There are many interested parties that have unique concerns in the development of an EVSE unit. Marrying the requests of drivers, government representatives, businesses, utilities and electricians can be a complicated endeavor. However, the input of all of these participants will increase the likeliness that the station will be utilized more often and that it will become a valued piece of a strategic charging network.

Table 14: EV Stakeholder Engagement Matrix[116]

Key stakeholder group	Key stakeholder interests and considerations
EV owners/advocacy groups	Location, convenience, accessibility, lighting, signage, promotion and cost
Utilities	Rate structure, availability of power, metering, total load management, demand charges and level of charging
Local governments	Planning, zoning, permitting, right-of-way access, signage, traffic and inspection
Original Equipment Manufacturers	Impact on vehicle sales, development of vehicle technologies, ratio of chargers to vehicles, vehicle capabilities and level of charging
Business owners	Business case (including publicity, cost-sharing, public-private partnerships and advertising), promotional value, operational and ownership responsibilities and payment methods
Contractors	Site assessments (proximity to utility panel, flooding/water and safety), building codes, zoning, permitting, electrical plans, meter requirements, equipment costs and hourly labor rates

Costs and Considerations Associated with EV Charging

There are a variety of costs that should be considered when evaluating the purchase and installation of an EV charging station. Line items that make up a total project cost include the cost of the EVSE unit, contracted labor, in-house labor, materials and incidentals, equipment rental (backhoe, jackhammer, etc.), sidewalk demolition and repair, EVSE features such as radio frequency identification (RFID) card reader, signage and paint, and permitting and inspection costs—as well as the incentives that could be claimed to offset the cost of installation.[117] There are a myriad of ways to keep costs low if budget is the main constraint for the project, and there are also ways to add features to build a custom charging experience for users of the station if visibility and a high profile are the main objective. A 2013 study by the Electric Power Research Institute (EPRI) showed that the four main cost areas of an EV charging station are labor, materials, permits and tax.

---

[116] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, 2012, http://www.afdc.energy.gov/pdfs/51227.pdf.

[117] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, 2012, http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf.

EVSE Equipment and Installation

The costs vary widely for the installation of EV charging stations. The two elements that stand out as having the biggest potential impact on the project budget are the equipment's features and the location of the charging station. Charging stations that lack extra features and offer the slowest level of charging, such as a simple Level 1 wall outlet, carry the lowest potential costs for equipment and installation. On the other end of the spectrum, a Level 3 DC Fast Charger that is fully networked with RFID cards and a LCD (liquid crystal display) monitor for advertising is likely to carry the largest price tag.

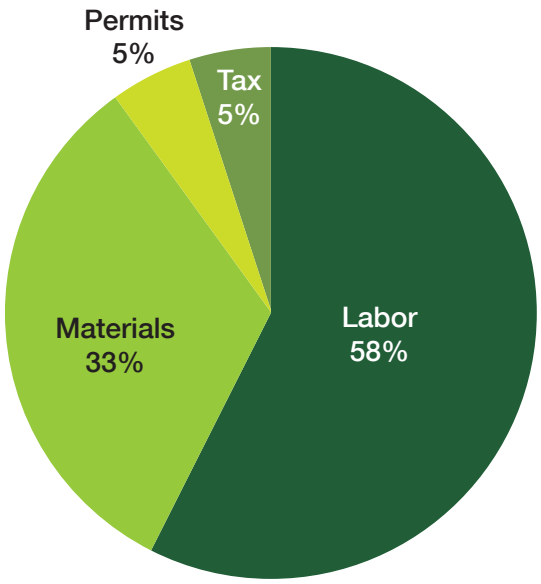
The cost of hiring an electrical contractor can vary depending on many factors, but research on www.salary.com suggests that the average hourly rate for an electrician is lower in Iowa when compared with the rest of the U.S. Most electricians also will secure the proper permits with the local government with jurisdiction over the charging station location. A best practice followed by many public and private agencies is to open a bid process to obtain multiple quotes for the project. Instead of selecting a contractor and equipment manufacturer based solely on the lowest cost, consider other factors such as experience in installing an EVSE, familiarity with the National Electric Code (NEC) Guidelines found in NEC Article 625, as well as references from other agencies that have used their services.

Table 15: Cost Estimates and Ranges for EVSE Equipment and Installation[118]

	AC Level 1	AC Level 2	Level 3/DC Fast Charging
Equipment cost range	$300–$1,500	$400–$6,500	$10,000–$40,000
Installation cost range	$0–$3,000	$600–$12,700	$4,000–$51,000
Total project range	$300–$4,500	$1,000–$19,200	$14,000–$91,000

[118] Margaret Smith and Jonathan Castellano, *Costs Associated with Non-Residential Electric Vehicle Supply Equipment*, U.S. Department of Energy, November 2015, http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf.

Figure 20: Average EVSE installation cost breakdown[119]



Electricity Upgrades

The level of charging that is planned, coupled with the site's electrical needs, may possibly require an electrical upgrade at the site. The reasons for needing an upgrade in electrical capacity can include the trenching of a conduit for a station that is not in close proximity to the electrical panel, plans for the expansion of charging ports to accommodate future EV growth (which is less expensive than modifying the site at a later time),[120] as well as for the installation of a submeter or to increase capacity of an existing electrical panel. A new transformer nearby may even be needed. Station hosts should receive all of this information in their estimate prior to selecting a vendor to complete the job.

Compliance with Americans with Disabilities Act (ADA) Regulations

In places where parking is provided to the public, requirements for providing accessible parking spaces (also called "parking for persons with disabilities") are established by the federal Americans with Disabilities Act,[121] Iowa Code Chapter 321L and administrative rules adopted by the Iowa Department of Public Safety (661 Iowa Administrative Code Chapter 18).[122]

---

[119] *Electric Vehicle Supply Equipment Installed Cost Analysis*, Electric Power Research Institute, December 2013, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002000577.

[120] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, 2013, http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf.

[121] *ADA Requirements for Workplace Charging Installation*, U.S. Department of Energy, 2014, http://energy.gov/sites/prod/files/2015/11/f27/WPCC_complyingwithADArequirements_1114.pdf.

[122] "Regulatory Assistance," Iowa Department of Public Safety, last updated June 28, 2011, accessed May 2016, http://www.dps.state.ia.us/regassist/accessible_parking.shtml.

Table 16: Compliance with ADA regulations

Element	ADA/ABA 2004 ANSI A117.1 2003 requirements
Number of spaces	Four percent of parking spaces, or one for every 25 spaces, in any given lot, should be designated as accessible; one out of every six spaces should be van accessible.[123]
Parking stall	Dimensions should be 8 x 18 feet for a car and 11 x 18 feet for a van.
Accessible route width	The minimum width is 36 inches.
Accessible route slope/ cross slope	The maximum is 1:20 (5 percent) for running slope and 1:48 (2 percent) for cross slope. There should be accessible vehicle spaces 1:48 (2 percent) in all directions and 90-inch clearance for vans.
Reach range	The reach range is 48 inches in front and on the side to allow reach to all operable parts from a wheelchair.
Accessible controls	The controls must be operable with one hand and not require grasping, pinching or twisting of the wrist or require exerting force of more than 5 lbs (exception: gas pumps).
Accessible ramps	A ramp or curb-cut must be accessible in order to allow for operation of charging station.
Facility accessibility	The facility must be connected by a 50-inch wide (at minimum) accessible route in proximity (not necessarily adjacent) to the entrance of the building.[124]
Side access aisle	A side access aisle, 60 inches wide, is needed to allow space for a wheelchair and equipment in and out of the space.
Accessible card reading devices	Accessible card reading devices must be connected by an accessible route (minimum 50-inches wide) in proximity (not necessarily adjacent) to the entrance of the building.
Other considerations	Ensure that bollards, wheel stops or the curb do not obstruct use of charging station.

Operation Costs

The cost of electricity is a major operating cost for an EV charging station, both from the consumption standpoint as well as from any demand charges that are incurred. Also included is the cost of networking a station so that it can transmit and receive data, any maintenance and repair work, and staff time to manage the EV charging station.

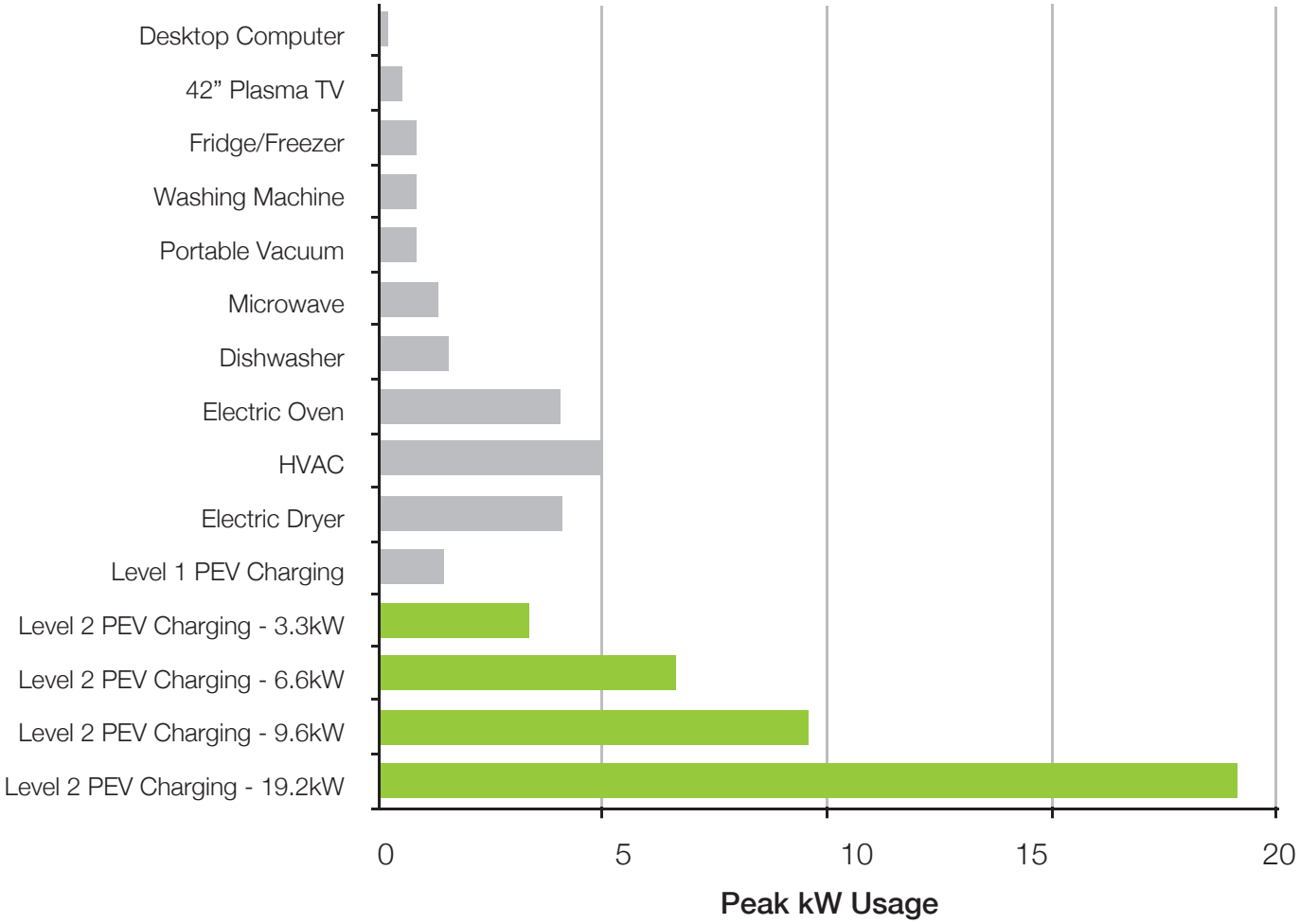
[123] David Mayfield, *Electric Vehicle Charging for Persons with Disabilities*, Sustainable Transportation Strategies, February 2012, http://www.vacleancities.org/wp-content/uploads/EV-Charging-ADA-Version-1.0s.pdf.

[124] *EV Project: Accessibility at Public EV Charging Locations*. ECOtality North America forU.S. Department of Energy, 2011, https://www.mwcog.org/uploads/committee-documents/al1fV1dd20111122135221.pdf.

Electricity Consumption

The energy demands of EV charging can vary greatly depending on the level of charging, amps required, and the equipment's specific needs. Level 1 charging electrical demand is comparable to that of a dishwasher or a microwave. Level 2 charging varies, but it can range from having less demand than an oven or home air conditioning unit at the low end, and at the high end, it can increase a home's total load by nearly a factor of four.[125]

Figure 21: Typical PEV residential charging load compared to other household appliances



[125] *Plug-in Electric Vehicle Charging Infrastructure Guidelines for Multi-unit Dwellings*, California Plug-In Electric Vehicle Collaborative, November 2013, http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/MUD_Guidelines4web.pdf.

Regardless of the amount of energy drawn at a peak power rate, utilities can bill customers for demand charges. This is done most commonly for commercial properties. In contrast to the total energy usage that is the more familiar utility charge, a demand charge is triggered by a one-time occurrence of an elevated power level (usually an average over a 15-minute interval) and is not a cumulative charge.[126] Demand charges can add significantly to the utility bill for an EVSE host, and they can make EVSE hosting cost-prohibitive. Customers should check with their utility to learn more about demand charges and determine which programs are in place to offset these costs and incentivize EV charging.

ECOtality's EV Project, which deployed more than 12,000 EV charging stations across the U.S., and collected charging data on 8,300 LEAFs and Volts, amassed a large database from 2012–2014 of EV driver charging behavior, representing almost 125 million miles of driving and 4 million charging events over 2 years. During their study, they determined mechanisms to avoid demand charges, which include the following strategies:[127]

1. Never allow the overall site power demand to exceed a specified value.
2. Attempt to ensure that the average power over the interval is less than or equal to a specified value.
3. Attempt to recoup the demand charge cost through structured pricing for EVSE charging.
4. Add an energy storage system that buffers the EVSE unit from high power demands during charging.
5. Aggregate demand among multiple EVSE installations into one demand charge calculation, taking advantage of the diversity that may exist in individual unit usage.
6. Provide demand response capability to the utility to either offset or circumvent demand charges.
7. Work with utilities to create a tariff that exempts EVSE usage from demand charges.

Network Fees

As an increasing number of EVs are deployed in Iowa, the demand for public charging will increase. This could lead EVSE station hosts to begin charging for electricity. When the market evolves to this point, there are many options for how stations can be networked to receive payment from drivers. Whichever network type is implemented, it is essential that it does not discourage public charging. Below is a table that illustrates the various network set-ups, as well as the pros and cons associated with each.

---

[126] *Lessons Learned – The EV Project DC Fast Charge - Demand Charge Reduction*, ECOtality North America, for the U.S. Department of Energy, May 2012, https://avt.inl.gov/sites/default/files/pdf/EVProj/DCFastCharge-DemandChargeReductionV1.0.pdf.

[127] *Lessons Learned – The EV Project DC Fast Charge - Demand Charge Reduction*, ECOtality North America for the U.S. Department of Energy, May 2012, https://avt.inl.gov/sites/default/files/pdf/EVProj/DCFastCharge-DemandChargeReductionV1.0.pdf.

Table 17: Network Feature Pros and Cons

Network type	Pros	Cons
Subscription-based	A fob or access card will grant access to all chargers in that network. Charging proceeds will offset installation costs. Drivers know what to expect with relatively consistent monthly rates.	Drivers without a subscription to the network are unable to charge at that location. Monthly/annual fees are not necessarily commensurate with use.
Pay-per-charge	There is flexibility for the EVSE operator—charge can be a flat or per-kWh (where legal) fee. EV owners are only charged per event and not on a monthly basis.	Iowa law prohibits charging for kWh on a watt-for-watt basis unless the operator is a utility. Drivers could end up paying more for one-off charging.
Mobile application	Anyone with a smart phone can instantly access the network to charge. No credit cards or cash are needed. Drivers can track electricity use and program charge events accordingly.	If the station is in an area with patchy service, it may be difficult to initiate a charging event. Not all drivers may have a smart phone.
Free charging	Free charging can rapidly expand EV deployment with drivers seeking free fuel. Free charging can attract drivers or employees to the business or location of EVSE.	There may be real or perceived issues of fairness if EV drivers are getting free fuel while owners of gasoline-powered vehicles are not. The EVSE owner/operator absorbs all costs and has no opportunity to pass on costs to drivers.

Maintenance and Repair

It is important that all owners and operators are prepared to keep their charging stations well-maintained and ready for EVs during regular hours of operation. The relatively limited ranges of EVs, coupled with the still-growing network of EV chargers, can lead to problems for drivers who have planned their trip and find themselves unable to access a charging station.

Examples of maintenance needs include making sure that access to the charging network (if applicable) is consistent for drivers, confirming that electrical access to the charging station is constant, regularly inspecting EVSE for damage to unit and cords and repairing/replacing as necessary, responding quickly to consumer concerns, and checking for hazards within the vicinity of the charging unit. Many manufacturers of EVSE also offer warranty or maintenance programs, which station owners should carefully evaluate to make sure that this option is cost-effective.

EV Signage

It is important for entities that provide EV charging to develop a clear internal policy that governs access, security, usage and other issues.[128] Signs are particularly important for public charging stations. Iowa should mark PEV parking/charging areas clearly with distinctive patterns on the ground and signs that can be seen over parked vehicles.[129] General service signs also are needed to direct motorists to charging stations. There are approved, advanced directional arrows that can be posted in combination with one of the identification signs for charging. There are generally four types of signage for EV charging stations:

- *Wayfinding* with arrows to point drivers in the correct direction
- *Permissive* (such as signs that allow parking for a certain amount of time) that are green and black on a white background
- *Prohibitory* (such as no parking signs) that are red and black on a white background
- *Regulatory* used for EV charging, which are needed to restrict access to charging stations and parking areas, or to limit the time of use

It is recommended that all EVSE owners and operators adhere to all federal, state and municipal

regulatory guidelines. To comply with these policies, guidance documents with detailed information and visual aids are available online:

- 2009 Edition of the Manual on Uniform Traffic Control Devices: http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm
- U.S. Department of Energy, Plug-In Electric Vehicle Handbook for Workplace Charging Hosts http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf
- U.S. Department of Energy, Plug-In Electric Vehicle Handbook for Public Station Charging Hosts http://www.afdc.energy.gov/pdfs/51227.pdf

According to DOE:[130]

> *Signage for EV charging stations is an important consideration at locations that offer access to charging. Appropriate charging station signage can:*
>
> - *Help PEV drivers navigate to and identify charging stations*
> - *Optimize use of EVSE by helping all drivers understand that parking spaces at charging stations are for PEVs only*

---

[128] *Plug-In Electric Vehicle Handbook for Workplace Charging Hosts*, U.S. Department of Energy, 2013, http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf.

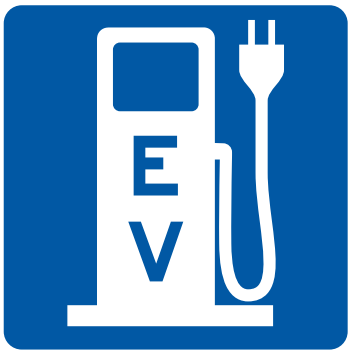
[129] Plug-In Electric Vehicle Handbook for Public Station Charging Hosts, U.S. Department of Energy, April 2012, http://www.afdc.energy.gov/pdfs/51227.pdf.

[130] "Workplace Charging Challenge: Signage Guidance," U.S. Department of Energy, Office Energy Efficiency and Renewable Energy, accessed May 2016, http://energy.gov/eere/vehicles/workplace-charging-challenge-signage-guidance.

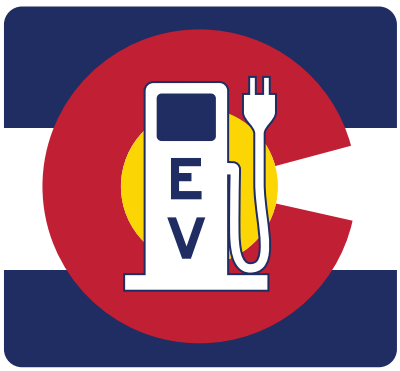
- *Provide information about regulations—such as access, time limits, and hours of use—and facilitate enforcement*
- *Promote awareness among employees by providing visibility for charging infrastructure to prospective PEV drivers*

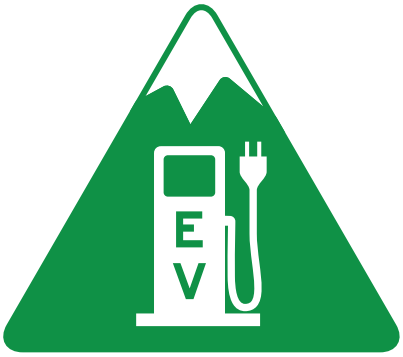
Parking areas, either publicly or privately owned, are not considered open to public travel and therefore owners and operators of parking areas with workplace charging are not required to comply with federal signage guidance. However, employers providing workplace charging may use this guidance as they strive to implement a successful workplace charging program.

The Federal Highway Administration uses the following signage to indicate that EV charging is available in public spaces:



As part of the *Electric Vehicle Market Implementation Study* published by the Colorado Energy Office in 2015, new signage options were created that utilize the framework of an EV charger but also have a Colorado look.





EV Charging Etiquette

"Station etiquette" is an important element to EV charging, and the policies that govern this can fall anywhere on the spectrum from informal management to legal repercussions for noncompliance. One of the most common ways to govern use of EVSE is to set time limits for charging. That way, numerous users can access the charging station throughout the day. It is recommended that the operator of an EV charging unit develop a policy that formalizes the time limits for each charging event, and designate an official manager to make sure that these rules are enforced. Installing clear, concise signage at the EV charging station also can help drivers understand the limitations to charging their vehicle. Where enforcement is limited or even nonexistent, this signage may be the only deterrent for non-EVs to park in front of charging stations and to limit the usage time of fellow EV drivers.[131]

The goal of EV stakeholders is to grow the charging network at a similar pace as the adoption of EVs increases. Early adopters of EVs should regard themselves as ambassadors of this mode of transportation. Ways that EV owners can demonstrate the positive attributes of this networking can include deferring charging their vehicle at a public station only when necessary, which makes charging available to those in real need. Unplugging cars that are charging and not complying with posted signage are discouraged. Additionally, station operators can designate parking spots for EVs that are not necessarily in a premium location to reduce the incentive for internal combustion engine vehicles to park in a plug-in vehicle charging spot.[132]

---

[131] *Plug-In Electric Vehicle Handbook for Public Charging Station Hosts*, U.S. Department of Energy, August 2013, http://www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf.

[132] Kyle Field, "Plug-In Vehicle Public Charging Etiquette," Clean Technica, January 20, 2016, http://cleantechnica.com/2016/01/20/plug-vehicle-public-charging-etiquette/.

Acronym Glossary

AC	Alternating Current (AC Level I and AC Level II Charging)
ADA	Americans with Disabilities Act
AEO	*Annual Energy Outlook*
BEV	Battery electric vehicle
CMAQ	Congestion Mitigation and Air Quality
CO_2	Carbon dioxide is a greenhouse gas
DC	Direct Current (DC Fast Charging/Level III)
DOE	U.S. Department of Energy
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
EV	Electric vehicle (inclusive of both PEVs and PHEVs)
EVSE	Electric vehicle supply equipment
HOA	Homeowners' association
HOV	High-occupancy vehicle
ICCT	International Council of Clean Transportation
IEA	International Energy Agency
IEDA	Iowa Economic Development Authority
IOU	Investor-owned utility
IUB	Iowa Utilities Board
KCP&L	Kansas City Power and Light
kWh	Kilowatt-hour
MSRP	Manufacturer's suggested retail price
MW	Megawatt
MWh	Megawatt-hour
PEV	Plug-in electric vehicle (runs on only electricity)
PHEV	Plug-in hybrid electric vehicle (runs on both gasoline and electricity)

NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
RFID card	Radio Frequency Identification card, used to identify users of charging stations
TOU	Time-of-use rate
V	Volt
VALE	Voluntary Airports Low Emissions program
VMT	Vehicle miles traveled
ZEV	Zero-emission vehicle

Appendix 1: Electric Vehicle Policy Table

Policy type	Brief Description	States/Federal
Airport	Zero Emissions Airport Vehicle and Infrastructure pilot programs covers 50% of costs for ZEV vehicles and additional funds for fueling stations.	Federal
Airport	The Voluntary Airport Low Emission (VALE) Program is to reduce emissions from vehicles in ozone and carbon monoxide non-attainment areas.	Federal
Building Codes	The California Building Codes Commission published mandatory building codes for EVs, and Washington requires all municipalities to create regulations for EVSE.	California, Washington
Carpool/Parking/ Exemptions	EV owners do not need to participate in emissions testing.	Arizona, Colorado, Connecticut, Florida, Idaho, Massachusetts, Michigan, Missouri, Nevada, New York, North Carolina, Ohio, Rhode Island, Tennessee, Virginia and Washington
Carpool/Parking/ Exemptions	Electric and alternative fuel vehicles are exempt from HOV lane requirements.	Federal, Arizona, California, Georgia, Nevada and North Carolina
Carpool/Parking/ Exemptions	Alternative fuel vehicles, including EVS, may park at metered spots without paying a fee.	Nevada
Carpool/Parking/ Exemptions	EVs are eligible for a discounted toll pass for off-peak hour crossings	New York and New Jersey
Carpool/Parking/ Exemptions	ZEVs sold do not have to pay state sales and use tax.	New Jersey
Carpool/Parking/ Exemptions	Alternative fuels are exempt from state retail sales and use tax.	North Carolina, Washington, West Virginia and Washington DC
Dealership	Alabama Power offers $250 to vehicle dealerships for each new PEV sale or lease.	Alabama
Dealership	Dealerships that sell new cars must make customers aware of alternative fuel vehicles and incentives.	Arizona
Carpool/Parking/ Exemptions	All parking lots with a minimum number of spots (designated by statute) must have a certain percentage of spots designated for EVSE.	California, Hawaii

Policy type	Brief Description	States/Federal
Employer Program	Local air quality planning agencies have funding available for employers to use in order to invest in charging station and vehicle procurement.	California
Carpool/Parking/ Exemptions	A vehicle that is not capable of charging may not stop, stand, or park in a spot that is designated for EVS.	Florida
Dealership	A vehicle manufacturer is not required to sell cars through a franchised dealership if the car is powered by an electric motor and only sells new or used cars that it manufactures. Also called the "Tesla Exemption."	Nevada and New Jersey
Fees	Any offender who commits an air quality violation must deposit a portion of the funds into the local school district to be used on expanding the district's alternative fuel vehicle program.	Nevada
Fleet Mandate	Numerous state fleets must do an evaluation to determine cost, efficiency and availability of EVs and purchase when appropriate.	Federal fleets, Alaska, Arizona, California, Colorado, Connecticut, Illinois, Iowa, Massachusetts, Minnesota, Missouri, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin and Washington DC
Fleet Mandate	The Public Fleet Pilot Project offers rebates to state and local public entities for fleet vehicles in disadvantaged communities.	California
Dealership	The Electric Vehicle Power Purchase Program exists in Colorado and is a mechanism for local community groups to work with dealerships in providing deep discounts on EVs to drive ownership.	Colorado
Employer program	State agencies and departments must evaluate opportunities for commuting options, including workplace charging.	Colorado, Rhode Island and Wisconsin
Fees	EVs are subject to increased registration fees, which are spent on road and bridge repairs and/or funding a public EV charging network. This also includes decal programs.	Colorado, Georgia, Idaho, Michigan, Missouri, Nebraska, North Carolina, Oregon, Virginia, Washington and Wyoming

Policy type	Brief Description	States/Federal
Fuel Corridors	The U.S. Department of Transportation must designate a national network of EV charging stations on highways, amongst other alternative fueling stations.	Federal
Incentives/Loans/ Financing	U.S. DOE provides loan guarantees through the Loan Programs Office for up to 100% of the cost of projects that reduce air pollution and greenhouse gases.	Federal
Incentives/Loans/ Financing	Per H.R. 2029 in 2015, station owners and operators may receive up to 30% of the cost of an EV Charging Station as a tax credit. Consumers who purchased qualified residential fueling equipment prior to December 31, 2016, may receive a tax credit of up to $1,000.	Federal
Incentives/Loans/ Financing	The CMAQ funding program allows electric vehicles to be purchased for an air quality nonattainment or maintenance area.	Federal
Incentives/Loans/ Financing	A credit is available for two-wheeled plug-in electric drive vehicles that meet other criteria, up to 10% of the cost of the vehicle and is capped at $2,500.	Federal
Infrastructure	Alabama Power offers $750 towards qualified PEV purchases.	Alabama
Miscellaneous	State and local governments may lease land for installing, maintaining and operating EVSE or EV battery exchange stations for up to 50 years for at least $1 per year.	Washington
Fuel Corridors	The Department of Transportation must construct and maintain at least one EV station at every location along toll highways where an entity is already providing fuel, facilities, garages, stores or restaurants.	Illinois
Outreach	The California Public Utilities Commission provides resources to the general public to determine if their residence will need an electrical upgrade, basic charging circuit requirements, utility rate options, and load management techniques.	California

Policy type	Brief Description	States/Federal
Incentives/Loans/ Financing	Different states in the U.S. (through state agencies, air quality districts, non-profits, utilities, etc.) offer a different package of incentives and rebates to help spur deployment of EVs and/or EV charging stations. This also includes conversions for certain states.	California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Mississippi, Montana, New Hampshire, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont and Washington
Parking	EV owners may park in carpool spots.	Arizona
Parking	Only EVs that are currently charging are allowed in designated parking spots or subject to fine.	Arizona
Multi-unit dwelling	The lessor of a dwelling or commercial property must approve written requests from a lessee to install EVSE in a parking space, provided the lessee cover the costs of installation, the equipment and removal as well as carry an insurance policy naming the development as additional insured.	California, Colorado and Oregon
Permitting	A county with more than 200,000 people must create an ordinance to expedited and streamlined EV charging.	California
Public Transportation	Financial assistance for public transit vehicles involving low or no emissions through the Federal Transportation Administration.	Federal
Outreach	States have EV license plates available to drivers.	Arizona, Massachusetts and Rhode Island
Resale of electricity	An entity that owns, controls, operates or manages a facility that supplies electricity to the public solely for the purposes of charging and electric vehicle is not defined as a public utility.	California, Colorado, Florida, Hawaii, Idaho, Illinois, Maine, Maryland, Minnesota, Oregon, Utah and Virginia
Stations	State agencies may install EVSE and make it available to the public when none exists in a geographic area.	Oklahoma and Oregon
Stations	A PEV station must be identified by vertical signage that properly identifies the station and indicates that that it is only for PEV charging.	Washington

Policy type	Brief Description	States/Federal
Utility	Discounted TOU rates are available for customers of certain utilities. These are available from both utilities and from utility districts. Minnesota mandates this for all utilities.	Arizona, California, Georgia, Iowa, Michigan, Minnesota, New York, Virginia and Washington
Utility	The Maryland Department of Motor Vehicles is allowed to share vehicle registration data with the utility in the appropriate service area.	Maryland
Utility	Public Service Electric and Gas (utility) provides free EVSE to companies in their service territory for the purpose of workplace charging.	New Jersey
Utility	Utilities may seek recovery of costs associated with EV charging as part of a rate case filing through the state PUC.	South Carolina
ZEV Mandate	ZEV mandate states signed a memorandum of understanding to support the deployment of ZEVs.	California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island and Vermont

Appendix 2: Sample Resale of Electricity Language

California:

Assembly Bill 631, Ma. Public utilities: electric vehicle charging stations.

"Under existing law, the Public Utilities Commission has regulatory authority over public utilities, as defined. The existing Public Utilities Act requires every public utility to furnish and maintain adequate, efficient, just, and reasonable service, instrumentalities, equipment, and facilities as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public. This bill would provide that the ownership, control, operation, or management of a facility that supplies electricity to the public only for use to charge light duty plug-in electric vehicles, as defined, does not make the corporation or person a public utility for purposes of the act."

Illinois:

"An entity that furnishes the service of charging electric vehicles does not and shall not be deemed to sell electricity and is not and shall not be deemed a public utility notwithstanding the basis on which the service is provided or billed. If, however, the entity is otherwise deemed a public utility under this Act, or is otherwise subject to regulation under this Act, then that entity is not exempt from and remains subject to the otherwise applicable provisions of this Act. The installation, maintenance, and repair of an electric vehicle charging station shall comply with the requirements of subsection (a) of Section 16-128 and Section 16-128A of this Act."

Maryland:

"FOR the purpose of altering certain definitions of 'electricity supplier' and 'public service company' to exclude, for purposes of certain provisions of law, a person that owns or operates equipment used for charging electric vehicles; altering a certain definition of 'retail electric customer' to include certain persons and to exclude, for purposes of certain provisions of law, a person that charges an electric vehicle at an electric vehicle charging station, with a certain exception; and generally relating to exclusions from certain provisions of law for electric vehicle users and charging stations."

Appendix 3: Sample Employee EV Program Survey

1. Do you currently own a plug-in electric vehicle (PEV)?
    a. Yes
    b. No
2. Have you considered a PEV for your next vehicle?
    a. Yes
    b. No
3. Would access to charging your vehicle at work increase your likelihood of purchasing a PEV?
    a. Yes
    b. No
4. Would you be willing to pay for the electricity to charge your PEV at work?
    a. Yes
    b. No
5. What is the round-trip distance for you to commute to work each day?
    a. <5 miles
    b. <10 miles
    c. <25 miles
    d. <50 miles
    e. 50+ miles
6. Do you think we should offer PEV charging as an employee benefit?
    a. Yes
    b. No

Appendix 4: Sample Employer Considerations for Workplace Charging

The employee survey in the previous section can be used to gather information from staff. The questions below can be used to aggregate responses and then use in the "Best Practices" section to provide an effective workplace charging program.

1. How many employees do you have at the location you're considering for workplace charging?

2. How many employees currently drive plug-in electric vehicles (PEVs) at the workplace charging location?

3. How many employees have considered a PEV for their next car?

4. Are you willing to provide electricity to employees without a fee or cost for charging?

5. What percentage of your employees are full-time?
   - ❑ 0%–25%
   - ❑ 25%–50%
   - ❑ 50%–75%
   - ❑ 75%–100%

6. Do you own the property where your employees park?

7. How far is the nearest electrical outlet/infrastructure to the parking spaces you're considering for workplace charging?
   - ❑ <10 feet
   - ❑ 10–20 feet
   - ❑ 20–50 feet
   - ❑ 50–100 feet
   - ❑ 100+ feet

8. Do you want your company's charging stations to be open to the public at any time?
    a. Yes
    b. No
9. What data do you want to collect on charging usage? (Check all that apply.)
    a. Electricity used by each station
    b. Electricity used by all stations combined
    c. Time of day charging occurs
    d. Length of time charging occurs
    e. Who is charging
    f. We don't want to collect any data
10. Do you want the electricity you provide to be from renewable sources?

11. What is your project budget?

DOE encourages the Recipient to publish or otherwise make publicly available the results of work performed under this Award. The Recipient is required to include the following acknowledgement in publications arising out of, or relating to, work performed under this Award:

- *Acknowledgment:* "The information, data, or work presented herein was funded in part by the Office of Energy Efficiency and Renewable Energy (EERE), U.S. Department of Energy, under Award Number DE- DE-EE0006209.

- *Disclaimer:* "The information, data, or work presented herein was funded in part by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

IOWA® economic development

Iowa Clean Cities Coalition

BCS INCORPORATED

IOWA®
economic development

Iowa Economic Development Authority
200 East Grand Avenue | Des Moines, Iowa 50309
Phone: +1.515.725.3000 | E-mail: info@iowa.gov
iowaeconomicdevelopment.com