ELECTRIC VEHICLE PUBLIC CHARGING STATION HOST'S HANDBOOK

Iowa Clean Cities Coalition is a program of

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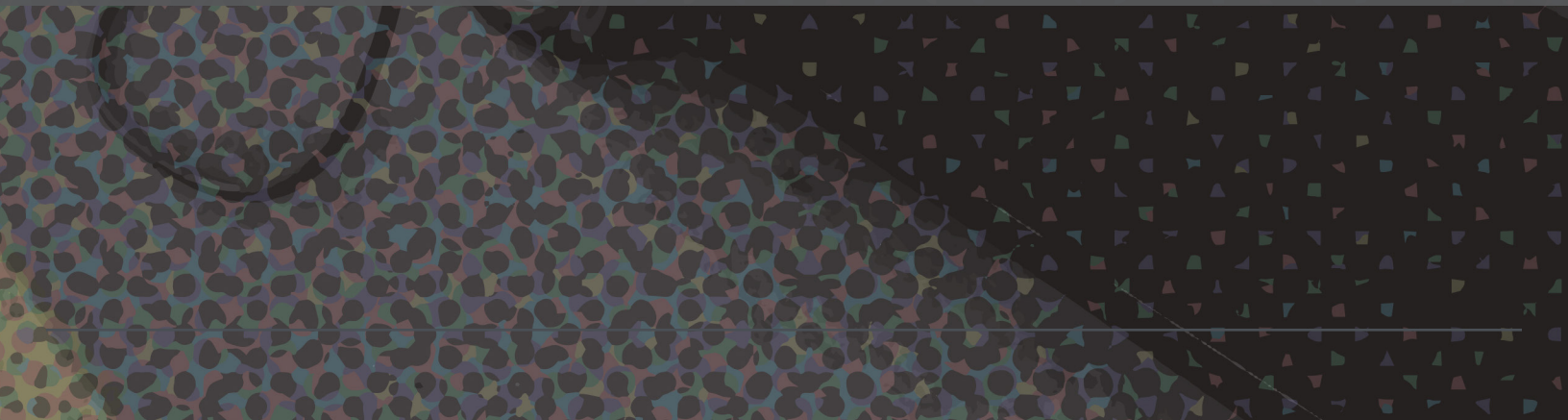

ELECTRIC VEHICLE PUBLIC CHARGING STATION HOST'S HANDBOOK

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INTRODUCTION

As electric vehicles grow in popularity and costs decrease while battery range increases, states across the nation are recognizing the importance of building the infrastructure required to fuel these vehicles. As plugin EV drivers commute, take intrastate drives and make cross country trips, a network of electric vehicle charging stations will be an essential part of EV travel. This guide is designed to aid those considering hosting a public electric vehicle charging station by providing a clear understanding of what a charging station includes and the process of becoming a station owner.

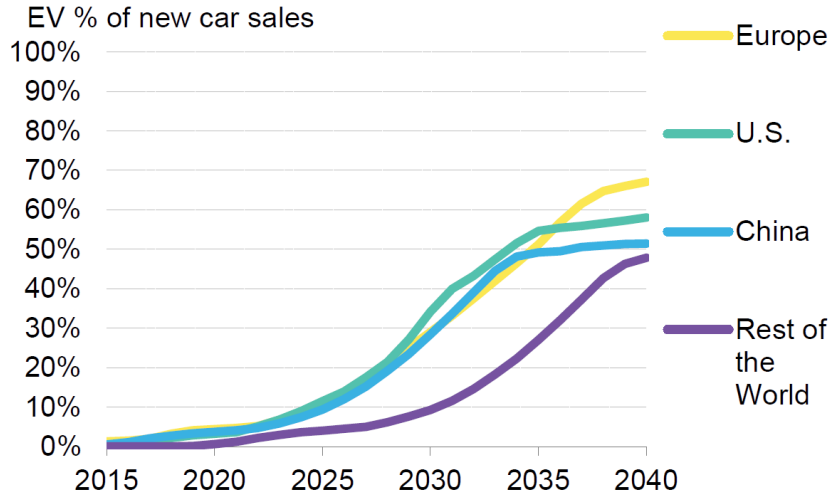
PREPARING FOR FUNDING OPPORTUNITIES

This guide is designed to improve the understanding and implementation of electric vehicle charging stations and is intended to help potential site hosts as they prepare to apply for funding through the State of Iowa from the Volkswagen Settlement Environmental Mitigation Trust (EMT), which is administered in Iowa by the Iowa Department of Transportation (see **Appendix B: Volkswagen Settlement Overview**). Eligible charging stations include publicly accessible DC fast charging stations and Level 2 charging stations. Due to the eligibility parameters of this funding source, this document focuses on Level 2 and DC fast charging stations.

ELECTRIC VEHICLE OVERVIEW

Electric vehicles and the charging infrastructure needed for these vehicles are relatively new to Iowa. Recent developments in technology and the need to address Greenhouse Gas (GHG) emissions have paved the way to the commercial development of EVs at scale beginning around 2008. Current projections show new EV sales are expected to climb from about 2% today to 30% by 2030 and over 50% by 2040.

Long-term EV sales penetration by country



Source: Bloomberg New Energy Finance
data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf

In the U.S., the first successful electric car made its debut around 1890 thanks to William Morrison, a chemist who lived in Des Moines, Iowa. energy.gov/articles/history-electric-car

The following two sections provide a brief overview of these technologies to ensure a strong foundation of understanding for potential site hosts.

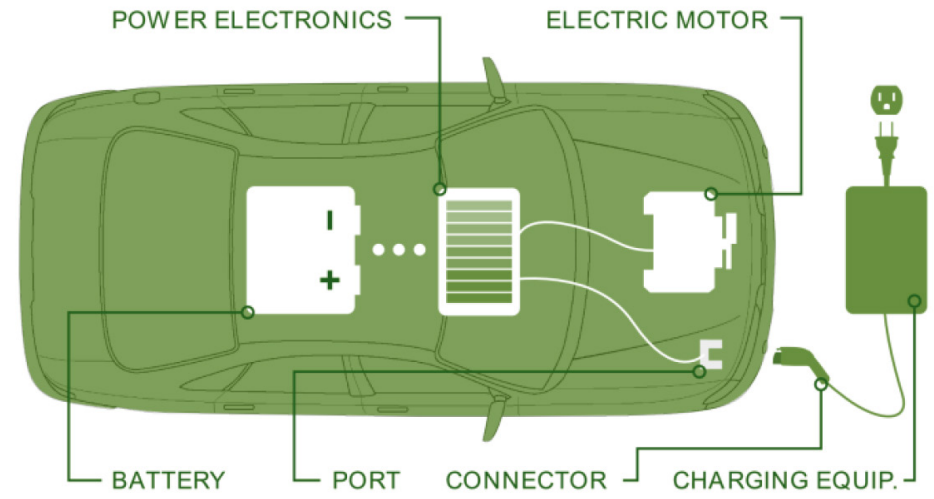
Types of Electric Vehicles

There are two primary types of plug-in electric vehicles:

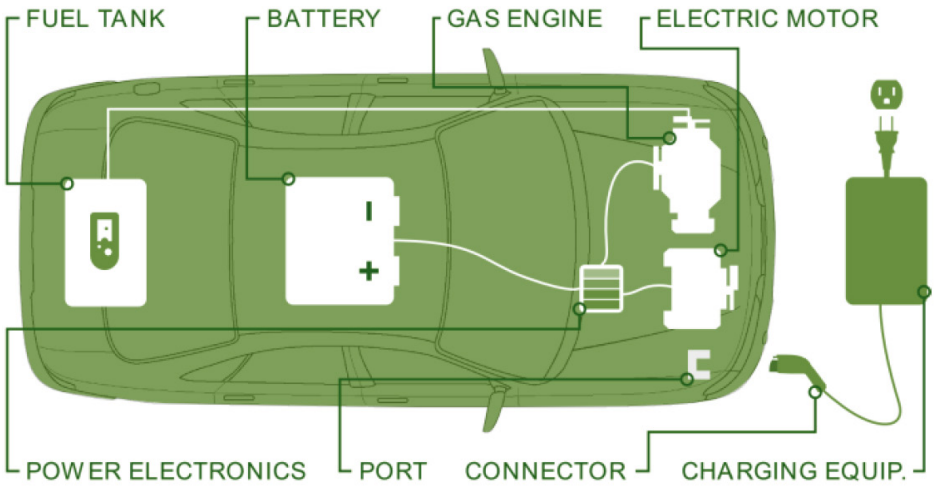
- Plug-In Hybrid Electric Vehicles (PHEVs) - PHEVs run entirely off electricity stored in an on-board battery and can also operate solely on liquid fuel. These vehicles can be plugged into an electric power source to charge the battery.
- All-Electric or Battery Electric Vehicles (BEV's) – BEV's use a battery to store the electric energy that exclusively powers the motor. EV batteries are charged by plugging the vehicle into an electric power source.

Types of Plug-in EVs

All Electric Vehicle (AEV)



Plug-in Hybrid Electric Vehicle (PHEV)



Source: DriveElectricVT.com

Most of the electric vehicles on the roads today are light-duty passenger vehicles. However, all-electric school buses and transit buses are commercially available. Heavy-duty trucks are limited in availability, but several manufacturers are working on new models with anticipated availability by 2020.

CHARGING OVERVIEW

Like gasoline powered vehicles need access to gas stations, plugin electric vehicles need access to charging stations. Studies show, in most instances, over 80% of charging occurs where a vehicle is parked overnight. This can provide most of the power needed for daily travel. Charging stations need a power source, a cord and a special plug that fits in the port of the vehicle.

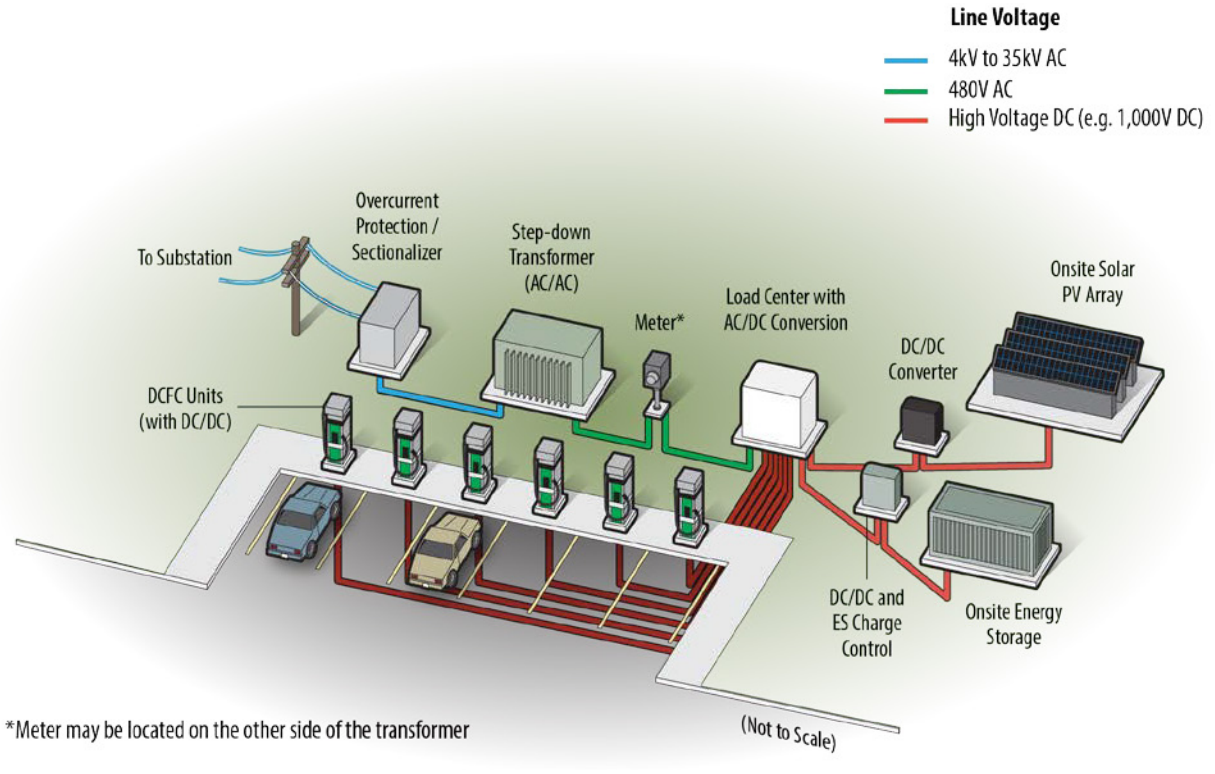
Charging equipment for EV's can be classified by the power at which the batteries are charged. Charging times vary based on the battery's current state of charge, how much total energy it holds, the type of battery, the onboard charger/batteries acceptance rate, the type of charging equipment and configuration.

All vehicles and charging stations are not yet fully compatible. Some electric vehicles, primarily PHEVs, cannot plug into a DC fast charging station due to both the type of port needed on the vehicle and the capability of the vehicle's onboard charger/battery. Tesla charging stations only accept Tesla vehicles due to a proprietary technology configuration, although Tesla vehicles can use an adapter at other types of stations. All-electric vehicles (BEVs) commonly can take a fast charge, and this is the fastest growing segment of the national EV market.

Types of Electric Vehicle Charging

Type of Charging	Level 1 - 110V (~1.4kW)	Level 2 - 220V (~7.2kW)	DC Fast Charger (50 kW and above)	Extreme Fast Charging (350kW and above)
Charging Station 101	Provides same electricity as a regular electrical outlet	More powerful than Level 1; Comprises majority of the stations in U.S.	DC current directly supplied to vehicle; Commonly adds 60-80 miles of range in ~20 minutes	Power output can decrease to match EV battery capacity; Higher power output may be fully realized by EVs within 10 years
Range gained per hour of charge	2-5 miles	10-20 miles	Up to 180 miles	787.5 miles (more than today's EV range)

Multi-Port DCFC Complex with Onsite ES and Solar PV System



EV Charging Unit Costs

TYPE	COST RANGE
Level 1	$300 - $1,500
Level 2	$400 - $6,500
DC/Fast Charging	$10,000 - $40,000

Based on units available in 2015, does not include installation costs

Costs Associated with Non-Residential Electric Vehicle Supply Equipment. (2015, November) US Department of Energy. Retrieved from: afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

There are two key types of electric vehicle chargers - networked chargers and stand-alone or non-networked chargers.

Networked chargers have oversight and services to support one or more EV chargers. Connection to cellular data or internet is required. Services are available to EV drivers, as well as site hosts or network administrators. A network adds a variety of capabilities. For drivers, services may include payment options, real-time station location and availability information, and options such as reservations, messaging and summary reports, as well as notifications when charging is complete. Site host services include payment management, customer support, station status, data reporting and typically access to an online network dashboard. Networked chargers are updated regularly to stay current with latest software versions and features.

Stand-alone or non-networked chargers do not have network access; they are essentially electrical outlets with circuitry to enable communication and safe charging with the vehicle. Without network access, stand-alone chargers mostly cannot process payments. Stand-alone chargers have lower installation costs, simpler designs, and no recurring fees for features such as payment processing and cloud connectivity. They may also be the only viable option in locations with poor cell reception or at low-use sites where network fees would likely exceed the cost of allowing free access.

Please note: Networked chargers are required under the Iowa Volkswagen Settlement Zero Emissions Vehicle Infrastructure funding.

SAFETY

Electric Vehicle chargers are often referred to as Electric Vehicle supply equipment (EVSE). EVSE systems include the electrical conductors, related equipment, software and communications protocols that deliver energy efficiently and safely to the vehicle.

When an EV initiates a charging session, the driver will pull up to the charger and follow the onscreen (or printed) instructions to start the process. The charger then communicates with the vehicle to ensure the charger is safe to charge and plugged in correctly. Once the vehicle determines it's connected and safe, the charger begins to transfer electricity to the vehicle. As a result of these protocols and standards, chargers are safe to use in variable weather conditions experienced in Iowa.

Steps should be taken to ensure chargers meet safety standards set by a nationally recognized testing laboratory (e.g., UL, etc.).

WHERE AND HOW ELECTRIC VEHICLES CHARGE

Most drivers of EVs charge their vehicles overnight at home using Level 1 or Level 2 charging equipment. However, multi-unit residential complexes often lack available outlets or charging stations. This can limit electric vehicle adoption if property managers aren't amenable to making charging available for interested residents. Networked charging stations can allow site hosts to offer charging to its tenants, the public or both. Site hosts can set separate charge rates for each, resulting in a convenient solution and value-added amenity to offer existing or potential tenants.

Workplace charging can increase the convenience and affordability for electric vehicle drivers when implemented by employers. These locations are often served by Level 2 charging stations and are especially useful for employees with longer commutes or without convenient access to charging at home. Many companies are installing chargers as a benefit/perk to attract new employees.

Charging in public places, such as businesses or public parking garages, helps increase the convenience of having an electric vehicle. Most public charging facilities use Level 2 chargers, DC Fast Chargers or a combination of the two.

Organizations with fleets of vehicles, such as commercial trucks or school buses, have unique charging needs. Adoption of electric vehicles in these applications works best with a fixed route or predictable travel patterns with charging infrastructure in the domiciled location, like a garage or depot. Heavy-duty electric vehicle charging at these locations will require more thorough planning with the utility, due to larger batteries, greater power needs and specific charging time requirements. Some vehicle technologies being developed and tested include vehicle-to-grid applications. This uses the vehicle batteries as energy storage while parked and plugged in, allowing electricity to flow both to the vehicle and back to the grid at different times.

Fast charging stations are particularly needed along travel corridors to provide electric vehicle drivers the confidence to take longer trips. However, the cost to install and operate fast charging stations is significantly higher than that of Level 2 stations and can require utility upgrades to accommodate the level of power needed onsite. With any EV station, installation costs can vary greatly per location. Factors impacting installation costs include, but are not limited to, the location and amount of power supply needed, capacity of existing equipment, underground obstacles or structures, trenching or boring requirements, construction of a concrete pad or building mounting structure, as well as other project and site-specific considerations.

CHARGING STATION DEVELOPMENT IN IOWA

As of September 2019, there were 115 publicly available stations in Iowa, not including Level 1 / wall outlets. These stations include a total of 291 plugs, meaning there is more than one spot to plug in at most locations; 23 of these stations with a total of 89 plugs are exclusively for Tesla vehicles. Some of the stations are intended only for use by guests of the business, but this is still considered publicly available.

The number of publicly available stations is steadily increasing and planning for new stations is constantly underway. Efforts are ongoing to add DC Fast Charging infrastructure to the travel corridors throughout Iowa.

HOSTING A CHARGING STATION

Benefits

There are many benefits to hosting an electric vehicle charging station, including the attraction of more customers to a business. In addition to bringing in EV owners that need a charge, hosting an EV station shows consumers that steps are being taken to be more environmentally friendly, which will attract customers who align with those values. Charging stations offer potential revenue generating opportunities through new customers, longer dwell times and the ability to sell advertisements (on the display panels or on the chargers themselves). And, of course, hosting a charging station will encourage more people in the surrounding area to purchase an EV by helping to reduce range anxiety. In turn, this will reduce the amount of tailpipe emissions in the air that people breathe and will increase energy security in the state by reducing dependence on fuel from other countries.

Costs

Costs can vary significantly depending on available power at the site, existing capacity, desired location of the chargers, equipment costs, etc., in addition to installation and construction costs. It is important to contact the utility early in the process to understand the parameters of a project, potential challenges or considerations, billing/rate options and what to be aware of to help keep costs as low as possible. An early consultation could save time and money long-term.

Charging Station Hosts

There are many types of potential charging station hosts. Below is the most common station hosts and the charging level that works best for the business.

Types of charging station hosts and best charging level

	Level 2	DC fast charging stations
Fueling Stations		X
Retail and Grocery Stores	X	X
Parking Garages	X	
Governments	X	
Utilities	X	X
Hospitality	X	
Car Dealerships	X	

SITE NEEDS ASSESSMENT

Following is a non-exhaustive list of items a site host needs to plan for and prepare throughout the process of developing a charging station.

Location

Choose a high-demand, high-visibility location close to the power source. Work with your utility and a contractor to find the best location for the chargers. Use wayfinding signage to increase visibility. It's important to note that DC fast chargers require three-phase power. Choosing a site that already has or is close to a three-phase power source will save significant money.

Space

The site should have adequate space to fit the electric vehicles that will use the chargers at the same time, and perhaps even a few in the queue. Consideration should be given to possible expansion. Adding additional make-ready infrastructure during initial construction will save money later and prevent additional disruption of the site (see future proofing).

Amenities

At a minimum, there should be adequate lighting, as well as 24-hour access to bathrooms and shelter. Ideally, activities such as shopping, restaurants, a park, movie theater etc. is available so guests have canpass the time while the car charges. Remember, most cars need to charge for at least 30 minutes with a DC fast charger and two to four hours with a level 2 charger.

Contractor

As with any construction project, research the contractor. Read reviews online and talk to previous customers to ensure the contractor is from a reputable company that will treat the project with a high level of importance.

Station Design

Accessibility

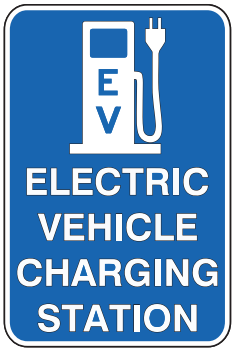
Under the Americans with Disabilities Act (ADA), federal law requires site hosts to provide accessible parking spaces at electric vehicle charging stations. When deciding the layout of a charging station, include adequate space for exiting and entering the vehicle, unobstructed access to the charger, free movement around the charger and connection point on the vehicle, and clear paths and close proximity to building entrances. The table below summarizes the most pertinent ADA requirements when designing an EV charging station.

Element	ADA/ABA 2004 ANSI A117.1 2003
Number of Spaces	4% of parking spaces, or 1 for every 25 spaces, in any given lot, be designated as accessible; 1 out of every 6 spaces should be van accessible
Parking Stall	8x18 feet for a car and 11x18 feet for a van
Accessible Route Width	Minimum 36 inches wide
Accessible Route Slope/ Cross Slope	Maximum 1:20 (5%) running slope and 1:48 (2%) cross slope; Accessible vehicle spaces 1:48 (2%) in all directions and 90-inch clearance for vans
Reach Range	48 inches front and side to allow reach to all operable parts from a wheelchair
Accessible Controls	Operable with one hand and not requiring grasping, pinching, or twisting of the wrist or force 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	Must be connected by a minimum of 50-inch-wide accessible route in proximity (not necessarily adjacent) to the entrance of the building
Side Access Aisle	Side access aisle of 60 inches wide to allow space for wheelchair and equipment in and out of space
Accessible Card Reading Devices	Must be connected by a minimum 50-inch-wide accessible route in proximity (not necessarily adjacent) to the entrance of the building
Other Considerations	Ensure that bollards, wheel stops, or curb do not obstruct use of charging station

Signage

Many EV drivers rely on websites, apps or on-board navigation systems to find charging locations. Still, there is a clear need for roadside signage for charging stations. Drivers may be visitors to the area, and signage will help alleviate anxiety about finding a place to charge. Furthermore, roadside signage will help draw customers to a station.

The Manual on Uniform Traffic Control Devices (MUTCD) has adopted a standard sign symbol for EV Charging Stations, which is shown in the figure to the right.



Onsite signage is important to help EV drivers locate chargers, as well as to ensure Internal Combustion Engine (ICE) vehicles do not restrict access to the chargers. Examples are to the left for reference.

A charging equipment supplier or utility may have access to stencils used when painting the parking space to indicate EV charging like the way handicap parking spaces are indicated.

Station Design Best Practices

Future Proofing

When designing a charging station, planning for growth in the future will save time and money. Future proofing means to design for growth. EV Charging station future proofing includes sizing and running conduit for more chargers than initially planned for installation. When it's time to add more chargers, it's easy to simply install the charger(s) and avoid having to trench the ground or upgrade electrical service. This can include planning for additional parking spaces or upgrading to faster charging (e.g., from 50 kW to150kW-350kW+).

Distributed Generation

When designing a charging station, think about whether the electricity will come from a traditional electricity source or if there may be a benefit to installing solar panels or other renewable energy sources. Contacting the local utility is the first step in determining project feasibility and to understand connection protocols that need to be followed.

Storage

On-site storage can be a huge asset to a charging station. To avoid demand charges during peak electricity usage hours, charge an onsite battery during off-peak hours when electricity prices are cheaper. Use the stored electricity to provide power to chargers when electricity prices are more expensive. Storage can also be used to store renewable energy generated on site when the charger isn't in use.

An electrical service provider, utility or solar installer can help explain the options available.

Permits

Necessary permits for installation of an electric vehicle charging station will vary by city and county since there is currently not a uniform permitting process. The contractor is responsible for pulling the necessary permits for a site.

Construction

Depending upon the needs of a site, construction could take anywhere from one to three months. Consideration should be given to colder winter months as groundwork may not be possible. Always communicate with the contractor to obtain regular progress updates.

Inspection
Like permitting, the contractor will be responsible for requesting an inspection of the charging station.

Marketing
As mentioned earlier, EV drivers rely on websites, apps and onboard navigation systems to find charging stations. Ensure the charger is listed on these websites and apps to draw customers to the station. A good place to start is the Alternative Fuels Data Center (AFDC) Station Locator, which allows drivers to look up individual locations near them or plan a route to a destination based on charging availability. Once a site is up and running, register it on the Alternative Fuels Data Center Station Locator. Other places to register a station include: PlugShare, ChargeHub and Open Charge Map.

Signage
On-site signage to announce the opening of EV charging, as well as an announcement in the local paper and/or on the business's Facebook page, newsletter, etc. is recommended. The Iowa Clean Cities Coalition can also announce new EV Charging Stations in its quarterly newsletters. To include a station on the list, contact MK Anderson at cleancities@iowaeda.com or 515.348.6223.

Ongoing Maintenance
General maintenance may be periodically required on a charging station to ensure it's working properly. Create a plan with the charging station supplier to address maintenance concerns. Many charging station companies include maintenance in the equipment warranty. Know who to contact if maintenance is required.

Other required maintenance may include mowing, snow removal and general upkeep, such as litter removal, vandalism prevention, etc. This includes the parking spaces and area surrounding the station.

OVERVIEW OF RESPONSIBILITIES
There are four main parties involved with installation: business owner, contractor, city/county and the utility. Below is a general breakdown of responsibilities during the planning and development of a charging station.

Business Owner
- Consults with utility
- Consults with governing authority
- Consults with electric contractor
- Markets station
- Ensures ongoing maintenance is performed when necessary

Contractor

- Performs site visit
- Provides cost estimate
- Develops site plan
- Requests permits from city and county
- Requests easements from city and county, if necessary
- Requests new address from city, if new meter is required
- Works with local utilities for servicing and understands where the underground pipes/wires are prior to construction
- Installs station
- Requests inspection and obtains approval

City/County

- Reviews permit application
- Performs inspection

Utility

- Consults with site host
  - Identifies funding opportunities
  - Identifies possible equipment location(s)
  - Serves as a resource for vendors and equipment
  - Assesses service compatibility
- Upgrades service, if necessary
- Installs meter
- Identifies best rate plan

BUSINESS MODELS

There are several different business models for hosting an electric vehicle charging station. The most common are listed below.

Owner and Operator

The site host owns the charging equipment and is responsible for the operations of the site, ensuring the chargers work properly, setting the price of the electricity sold and attracting customers. In this model, the site host keeps all revenue from the charging station.

Host

Models can include leasing agreements, easements and intent to transfer agreements. Specific details of these models are often open to negotiation and are based on unique circumstances of each individual location.

APPENDIX A:
CODES AND REGULATIONS

Codes and regulations for electric vehicle infrastructure include:

- Energy Transfer System for EV (SAE J-2293)
- Utility Factor Definitions for Plug-In Hybrid Electric Vehicles (SAE J-2841)
- National Fire Protection Association National Electrical Code
  - Electric Vehicle Charging System Equipment
  - Electrified Truck Parking Spaces

For more information on electric vehicle infrastructure codes and standards, visit:
afdc.energy.gov/files/pdfs/48605.pdf

APPENDIX B:
VOLKSWAGEN SETTLEMENT OVERVIEW

In 2016, the EPA filed a complaint alleging Volkswagen violated the Clean Air Act by the sale of approximately 580,000 motor vehicles containing 2.0 or 3.0 turbocharged direct injection (TDI) liter diesel engines equipped with "defeat devices" between model years 2009 and 2016. The subject vehicles are equipped with devices in the form of computer software designed to perform differently during normal vehicle operation than during emissions tests. It is alleged that during normal use, the subject vehicles emit level of nitrogen oxides (NOx) in excess of the EPA compliant levels and are a serious health concern.

As a result of two related Volkswagen settlements, the State of Iowa is expected to receive approximately $21 million in environmental mitigation trust funds to be spent over the next 10 years for projects that reduce emissions of NOx.

As required by the trust, Iowa submitted a Beneficiary Mitigation Plan, stating how the money would be used. This plan addresses the following:

- Iowa's overall goals for use of the funds
- The eligible mitigation actions selected to achieve Iowa's goals
- The estimated percentage of the funds assigned to each action
- A general description of the range of expected emission reductions
- Prioritizing air quality improvements in areas disproportionately affected by air pollution
- Outlining how Iowa will seek and consider public opinion on its plan

Iowa's Eligible Mitigation Projects

- Class 4-8 School Bus, Shuttle Bus or Transit Bus
- Freight Trucks and Port Drayage Trucks
- Non-Road Transport and Equipment
- Zero Emission Vehicle (ZEV) Supply Equipment
- Diesel Emission Reduction Act (DERA) Grant Program

For more information or to read the entire beneficiary mitigation plan, visit:
www.iowadot.gov/vwsettlement

To read the Volkswagen Partial Consent Decree, visit:
www.epa.gov/sites/production/files/2016-10/documents/amended20lpartial-cd.pdf

APPENDIX C:
ADDITIONAL RESOURCES

Clean Cities

Clean Cities Coalitions help connect fleets to other fleets, vendors and associations doing similar projects to build partnership and foster collaboration. Clean Cities Coalitions also serve as a conduit to technical expertise for fleets.

Tiger Teams

This technical assistance helps Clean Cities coordinators, stakeholders, original equipment manufacturers and fuel providers overcome obstacles to deploying alternative fuels, advanced vehicles and making informed choices to reduce fuel consumption.

Tiger Teams will consider technical assistance requests for the following types of projects:

- Technical Problem Solving – Vehicle Operations: Issues pertaining to vehicle performance, drivability, safety, maintenance, driver acceptance, training or best practices for implementation of alternative fuel vehicles at specific sites.
- Technical Problem Solving – Infrastructure Operations: Issues relating to fueling station design, siting, interaction with alternative fuel providers or fire safety code officials, fueling station performance, maintenance requirements, or user and operator training.
- Evaluation of Project Potential: Some projects (including transit systems and airports) may qualify for technical assistance if expertise is not available from local or regional resources or stakeholders. When there is demonstrated local interest, a Tiger Teams expert can evaluate local market conditions, conduct infrastructure assessments, gauge stakeholder needs and assist in defining project execution feasibility.

Plug-In Electric Vehicle Handbook for Public Charging Stations

afdc.energy.gov/files/pdfs/51227.pdf

Plug in Electric Vehicle Handbook for Workplace Charging Stations

afdc.energy.gov/files/u/publication/pev_workplace_charging_hosts.pdf

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