Guidelines for the Installation of Electric Vehicle Charging Stations at State-Owned Facilities

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electric vehicle charging solutions

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Acronyms

ADA	Americans with Disabilities Act
DAS	Department of Administrative Services
DCS	Department of Construction Services
DEEP	Department of Energy and Environmental Protection
EV	Electric Vehicle
ICE	Internal Combustion Engine
OCPP	Open Charge Point Protocol
RFID	Radio Frequency Identification

Executive Summary

These guidelines are a detailed description of the process for procuring and installing EV charging stations at state-owned facilities. It contains helpful information for facility and fleet managers, ranging from how many chargers you may need, based on demand; to what charger level is better suited for your user base.

Overview

Connecticut is leading the nation in clean vehicle adoption with more plug-in electric vehicles (EVs) hitting our roads each day. Is your facility ready? As a State, we need to be prepared for this increase in EV deployment. The purpose of this document is to provide state facility managers and procurement experts one stop shopping for EV charging infrastructure deployment.

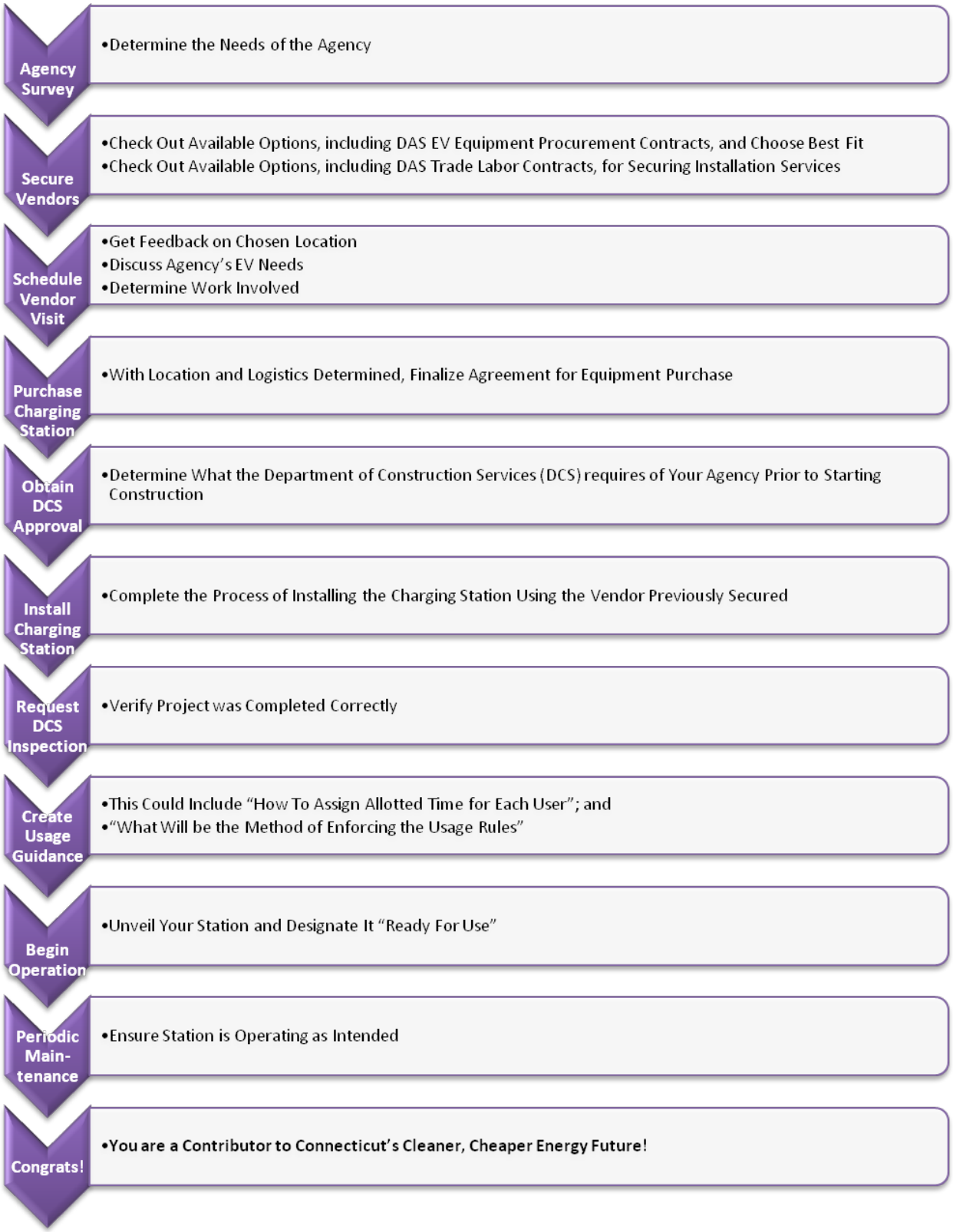
As more fleet operators, including DAS, and individual motorists begin to shift towards EVs because of their many environmental and economic benefits, including lower operating costs and less air pollution, now is the perfect time for state facility managers to consider the future needs of their visitors, customers and employees. Recognizing a change in the transportation industry and the growing demand for EV infrastructure, workplace charging is emerging as a great way to position your facility to address changing visitor, customer, employee and fleet needs. You are also in a position to help Connecticut compete for the newest advanced technology vehicles because prospective buyers may be influenced by their ability to charge their vehicles at work or at regular destinations.

EVs are no longer coming, they are here!
Plug-in electric vehicle sales in 2013 nearly doubled their sales from 2012.

The information outlined in these guidelines will enable any state agency facility manager to successfully install electric vehicle charging stations. The suggested guidelines for electric vehicle charging station installation varies throughout the state and across the country based on existing laws, regional requirements, and consumer needs. These guidelines take into account the parameters within which Connecticut State Agencies operate.

Additionally, DEEP has worked with DAS to establish procurement contracts for the purchase of EV charging equipment and the installation of this equipment can be facilitated using DAS's Trade Labor contracts. Information about procuring EV charging equipment and installation services are also outlined in these guidelines. Below is a flow diagram of the typical process from installation to operation of an EV charging station.

Installation/Operation Process Diagram



The table below contains basic important information about electric vehicle refueling infrastructure that will be helpful during the planning stages of the installation process.

Charger Type	Charge	Time to Charge Vehicles at Various States of Charge			Charger Hardware Costs	Installation Costs	Typical Range of Total Costs	Average Total Costs
		Volt 16 kWh	Leaf 24 kWh	Tesla 53 kWh				
AC Level 1 1.4kW 120V	Half	6 hrs	8.5 hrs	19 hrs	$300 - $500	$300 - $500	$600 – $1000	$900
	Full	11 hrs	17 hrs	38 hrs				
AC Level 2 7.5 kW 240V	Half	1 hrs	1.5 hrs	3.5 hrs	$500 - $1500 home $2000 - $6000 commercial	$500 - $2500 home $3,000 – 5,000 commercial	$1500 – $4,000 home $4,000 - $11,000 commercial	$2200/home $8000/commercial
	Full	2 hrs	3 hrs	7 hrs				
DC Fast 50 kW 480V	Half	10 min	15 min	35 min	$25,000 $55,000	$15,000 -$30,000*	$40,000 $85,000	$65,000
	Full	20 min	30 min	70 min				
DC Fast 150 kW 480 volts	Half	5 min	8 min	17 min				
	Full	10 min	16 min	35 min				

Estimated Vehicle Charging Times and Charger Hardware and Installation Costs

EV Charging Infrastructure: Successful Installation and Usage

Agencies Leading by Example

As state agencies, it is important to that we're aware of the increase of EVs on our roads. EVs will play a bigger role in our energy future as well, so it is also important to keep the momentum going for EVs by ensuring that the necessary infrastructure is available in public places. The installation of EV charging stations provides visitors, customers and employees to your facility with a visible assurance that a charge is available if needed. Early installation will also enable your agency to easily increase the number of charging stations at your facility when the need for EV chargers becomes even greater.

The Department of Energy and Environmental Protection (DEEP) currently has two publicly accessible EV charging stations installed at its headquarters in Hartford and is steadily working towards installations at other satellite sites. DEEP has also purchased EVs off state contracts.

EVs are here to stay!
Navigant Research predicts there will be more than 2.7 million plug-in electric vehicles on our roads by 2023

Gauging Agency Need

EVs and plug-in vehicles are here to stay! When installing initial charging stations, each agency should consider starting with enough infrastructure to simultaneously charge 2-4 vehicles. As vehicle technology continues to improve leading to more electric vehicles on the road, each agency will need to consider installing additional charging stations at a later date. Given anticipated increased demand for EVs, each agency's initial charging infrastructure should, to the extent possible, be capable of expansion to accommodate the installation of additional charging stations to meet increased demand.

Sample Survey

A survey geared towards understanding staff's interest in EVs and what their current or potential needs are when it comes to EV charging, will go a long way towards assisting your agency with devising a plan to meet this growing demand. The link below is to a sample survey that can be used when determining whether or not the demand is there for additional charging stations at your facilities. This can be used, and modified as needed, to help with gauging increasing demand.
Sample Survey

Identifying Agency Champions

The data obtained from the planning survey will help your agency identify and quantify its need for charging infrastructure. However, the process that takes you from the point of realizing your need for a charging station(s) to the actual installation and operation of the charging station(s), is an involved process and it requires a committed project manager. It is important that the project manager be focused on the completion of this task. It may also be helpful if the project manager has some knowledge of EVs and is excited about the project; a cheerleader for the cause, if you will.

Site Design Considerations

Installation

Charge Level

There are three different levels of charge that can fuel an electric vehicle; Level1, Level 2 and DC Fast Charge. Targeted users of the charging station should be considered when choosing a charge level for a given facility.

Level 1—Standard Electrical Outlet

When installing a charger intended for use by a fleet, a Level 1 charger can be installed.

Level 2—Standard J1772 Connector

A Level 2 charger is better-suited for public/visitor charging. For employees, the choice of Level 1 or 2 varies, and is dependent several factors, including the number of stations being installed and their location. For example, if the stations are installed at an employee parking area some distance from employees' work location, Level 1 chargers may be appropriate since it's unlikely employees will be returning to the parking area during the workday to move their vehicles. Conversely, if parking is located closer to the work site, Level 2 stations, in conjunction with some sort of reservation system /see Section on *Rules Governing Usage/* may be appropriate. It is not necessary to install a DC fast charger for visitors, employee or fleet charging because the majority of users will be at the facility for a while, if not the entire work day, allowing them the opportunity to get a complete charge from a Level 1 or 2 charger. In addition, the cost associated with the installation of a DC fast charger is significantly higher than that of a Level 1 or 2 charger. If installing Level 1 chargers, the installations should be upgrade ready in order to handle higher powered charge levels (Level 2), should the need arise.

Proximity to Power

Complexity of charging station installation and surface preparations raise cost. The costs associated with cutting, trenching and drilling can be significant. Therefore, the greater the distance between the power source and the EV charging station, the higher the installation costs are likely to be. These costs may eliminate some site locations from further consideration. Select a location where it is as inexpensive as possible to provide AC Level 1 (120V) or 2 (240V/40A) electrical supply. For example, placing the charging station in a parking garage, near an elevator could reduce the cost of installation because there will be a power source in close vicinity to equipment thus reducing the amount of site preparation that needs to be done. When installing charging stations at older buildings, existing electrical panels may already be used to maximum capacity. This should be considered during the planning stage of installation.

Mounting Approach

Pedestal Mount EV Charging Station

There are several options available to mount a charging station. An existing wall, pole, column, post or pedestal could be used to mount the charging station. Use of existing walls and poles is less expensive than installing a new post or pedestal.

Also, mounting on a wall with an existing electrical panel may help to minimize disturbance to existing infrastructure and reduce costs.

Wall Mount EV Charging Station

Overhanging Mount EV Charging Station

Alternatively, an overhanging unit can be used to mount the charger overhead. While adding to the cost, this approach would help prevent tripping on cords and may prolong the life of the cord.

Charger Protection

While designing your electric vehicle charging stations, ensure they are protected from vehicle collision. This is especially imperative for the side of the charging station that a vehicle will approach. Protective barriers may include guard posts (bollards), wheel stops, curb protection or wall-mounted barriers for wall-mounted charging station. When siting bollards, be mindful that the accessible reach to the device control panel is appropriately maintained. Although there are currently no accessibility requirements specific to EV charging stations, it is advised that every effort is made to make the charging station accessible by all. (See section on *Accessibility*).

Bollards around Charging Station

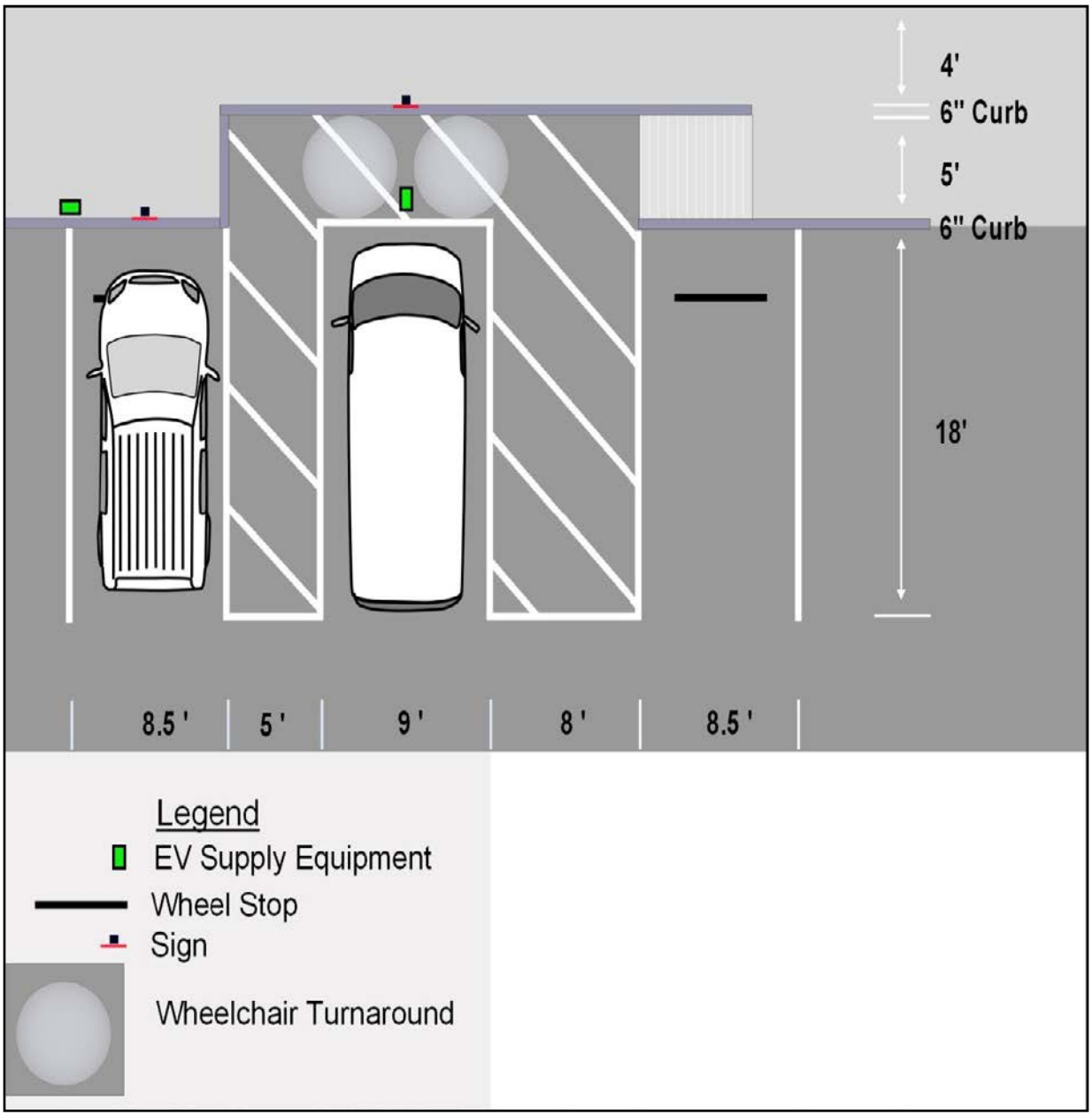
Number of Cord Sets

Most charging stations are able to accommodate two cord sets, although it is possible to have just one cord set on a unit. It's important to verify with your contractor that the availability of two cords on your charging station translates to the ability for two vehicles to be charged simultaneously. An agency should determine their best option while considering the placement of the charging station within the parking area and the needs of the targeted users (See section on *Visibility and Location in Lot*).

Parking Space Dimensions

Typically, an EV charging space requires more area than a standard parking space. In order to ensure safe and easy movement around the charging station, it is recommended that an agency's first charging station installation be configured for ADA compliance (See image below).

If you have only one EV charging station, make the associated parking space ADA accessible.



ADA Accessibility:
The charging station on the right is ADA-van accessible. The charging station left of the van space is not fully ADA-accessible.

Environmental Conditions and Hazards

Environmental conditions can pose a threat to equipment. While charging stations designed for outdoor use operate safely under wet conditions, avoid installations in flood plains. Wall or pole mounted equipment should be considered where localized pooling could occur. Cold weather charging is especially problematic while using the charging cable because snow and ice can encase the cable if it is lying on the ground or otherwise exposed. This can be mitigated with equipment that has a retractable cable which remains flexible in extreme cold conditions.

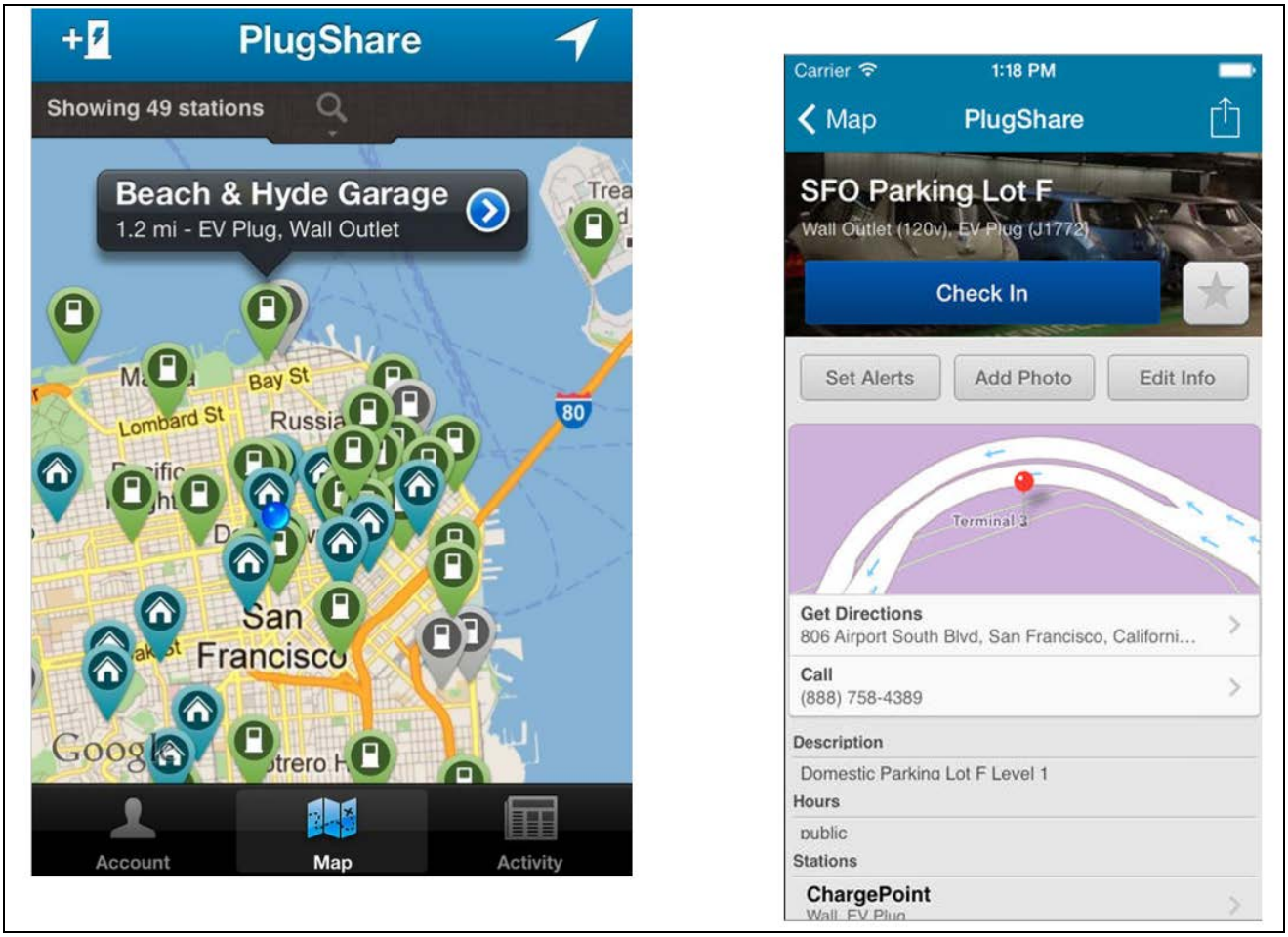
Tripping, as a result of an extended EV cord, is a common and manageable hazard associated with EV charging stations. The charging station should be located in an area of minimum pedestrian traffic. In addition, consideration should be given to installation of an overhead support or trolley system to allow the cord to hang above the vehicle in the area of the EV inlet. The utilization of retractable cords would also minimize or eliminate tripping hazards.

Technology and Network

In an effort to standardize the EV charging network, agencies should choose charging equipment with payment technology systems that comply with the Open Charge Point Protocol (OCPP). OCPP standards ensure the electric vehicle charging equipment includes computer hardware for payment systems that can accommodate software from a variety of payment processing services. This means that the equipment should be able to accept all major credit and debit cards with no additional contact and users will not have to subscribe to an outside service. OCCP also permits the flexibility of contracting different software and network providers, as may become necessary throughout the life of the charging station.

There are several potential user benefits of networked EV charging station systems. For example, smartphones and internet enabled device applications may feature maps of nearby publicly accessible charging station and provide driving directions to their locations. These applications may also function to reserve a charging session at a chosen EV charging station, to receive email or SMS text message alerts to tell when a charging session is completed or interrupted, and to report a problem with a charging station.

Some potential operator benefits of a networked system includes the opportunity to view and download charging history and approximate carbon savings associated with the charging station; the ability to set time-of-day charging options to take advantage of off-peak electricity rates; maintenance reminders and other notification on the charging station's display; and centralize account control for fleet vehicles (see Section on *Data Collection and Metering*).



EV Charging Network Smart Phone App

Access

Accessibility

The primary function of a parking space with an electric vehicle charging station should be EV charging. There are currently no federal or State Americans with Disabilities Act (ADA) standards specific to charging stations, but it is expected that these standards will be developed. Any agency installing charging stations should consult their safety office regarding the status of such standards. In the meantime, there are ADA standards for parking and at least one charging station stall should be ADA accessible. While efforts should be made to ensure that the parking space is ADA accessible to the extent practicable, it should not be identified with signage that would mistakenly indicate that it is available for use by individuals with disabilities who are solely parking and not charging.

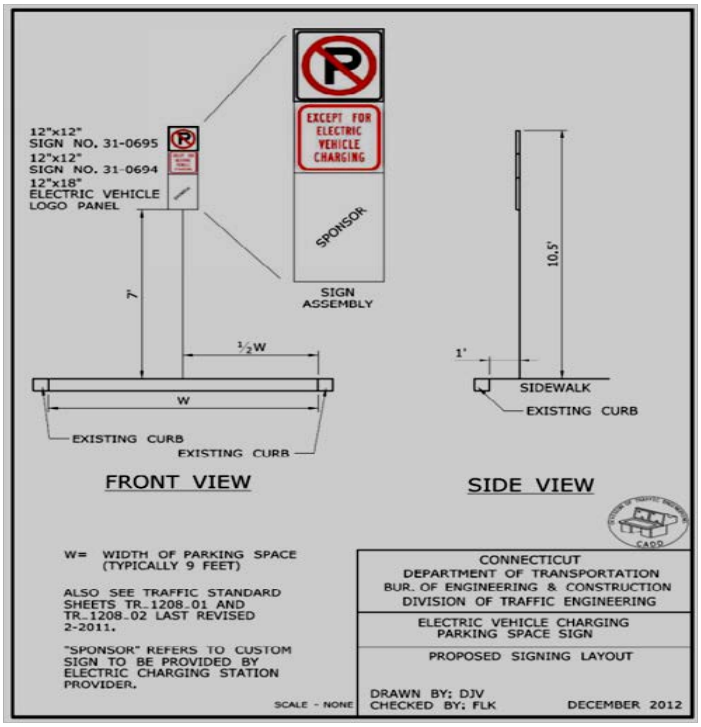
Lighting

Lighting at the charging station makes the station more visible to the EV driver, enhances driver safety and helps to deter vandalism to the equipment. Where charging station equipment is installed, lighting levels should be compliant with local codes because lights that are too dim can increase the likelihood of tripping hazards. Installing an EV charging station may also present an opportunity for needed lighting upgrades.

Signage and Way finding

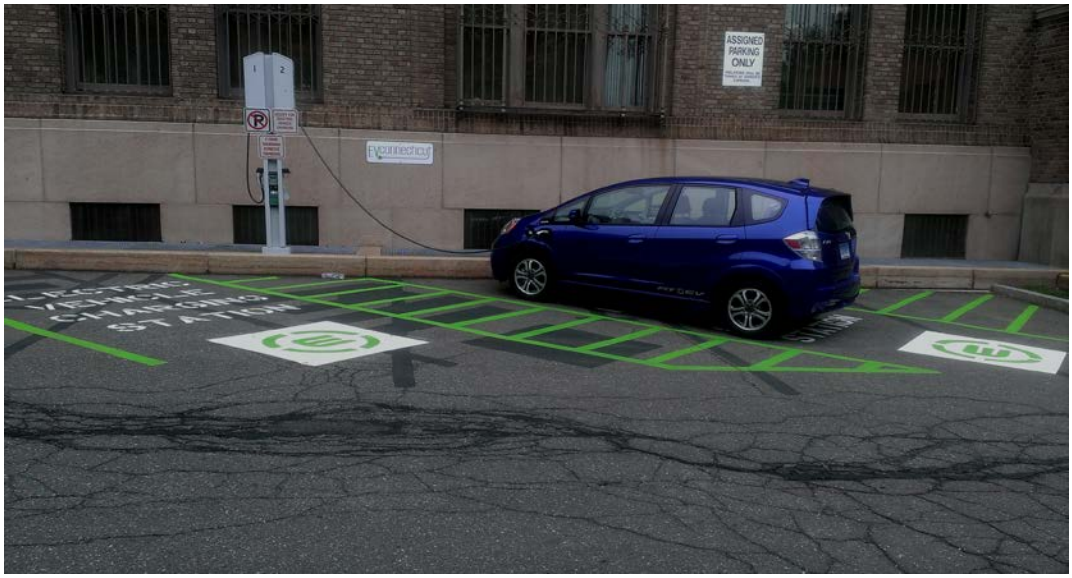
Making your EV charging station visible to motorists will help EV drivers locate it. Tiered way finding signage guiding EV drivers from highly traveled roadways to charging stations is one way of increasing the station's visibility. It is recommended that signage be placed at the entrance of the EV charging station's location, with supplemental arrows to help guide individuals to the station (if needed). Consistency and visibility of signage throughout a city, state or region can help drivers locate charging stations regardless of network access.

Signage should clearly show that the parking spot is only to be used by an EV that is physically charging. Signage serves to deter people parking non-EV vehicles in EV spots and should state if non-electric vehicles are subject to fines or towing. Other signage should be installed immediately adjacent to and visible from the EV charging station and should include station parking restrictions, operation instructions, hours and days of operation, and contact or registration information if the operator has questions about the charger. Information on any fees, operating instructions and terms of use should also be posted and be clearly visible in day or night time conditions.

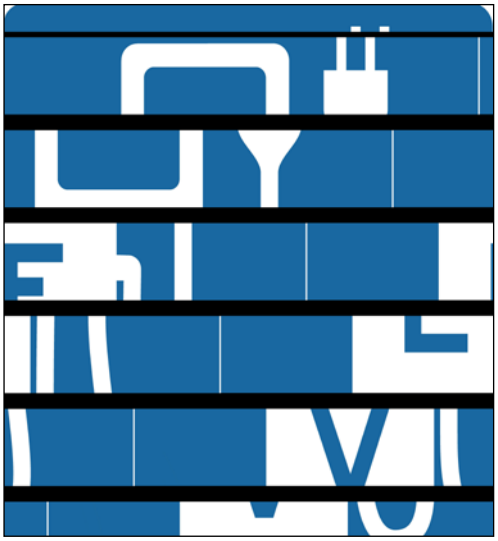


"No Parking Except for Electric Vehicle Charging" Sign

The pavement of the EV parking spot should be painted to clearly indicate to others that the spot is designated for electric vehicles. Pavement markings, similar to striped markings used for spaces reserved for handicapped parking; as well as markings on vertical surfaces should be used to identify EV charging spaces. Often times both a parking spot and a curb is painted to identify a spot designated for EVs.



EV Charging Stations at DEEP Headquarters



"EV Charging Station" Sign

This blue EV pump sign is used in Connecticut as the universal image guiding EV drivers to accessible charging stations.

Pedestrian Traffic

EV charging stations and cord sets should not interfere with pedestrian routes. Charging stations should not be placed in a location that would cause a cord to pose a tripping hazard (See Section on *Hazards*). Pedestrian paths should be taken into account when designing where to install an EV charging station. Charging station site choices should consider building entry ways, pathways, street crossings and meeting points so as not to impede pedestrians.

Operation

Host-Operator Agreements

Since these guidelines are tailored to installations on state-owned property, the host-operator scenario that would likely apply would be between the Agency where the charging station will be installed and any third party the Agency may contract with to operate and maintain the charging station. It is up to each Agency to decide if they will assume the responsibilities of operating and maintaining the charging station themselves, or enlist a separate operator to do so. If the decision is made to have a third party agent operate the charging station, an agreement outlining each party's obligations should be created.

Visibility & Location in Lot

An ideal station location is convenient and highly visible to a large number of potential and actual EV drivers. However, location will depend heavily on targeted users. If the charging station will be for public use, it should be prominently placed, allowing it to be easily found by potential users. In addition, vehicle and pedestrian traffic patterns, both within and surrounding the proposed station location should be carefully evaluated to ensure station accessibility and user safety. On the other hand, if the charging station will be used primarily for employee or fleet charging, a more economically efficient location within the parking area may be chosen. It is also important to make sure the charging station area is always well lit to ensure safety and prevent vandalism (See *Lighting* section).

Data Collection and Metering

The charging station will need to communicate with the utility grid to measure and meter the amount of electricity being used, so the local utility company may need to be contacted. Depending on how an agency plans to bill and track usage of the charging station, it may be beneficial to have the charging station on its own separate meter; in some cases, it may even be required. Having a separate utility meter, dedicated to the charging station, may make it easier to track usage at the charger, especially if the charging station is not equipped with data collection equipment. Equipment usage or tracking software is an additional service which may incur further costs beyond the purchasing and installation costs. However, it is a beneficial service because it is able to collect information beyond electricity usage which may better help the owner/operator understand how the station is being utilized.

Insurance and Indemnification

It is important to review your current insurance coverage to determine what, if any, changes are needed as a result of the addition of a charging station to your facility.

Length of Stay

When deciding on what level of charging should be installed, it is important to consider who the typical user of your charging station will be. If the typical user will be charging over long periods of time, for example an employee vehicle parked in a lot for eight hours or more daily, you may not require more than Level 1 charging stations. However, it should be capable of being upgraded to Level 2. It is important to remember that a Level 1 charger can only service one vehicle during the workday, while a Level 2 charger is able to service more than one car during the workday.

If the typical user will be visitors to your facility, or if the station will be used for both employees and visitors, then Level 2 may be the most efficient and cost effective level to install.

It is also important to devise a policy of use for the charging station. This should cover issues relating to how the charger is utilized by patrons. It should cover topics such as whether or not reservations are

required for the spot, how a reservation can be made, how long an EV is allowed to charge, what happens if the allotted time is exceeded, etc. (see Section on *Rules Governing Usage*).

Future-Proofing

If possible, it is better to utilize charging networks based on OCPP standards rather than proprietary networks. Open networks provide the freedom to switch network management providers without having to purchase new stations (See *Technology* Section). They also allow for modifications and upgrades to your station that may be required as the technology changes.

Fees Collection

The State is prohibited from re-selling electricity, however a user fee may be charged for the operation and maintenance of the equipment. Rates are subject to the discretion of the Agency, but those fees should not be excessive as to discourage use of the station.

Since users of the charging station will be allowed to make payments using credit cards, it is important to discuss payment provisions with the Agency's Accounting division to ensure that collection of credit card payments are handled in accordance with the revenue collection requirements outlined in the State's Accounting Manual. According to the State's Accounting Manual, an Agency must invoice all revenues. Therefore, if a third party is collecting payments on behalf of the Agency for EV charging, the Agency is required to invoice that third party for all revenues received for EV charging, then in turn make a payment to said third party for any transaction fees incurred.

Obtaining Necessary Permits

All agencies should consult their facilities management during the planning stages of charging station installation to determine the necessary approvals required for the installation.

Most projects that are solely the installation of an electric vehicle charging station will fall below the $500,000 threshold (for most agencies) making them Agency Administered projects. Most executive branch agencies (DOT, UConn are exceptions) are required to obtain approval from the DAS Division of Construction Services (DCS) to self-administer a project. Details regarding who is required to obtain approval, as well as the process steps are outlined in the Agency Administered Projects Procedure Manual located in the DCS website library.

In any construction situation, it is always beneficial to send a sketch of the proposed project to DCS' Code Unit. This will allow them to identify any code violations prior to the contractor starting the project, and eliminating the need to redo the work after it has been inspected. Currently, the contact for DCS' Code Unit is:

John Nolan
Phone: 860-713-5838
Email: John.Nolan@ct.gov

State Contracts

Charging Station Procurement Contract

The State of Connecticut is working to expand the use of Electric Vehicle Charging Stations throughout Connecticut. For municipalities or state agencies that are looking to purchase EV charging equipment from vendors awarded state procurement contracts please visit Contract 13PSX0316 on Connecticut's State Contracting Portal.

Other Procurement Contracts

Electrical installation services, along with any other construction needs, may be contracted using the DAS Trade Labor contract. Any additional services, such as pavement marking and signage, can be procured using standard state purchasing practices. Purchasing EVs for your agency's fleet can also be procured using DAS contracts.

Maintaining and Using EV Charging Stations

Inspections

For agencies that do not have inspection staff, following the installation of an electric vehicle charging station, arrangements should be made for the unit(s) to be inspected by DCS. DCS currently has a 48 – 72 hour turnaround time from date of inspection request to date of inspection. The current contact for scheduling site inspections is:

Diana Whitehead
Phone: 860-713-5620
Email: Diana.Whitehead@ct.gov

Testing and Maintenance

Cleaning and testing of the functionality of the charging station is very important. After installation of the charging station, it is normal for the vendor/installer to come out and inspect the unit to ensure it's installed correctly and working as intended. The warranty period typically begins following such an inspection. It is recommended that repairs are performed swiftly and as necessary to keep the charging station running smoothly at all times. The location surrounding the charging station should also be kept clean and structurally sound. As an example, the pavement surrounding the charging station should be kept in good repair.

Rules Governing Usage

Reservation Options

Rules governing the operation and usage of the charging station will be needed to ensure that the station is utilized as efficiently as possible. One such rule surrounds time allotment for the usage of the charge. Specifically the Agency/Operator of the charger should post or publish a time limit for the use of the charging station, making it clear that vehicles are not allowed to remain parked at the charging station longer than the specified amount of time. Also, the Agency should make it clear that parking spaces with charging stations should only be use while actively charging.

RECOMMENDATIONS

- Allotted Charge Time (ex. 4 hours max)
- "No Parking Unless Charging" signage

Charge to Users

You may be asking yourself: "What is an appropriate fee for usage of our EV charging station?" There are varying schools of thought on whether or not a fee should be charged for the use of the stations and what that fee should be. Some believe that a minimal fee should be charged, if only to mentally prepare the user for the eventuality of a charge when, with the rise in EV deployment, it becomes an absolute necessity to charge for the service. Others believe that offering usage of the charging station as a free service, even if only initially, will be an attractive benefit of EV ownership that may incent additional drivers to consider EVs as a viable alternative to conventional fuel vehicles.

Suggested Courtesies Governing Charging Station Usage

There are certain things that will go a long way in ensuring the safe and cooperative use of your Agencies charging station. It may be beneficial to post a list of "EV charging Etiquette or Courtesies" in an area close to the charging station as a reminder to users. The list can be as extensive as needed but be careful not to make it so long as to deter users from reading it. Below are some items that may be useful to include on this list:

EV Charging Etiquette
EV Spots are for EVs
Charge Up and Move On
Safety First

1. EV spots are for EVs: It is not acceptable for an internal combustion engine (ICE) car to park in a spot designated for a plug-in car. This does not mean pure EV drivers have the right to unplug plug-in hybrids because they have a back-up ICE, UNLESS the plugged in car is clearly finish charging. The driver doing the unplugging should leave a note explaining why the car was unplugged. The note should be polite and include your contact information. NOTE: Unplugging a vehicle that has already been charged also applies to plug-in vehicles other than hybrids; and the responsibility to be polite to the other driver also applies
2. No Nasty Notes: EV drivers should never leave nasty notes for other drivers parked in an EV spot. If any vehicle, other than a plug-in vehicle, is parked in an EV spot, it is appropriate to leave a note letting the driver of that vehicle know that the spot is for plug-in vehicles only. However, even in this situation the note should be polite.
3. Charge Only When Necessary: Do not plug-in solely because a charger is available. The spot should be left free for EV drivers who may need to charge in order to complete their travels.
4. Charge Up and Move On: EV drivers should only occupy a charging spot while their vehicle is being charged. Once the vehicle is charged, the driver should be prepared to unplug and move their car as soon as possible. This is applicable even in situation s where there is a maximum allotted time for a charging station. If the car is charged before that time runs out, it should be moved once charged.
5. It's OK to Ask for a Charge: If the charging spot you need is being used, and you are able to park next to the car that is currently charging, it is ok to leave a note asking the driver to plug you in after his or her charging is complete. Conversely, if you receive a similar note, you should do the same for the requesting driver. If there is a fee the use of the charging station, there is no obligation to honor that request and incur a fee. The choice is yours.
6. Safety First: It is important to charge safely. After charging, return cords and connectors to their holders to avoid tripping hazards and damage to the charger.

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Images Reference

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Page 9	**Wall Mount EV Charging Station Image** *Courtesy of "Phillips Chevrolet's Solar Charging Station for Electric Vehicles" by Phillipschevy - Own work. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons*
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EV Charging Network Smartphone App Image
Courtesy of Technology Tell's "ChargePoint Introduces New Electric Vehicle Charging Station Mobil App" by Terry A. Miller

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"No Parking Except for Electric Vehicle Charging" Sign
Courtesy of Connecticut Department of Transportation

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EV Charging Stations at DEEP Headquarters Image
Courtesy of DEEP

"EV Charging Station" Sign
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