Washington
Green Transportation Program

Milestones for Electrifying Public Fleets

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Moving forward with Washington's public fleets

The Washington State legislature passed legislation in 2019 directing the **WSU Energy Program** to establish and administer a technical assistance and education program for public agencies on the use of alternative fuels and vehicles. The **Green Transportation Program** provides education and assistance about alternative fuels and vehicles to all public agencies in the state, including cities, counties, tribes, transit agencies, ports, school districts, colleges and universities, utilities and PUDs, and other political subdivision.

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Introduction

We created this guide to help public entities plan and implement steps to add electric vehicles (EVs) to their fleets now and in the future. While the steps follow a logical pathway for adding EVs to your fleet, they are flexible to accommodate how individual organizations get things done. The first six steps involve planning; the last four steps involve procurement, construction, and implementation. As you consider your own organization, you can set your own path and your own timeline. You may undertake different steps in your own order and at your own speed. You may do some steps simultaneously or revisit steps after getting new information.

Fleet Operators Play an Important Role

Fleet operators are at the center of the activity as Washington moves away from internal combustion engine (ICE) vehicles and toward using EVs to reduce Washington's carbon footprint. Gone are the days when a fleet operator simply purchased new cars and decided how to provide them with gasoline. Technological advances in EVs and cost-sharing opportunities to assist with purchasing EV supply equipment (EVSE) requires planning and coordination among many departments and individuals in an organization. This guide presents this process as a series of steps to:

- Identify key team members and set goals for various planning stages.
- Include recommended activities and technical information needed to navigate this process and support conversations with local electrical utilities and equipment vendors.
- Direct public fleet owners to complete vehicle and electrical assessments to streamline charging station installations.
- Provide scenarios to consider while deploying EV charging infrastructure so savings and other benefits of fleet electrification are quickly realized and common roadblocks are avoided.
- Identify key topics, design specifications, and best practices to help fleet operators develop a site assessment, from initial inquiry through layout and design, to the RFP or procurement process.

A Word About the Guide's Organization

We have organized each step to identify key team members, goals, activities, best practices, and outcomes. Like the steps themselves, the ideas contained in each section of a step are flexible. You can adapt, change, reorder, or add to them as you and your team find useful.

The guide also provides resources to help with this process, including details about the EVSE provider landscape, and discussion about EVSE networks in comparison with vehicle telematics options.

Feel free to let us know how the guide worked for you or what your organization changed to make it work better.

Contents

Terms You Want to Know

Vehicles

EV: Broad category used to describe all vehicles that are powered by an electric motor.

BEV: Battery EV that runs on an all-electric motor using a rechargeable battery. It is plugged into an external electricity source (Level 2 and DC Fast Charging) to recharge. BEVs cannot use gas.

FCEV: Fuel-cell EV. These vehicles power an electric motor using a hydrogen fuel cell.

ICE: Internal combustion engine. The gas- or diesel-powered engine in most cars and trucks.

PHEV: Plug-in hybrid vehicle with Level 1 or Level 2 charging. These have an ICE as well as an electric motor (typically with a smaller battery) that can charge or use gas.

ZEV: Zero-emission vehicle. Produces zero exhaust emissions of greenhouse gases, particulates, or any criteria pollutants.

Hybrid: A vehicle with an electric motor and ICE that uses regenerative braking to charge the battery.

Regenerative braking: Braking system in a PHEV or BEV that transfers energy from the brakes to the vehicle battery where it can be stored and used.

Battery range: Distance, in miles, an EV can travel using stored electricity.

Electrical and EV Charging Terms

AC and DC: Alternating current and direct current. The U.S. electricity grid operates on AC. Typical household outlets are 110 to120 volts AC. Large home appliances like clothes dryers and air conditioning units use 240 v. Electric car batteries operate on DC.

kW: Kilowatt. The rate of electricity usage—a measurement of power. Either AC or DC power delivery. The higher the power, the faster the charging speed.

kWh: Kilowatt hour. The amount of electric power used to run a 1,000-watt application for one hour.

EVSE: EV supply equipment, which supplies electricity to the car. Commonly referred to as the EV charging station. This equipment has controls and safety features to allow people to safely charge the EV with electricity.

Load management: Proactively planning to take advantage of lower electricity rates using software to shift where energy is being used, such as by EV chargers, to different times of day when there is less demand (typically at night or in the middle of the day). This means offering more power to fewer charging ports or less power to more ports.

OBC: On-board charger. Located in the vehicle to convert AC from the grid to DC when charging the vehicle battery. The OBC determines the charge rate at which the vehicle can accept electricity. Different OBC units can handle power from 3.3 kW to 22 kW.

Duty cycle: For our use case, this is defined as hours per day or proportion of time that a vehicle is operated per day, week, or month, depending on how heavily the fleet is used.

Dwell time or charging window: Periods of time in the duty cycle when vehicles are idle or parked so they can charge, typically measured in hours.

V2G: Vehicle to grid. This technology enables energy stored in the EV battery to be pushed back to the power grid.

Utility Terms

Electricity rates: Amount charged for energy consumption, represented in cost per kWh. Depending on the electricity provider, these rates can vary throughout the day, depending on when there is the highest demand on the grid.

Electric load profile: How electricity consumption looks over time, typically on a daily basis. With EV charging, a load profile may be used to calculate the amount of power required each hour over the course of a day. Knowing when vehicles consume energy helps fleet managers plan for anticipated electricity rates.

Demand charge: Additional fee that utilities charge non-residential or commercial customers for maintaining a constant supply of electricity. Utilities apply demand charges based on the maximum amount of power that a customer used in any interval (typically 15 minutes) during the billing cycle, outside of their normal electricity rates. Load management will often help reduce demand charges.

Time of use (TOU) rates. Electric rates based on the time of day or night when electricity is used. TOU rates are used to discourage electricity use during peak periods of consumption and encourage electricity use, such as EV charging, during times of excess grid capacity. In some locations this may occur during the afternoon due to excess solar. The periods incentivized during the day or night may change as more EVs are charging and more renewable energy is added to the grid.

In front of the meter: The transmission wire, substations, transformers and other equipment on the utility provider's side of the electric meter.

Behind the meter: The equipment and uses of electricity on the consumer's side of the electric meter. Typically the consumer's responsibility. Electricians are trained in these specifics.

DER: Distributed energy resource. An opportunity to provide on-site clean power (e.g., solar or wind) to supply electricity for vehicle charging. Battery storage for the clean power is often included in a DER project.

Future proofing: Planning for growth in EVs and EV charging infrastructure anticipated in 5 to 7 years.

EV Charging: Speeds and Levels

Charging speed: Describes how fast energy is transferred from the electrical supply to the vehicle's battery. This speed varies within each charging level, depending on factors such as the ambient temperature, electrical supply, the car's OBC size, the battery capacity and state of charge (charge rates taper as the battery nears a full charge), and battery temperature.

Level 1 (L1): 110 V or 120 V, such as a common indoor or outdoor wall outlet. Safe L1 charging requires a dedicated circuit, typically 20 A, and is the slowest charging option.

Level 2 (L2): 208 V to 240 V. These charging staions use a 40 A circuit often found in residential, workplace, and public locations.

DC Fast Charge (DCFC): 480 V or higher. DCFC uses commercial three-phase power and can deliver power at various speeds.

CCS Combo: Combined charging system, also known as Combo. This charging plug supports AC (i.e., J1772 as part of the configuration) and DC charging power levels up to 350 kW. In practice, the charging ranges from 50 to 150kWh.

CHAdeMO: Charging plug used in DCFC systems. This is currently available in fewer models and is the only DC standard able to offer vehicle-to-grid (V2G) connectivity.

J1772: Plug/port style used for L2 (AC) charging. Part of the CCS configuration. (This is not the same as L2 for Tesla for "destination" charging.)

Tesla Superchargers: Proprietary charging system and port (250 to 400kWh) that can only be used for Tesla vehicles. The port also includes the AC L2 plug in.

SAE: Society of Automotive Engineers, the governing body that sets vehicle charging standards for the connectors AC-J1772, DC-CCS/Combo, and CHAdeMO.

Funding

TCO: Total cost of ownership. The total cost of buying and owning a vehicle, including incentives, upfront costs, and operations and maintenance. EVs typically have a lower TCO than ICE vehicles due to lower operation cost and less maintenance required.

Incentives: Money available through federal, state, utility, or air quality districts to fund the transition to ZEV. This can include funding for the vehicles, charging infrastructure, electricity rates, or lower carbon fuel usage.

Low Carbon Fuel Standard (LCFS) or Clean Fuel Standard (CFS): Market-based policies in some states designed to reduce carbon intensity in fuels. Organizations that deploy EVSE can benefit from LCFS or CFS programs by receiving credits for switching from high carbon (e.g., diesel or gasoline) to less carbon-intensive fuel (e.g., electricity).[1]

[1] Resource for some of the terms used here: *The Electric Vehicle Terminology You Should Know: From Regenerative Braking to Level 3 Charging*. Ali Clunk, Sales Operations Analyst, & Meghan Weinman, Director, Transportation Electrification. Accessed June 17, 2021.

Step 1. Assemble Key Team Members and Set Goals

As you get ready to electrify your fleet, consider ways your organization is ready to commit to an electrification strategy. Successful fleet electrification will require cooperation among a number of people or departments within your organization.

Goals

The goal for this step is to get started assembling your team. If people in your organization have discussed electrification, now may be the time to formalize a process to reach this goal. If there is already a team or committee, this may be a good time to review progress to date and get to work on each subsequent step.

Activities

Assemble key electrification team members

To successfully electrify your fleet, it is important to gather leaders and managers from multiple departments throughout the organization. While not all are directly involved in fleet management or fueling decisions, this team will determine best practices to ensure a cost-effective outcome. Your organization may not have individual people in all these functions. In smaller organizations, one person may fill several roles.

Fleet Operator

Responsible for fleet inventory, vehicle selection, dispatch, and maintenance. Likely has access to or manages data about vehicle models, usage and duty cycles, miles traveled, and fuel usage. May be the leader of the electrification effort. Consider NAFA Fleet Management Association, Green Fleets, or Sustainable Fleets for training and materials required to move forward more quickly.

Facility Owner/Manager

Adding charging infrastructure means the facility team will take an active role in installation and on-going management of the charging infrastructure. Several points in the process may require feedback from the property owner or lease holder, and the on-site property manager.

Energy/Sustainability Manager

If this is a separate job function, this person may have data on the status of site electrical usage and a relationship with the electrical utility account manager. They may be familiar with energy or environmental grants, incentives, or rebates; options and opportunities to add charging infrastructure on-site; and tips to encourage employee adoption and charging program success.

Planning Team

Depending on your agency, people in this role may already be involved in construction planning and permitting, and they may be thinking long term to meet the needs of your organization and the larger community. Internal and/or external planning may identify a best timeline and locate the most cost-effective sites to add charging.

Electrician or Electrical Contractor

If your organization has an on-site electrician or preferred electrical contractor, you can work with them to complete the estimate for installing the new charging hardware. These team members would be responsible for all the "behind the meter" infrastructure, electrical upgrades, and "make-ready" installation activities.

Utility/ Local Electrical Provider

The utility representative or transportation electrification lead should be able to provide assistance with the meter, transmission, and substation mapping to understand assets and the "in front of the meter" activities the electrical provider is responsible for. This includes power lines, transformers, substation, or city-wide capacity issues on their side of the meter. They can clarify energy costs, fees, or restrictions and how any pertinent demand charges or time of use (TOU) rate structures may influence fuel cost. In some cases, they may support some of the infrastructure installation costs.

Finance/Procurement Team

In most organizations, one or more people may be involved in managing fleet finances and purchasing new vehicles. They likely have data on fueling costs and may be involved in new fuels planning. These stakeholders also know the process of placing an order, working with purchasing rules, state procurement opportunities, and requirements for requests for proposals (RFPs) or requests for bids (RFBs).

Parking Management

This person is responsible for parking enforcement issues such as reserved sites or on-site parking permits that may impact costs for adding EV charging. The job may include placing bollards, painting and signage; and having a role in deciding the location of EVSE or new EV parking in a shared facility.

Convene the team and involve external stakeholders

The electrification team can meet to define expectations, roles, and initial timelines for completing various steps. Your organization's stakeholders may include employees, residents, drivers, clients, or constituents. They may also include key service providers or contractors. Early outreach and involvement with stakeholders can solidify their support for your actions later.

Establish key goals

Perhaps the biggest steps involve identifying the outcomes and establishing the policies needed to inform and support the steps described later in this guide:

- Establish budgetary, environmental, or other policy commitments to guide the planning effort.
- Find out if your organization has a climate action plan or emission reduction goals.
- Confirm if your organization is ready to commit staff and financial resources to a certain level of EV purchases in the near term.
- Assure that diversity, equity, and inclusion are incorporated into your goals for fleet electrification.

Gather important data

- Encourage your team members to bring information and data from their area(s) of expertise.
- Critical information includes fleet-related data about vehicle models, duty cycles, miles traveled, cost of fuel used, and maintenance costs.
- Calculations of the total cost of ownership for existing vehicles are valuable.
- Facilities and electrical system information is also important. Data showing the patterns of electricity consumption throughout a typical day is helpful.
- Finance and procurement information would be helpful from the start.

Make sure these initial steps have been discussed, finalized, and approved by your organization—up to the top-level decision makers.

Best Practices

- Better plans include short-term goals. How many new EVs will you acquire in the next year and in the year after that?
- Consider setting a goal for converting some percentage of light-duty passenger vehicles or to meet a percentage of whole-fleet conversion by a specific year, such as 2025 or 2030.
- Some organizations make an "EV-first" pledge; that is, they agree to purchase a plug-in (BEV or PHEV) option, unless it or another vehicle cannot meet the work need.

Step 2. Identify Electric Vehicle Candidates

Team Members: Fleet operator, energy/sustainability manager, finance/procurement team

Goals

You will review your organization's vehicle inventory to identify vehicles coming up for replacement or new additional vehicles the organization may require.

If you keep a basic list of vehicle assets, the team may want to add additional information about vehicles to help when comparing total cost of ownership (TCO) calculations.

Develop a list of candidate EVs to consider for electrification.

Activities

Review your organization's vehicle inventory

Many EV models are available to help public fleets meet a wide range of work requirements. Look first at your current inventory of vehicles. After you "right size" your fleet by eliminating or reallocating unnecessary or duplicative vehicles, identify candidates for replacement, starting with light-duty vehicles. This is where you have the most vehicle choices, including small utility vehicles, forklifts, and park or landscaping equipment. Light-duty EV sedans are common and provide increasing levels of range. More varieties of EVs—sport utility vehicles, pick-ups, and medium- and heavy-duty vehicles—are coming to the market all the time.

Consider data for the vehicle inventory

Organizations that have successfully begun transitioning to EVs find that having the following information is useful. If not already included in your vehicle inventory, add these data points:

- Vehicle Identification Number (VIN)
- Target replacement date
- Annual odometer readings
- Daily mileage—average and peak
- Duty cycles
- Dwell times or parking/charging windows

Review potential EVs available to your organization

Look for information about available EVs on the Green Transportation Program website, EPA resources, and other guides.

Review vehicle 05916 options from the state contract.

See what's available through joint procurement ventures.

Complete TCO calculations for comparison

You may have your own calculator or preferred program for comparing vehicle choices. The GTP website has some good tools you can use. Be sure to include these details:

- Initial purchase cost minus incentives
- Fuel costs with escalators

The Green Transportation Program provides resources to evaluate and compare EV choices for your work needs.

In 2019, the WSU Energy Program launched the Green Transportation Program (GTP) to:

- Support the adoption of passenger EVs and installation of more EV infrastructure by cities, towns, and public agencies.
- Expand success in green transportation, including electrification of public medium- and heavy-duty vehicles.
- Promote innovations in green transportation that are relevant to Washington communities.

- Insurance
- Maintenance
- Residual value of vehicle or battery (not just deprecation)

Fair TCO calculations often show vehicle options that make sense to go electric now. With this information the team can make the business case to upper management and decision makers.

Best Practices

- Fleet transition can start with two or three vehicles to illustrate lower TCO for further transition planning.
- Ask the right questions: What are the ***must-have*** features versus ***like to have*** capabilities? How often do drivers really need all-wheel drive, go off road, or have range needs longer than 100 miles per day?
- Consider plug-in hybrid options as well as all-battery EVs.
- Do you have medium- or heavy-duty vehicles coming up for replacement for which you can find EV alternatives? These may be good candidates for grant funding support, especially if you have older diesel class 4-8 vehicles.

Step 3. Estimate Power and Charging Station Needs

Team Members: Fleet operator, facility manager, energy/sustainability manager

Goals

You will develop a good estimate of the power demands for your candidate EVs and, based on their duty- and drive-cycles, you will have a good sense of the levels of charging required. You will also be able to identify the number and types of EVSE or charging stations you will require for each potential fleet location.

Activities

How much electricity will you need to charge the new EVs?

Estimating electricity need is important when deciding the best charging equipment for your fleet and for evaluating the capacity of your current facility to meet the needs of your preferred combination of vehicles and charging.

EV power consumption varies by time of day, mileage, battery temperature, weather (heater or AC use), driving route, topography, and time the vehicle sits idle (dwell time).

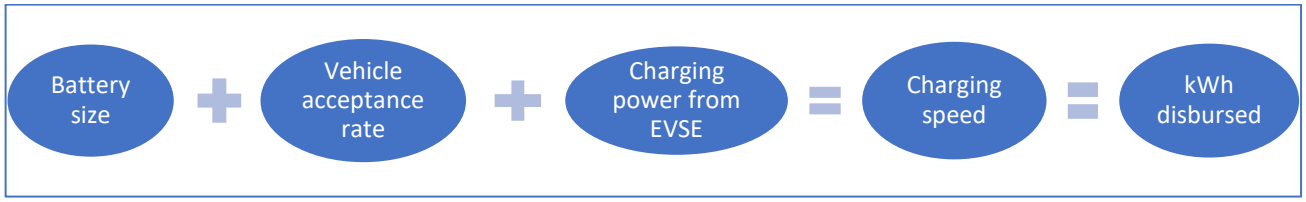
If you are adding a small number of EVs to your fleet, a simple method for estimating power demand looks at average and/or peak miles traveled per day ÷ average miles per kWh for the target vehicle, as follows:

$$Power\ demand\ for\ an\ electric\ vehicle\ (kW) = \frac{vehicle\ energy\ consumption\ \left(\frac{kWh}{mi}\right) \times\ max\ daily\ mileage\ (mi)}{Vehicle\ dwell\ time\ (hours)}$$

For many PHEVs or EVs with low demand (e.g., small utility vehicles, forklifts, landscaping equipment, or ATVs), a standard wall outlet on a dedicated circuit may meet the charging need. For EVs that travel 50 or more miles daily, L2 charging will likely be required to provide enough power. Many facilities with a 600 A panel can often handle the addition of several L2 EVSE.

You can add details to your power estimate when your plan for electrification includes more than a few EVs. Higher power is often needed to charge medium- or heavy-duty vehicles. This is important for evaluating the capacity of your facility's electrical system to meet the needs posed by greater demand. It is also important for limiting utility demand charges while meeting the charging needs of multiple vehicles.

The graphic below illustrates several factors used to more closely estimate the amount of electricity and time required to charge each EV in a fleet. The combined result for all EVs is referred to as your fleet's maximum power demand or load profile. This detail is useful when thinking about installing L2 or DCFC charging stations, and for planning a schedule for how and when to charge different vehicles. Many of a fleet's EVs will not ever need to be charged at the same time or up to 100 percent.



Amount of electricity and variables to charge EVs in a fleet

Where:

- Battery size is measured in kWh.
- Vehicle acceptance rate is the amount of power the OBC provides the battery when charging, in kW. Get this information for specific models from the vehicle specs.
- Charging power from EVSE, from 3.8 kW to 7.6 kW (on a 30 A to 40 A circuit).
- Charging speed.
- kWh disbursed is the electrical capacity. Energy needed to charge vehicles at the highest capacity.

This is also the time to think about the duty cycles, dwell cycles, and drive cycles for the EVs you plan to charge. This value is calculated by type of EVSE and time of day when charging will occur.

- The **duty-cycle** is the time of day the fleet (or vehicle) may be in use. Additional duty-cycle information could include the hours or shifts per day, days per week, total miles per cycle, and average or peak load profiles.
- The **drive-cycle** includes the maximum and average speeds, number of stops, and idle time.
- The **dwell time or charging window** is the period of time in the vehicle's duty cycle when it is idle or parked and can be charged.

EVs typically don't use a full battery charge each day. When calculating the power demand or load profile for your EVs at the highest capacity, investigate the time of day or night available to charge using data about usage and mileage. This may require knowing if employees take their work vehicles home and need to charge them there, or if the vehicles are left at a fleet site or other agency site to charge overnight. Survey employees who use fleet EVs to get this information.

Determine power usage and voltage required from panel, meter, or site.

Calculating the charging load profile	
Mileage expected for typical duty cycle	Duty cycle includes mileage, where it is parked, and how long it is parked each day or night
Battery size	Battery size and kWh to charge the vehicle. Leaf may be 24 kWh at 3.3, or 60 kWh at 6.6 kW; Bolt at 7.6 kW; or Tesla at 9.6 kW or 11.1 kW.
Location of charging depot or distributed	For L2 at 240 V, vehicle may charge for 4 to 8 hours. DCFC charging may add 26 miles per hour in 30 min at 480 V (3 phase).

Consider Options for EVSE/Charging Stations

Based on known vehicle models, battery sizes, estimates of power demand, and the potential charging windows for each vehicle, consider what you will need to charge the EVs in your plan. Appendix B provides details about many charging equipment vendors.

The charging speed describes how fast energy is transferred from the electrical supply to the vehicle's battery. This varies within each charging level, depending on several factors including the electrical supply, the car's OBC size, the battery capacity and state of charge (charge rates taper as the battery nears a full charge and when in extreme heat or cold conditions), battery temperature, and vehicle acceptance rate.

- **Level 1 (L1) EVSEs**: Use 120 v, such as a common indoor or outdoor wall outlet. Safe L1 charging requires a dedicated circuit, typically 20 A, and is the slowest charging option, charging at 8 or 12 A. Depending on the vehicle's OBC and battery, L1 charging may take 16 to 30 hours to charge an EV battery to 90 percent (that's a charging rate of about 2 to 5 miles of range per hour). For fleets, L1 charging is for limited usage EV charging, such as small utility or landscaping equipment, or for PHEVs.
- **Level 2 (L2) EVSEs**: Use 208 V or 240 V. These charging staions use a 40 A circuit often found in residential, workplace, and public locations. They may be attached to a wall or on a free-standing pedestal. L2 stations typically provide a charging rate of about 10 to 20 miles of range per hour. They can take 4 to 8 hours to charge an EV battery, depending on its size. This charging rate makes L2 stations useful for overnight fleet charging or daytime workplace charging. L2 is the most widespread type of charging.
- **DC Fast Charge (DCFC) chargers**: Use 480 V power, converting high-voltage AC power to DC power for direct storage in EV batteries. DCFC uses commercial three-phase power. Depending on the vehicle and battery level, it may take 20 to 50 minutes to charge the battery to 80 percent, which is a charging rate approaching 60 to 80 miles per 20 minutes. Higher-power DCFC may be the best choice for charging medium- to heavy-duty equipment, buses, semi-trucks, and vehicles with large batteries. Planning DCFC charging stations may require new or upgraded substations, so early coordination with the electric utility is necessary to serve vehicle fleets with higher power requirements.

Consider requiring open-OCPP (Open Communications Protocol) no matter which hardware or network system you choose. This can help as changes occur in the industry. If you are looking at a vehicle with proprietary charging, in most cases you can install an industry standard and an adaptor will be available for your specialized vehicle. Free is not always free if a proprietary standard does not fit with the rest of the growing fleet.

Discuss with your team how your organization would prefer to gather data about the new EVs and charging systems—using telematics equipment attached to each vehicle or with a networked charging system. Telematics equipment captures data about mileage, topography, and duty-cycles for a program that analyzes current usage of the vehicles. If your fleet already tracks the fossil fuel fleet with telematics, this may be an option going forward with EVs.

Looking at sharging station options, non-networked stations have one functionality—off or on. They don't collect any data about charging events or power usage. If you do not have an application capturing fleet data now you may find the network/software offered on the EVSE or DC Fast Charging equipment may offer the reporting and data capture requirements for your fleet. Consider data needs—fleet, facility for energy efficiency, sustainability goals for grants. Grant availability if you gather more or different data.

Load management equipment and software may be another useful option. Depending on the system selected, these software programs can shift power usage within a facility or within a group of EV charging stations. This can mean offering increased power to fewer ports, decreased power to more charging ports, or proactively planning for to take advantage of lower electricity rates.

Best Practices

- Consider what ratio of charging stations and nodes are needed for your fleet vehicles. Do you require one L2 charging station for each EV, or will adding load management and one L2 station for multiple EVs fit the fleet? Or are your needs so big they require a DCFC drive-through location?
- How long will it take to charge each of the EVs you are considering? A good resource for this information for light-duty vehicles is the Clipper Creek charging schedule.
- Depending on your organization's fueling, electrical and mileage data, and reporting needs, discuss managed/networked charging, which could save time and money
- To control charging costs, determine the level of charging that best fits the EV fleet and the site. Discuss:
  - Typical parking and travel patterns.
  - Where charging will occur for specific EVs: on site at a fleet depot, distributed throughout your organizations property, or at the employee's residence?
  - When charging will occur: overnight or during the day.

Step 4. Charging Site Assessment and Planning

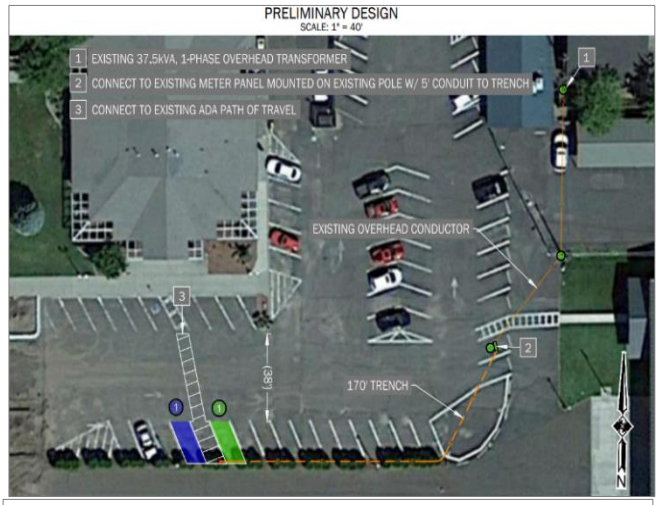
Team Members: Fleet operator, facility manager, electrician, energy efficiency/sustainability manager, parking team

Goals

Complete a preliminary site plan. This plan should show preferred charging and parking locations to optimize efficiency and control costs. Use a photo or diagram of each site being developed.

Document the team's decisions about how and when EVs will use the charging stations, if stations will be available for public use or employee personal use, and if special access[2] or fees are required.

As part of the information gathering task, the team will complete the Site Assesment form as shown in Appendix A. Prepare to meet with the local utility, EVSE vendors, and contractors with electrical system information, photos, and preliminary plans for charging equipment location.



Sample EV parking and charging layout
Source: College Park Pacific Power RFP

Americans with Disabilities Act Requirements

Fleet charging may be located at a centralized depot like fleet headquarters, or it may be placed in geographically dispersed properties throughout the territory, in the employee/driver's homes, or in shared parking that is open to the public. Shared use areas, such as spaces shared by the public, are subject to

Activities

Prepare preliminary site plan

Gather details about the sites identified for EV charging stations, including facility or parking lot plans or maps, aerial images of the sites with parking locations identified, and locations and photos of electrical panels near locations where EVSE may be desired.

Meet with the appropriate team members to discuss the preferred locations and layouts for the anticipated charging stations at each site. During these meetings, the team will want to:

- Identify preferred parking and EVSE installation locations in relation to an existing electrical panel, utility meter, or cabinet with transformer.
- Determine the proximity of charging stations to the electrical power service. Placing the charging equipment near an existing power supply will reduce cost, power loss, and time for installation; however, this is not always feasible and is highly dependent on the site.
- For networked charging, ensure the location has adequate cell connection or wi-fi. This is typically only an issue in a parking garage or remote rural area. You may need to add a cell repeater to resolve this issue.

[2] If fleet charging stations are shared with employees or the public, the parking spots may need to comply with the Americans with Disabilities Act. ADA requirements do not apply to areas restricted to fleet vehicles or to assigned parking spaces. The parking area for motor pool vehicles or the fleet manager's reserved parking space are not subject to ADA regulations.

Consider departmental policy, process, and billing (if shared facility)

- Employees may need to learn new behaviors when switching from filling up gasoline fleet vehicles and charging electric fleet vehicles. The team should address how these changes may affect vehicle check out or specific parking locations.
- Identify operating issues, costs, fees, and department chargebacks (for a shared facility) that may make a potential charging location ideal, mediocre, or unacceptable.

Assess power capacity

Gather information required for the Site Assessment (Appendix A), which includes documentation and specifications for L2 or DCFC charging equipment you are considering. Capture available electrical demand and usage records, and reports or analysis about opportunities for electricity efficiency measures. Determine electrical service and upgrades required to support charging infrastructure.

Complete a site walk through and a site assessment for each planned fleet charging location.

- Walk the site and facilities with a commercial electrician or other electrical professional.
- Using the preliminary layout plan, investigate selected electric panels, meters, or utility access points to determine electrical load available for charging station usage.
- Determine capacity required to add dedicated circuits for Level 2 EV charging stations. Identify which electrical panels have space and capacity to add two-pole 40 A breakers.
- Complete a load calculation for each panel and EVSE location. The electrician or electrical engineer will work out the final load calculation and determine if unused or excess capacity is available for charging.
- Adjust the location of EVSE charging stations, if appropriate, to be closer to the best electrical panel locations.
- You may find that the best preparation is to complete an initial electrical survey of the entire facility.

Best Practices

- Run conduit efficiently because the cost increases with every additional foot.
- An electrician can typically create an esimate for EV charging equipment installation.
- Owners can help by identifying adjacent electrical panels on the property and the current electrical loads.
- When trenching, asphalt offers a much lower cost than pouring new concrete.
- Depending on the mileage available and milage used, you may not need to install a charging station for every EV purchased.
- Analyze duty cycles to determine charging needs in the fleet.
- Consider revenue models such as sharing your charging stations with employees during the day when they are not in use for the fleet or offering them for daytime public charging.
- If you find a facility has insufficient power, consider using managed charging and load management software to maximize load from the panel.
- Familiarize yourself with planned new construction on site. Consider integrating work with new construction or electrical projects akready planned.
- Mitigate cost or barriers caused by the age of the building or current site configuration.
- Consider EV model(s) and plug-in locations. Back-in parking may increase room or may impede charging. Will the EVSEs be wall mounted, pedestal mounted, or other?
- Consider future proofing: add battery storage capacity, solar, or battery back-up for resiliency.

Step 5. Engage with Your Local Electrical Utility

Team Members: Fleet operator, facilities manager, energy team, utility account manager, electrician (if L2) or electrical engineers (if DCFC)

Goals

Establish how utility representatives can help your team review your preliminary plans, and how they can help coordinate and implement your plan.

Initiate estimates of any work or improvements that may be required by the utility to do the work planned; document these costs for budgeting.

Leverage tools, data, and any incentives offered by your utility to support EVSE installation.

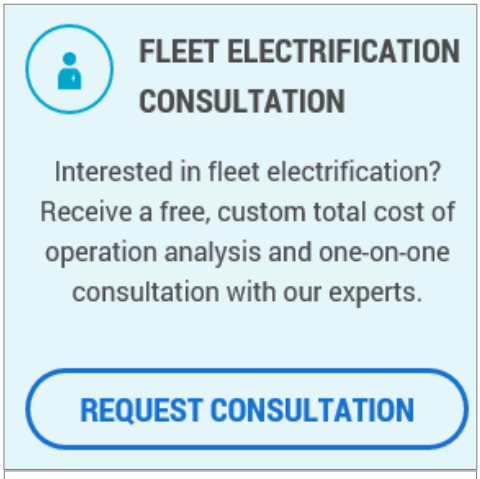
Questions for the Utility Team

- What is the time of use rate structure or EV tariff in your territory?
- Are there state-wide lessons learned?
- What are expected service upgrade costs?
- Is a commercial customer education program available for this area?
- What are the cost and timing of utility shut-down requirements in your area, if that is in the project, during construction?
- Do they offer a set fee for pre-paid or bundled utility or construction permits?

Activities

Contact your utility when you have preliminary plans for adding EVs and charging equipment to your facility. The utility may have an EV customer specialist who can address technical questions, confirm the new electrical usage, or explain if they have any programs or incentives to support fleet or workplace charging.

Use the preliminary layout (from Step 4) to document known electrical limitations, and understand required upgrades and related expenses. Focus on the specific charging sites to determine best fit/ lowest cost and stay flexible on location. A small adjustment in EVSE placement may save your organization time and money. This analysis will have the biggest influence on the final design and budget.



Source: Puget Sound Energy's fleet electrification consultation resource

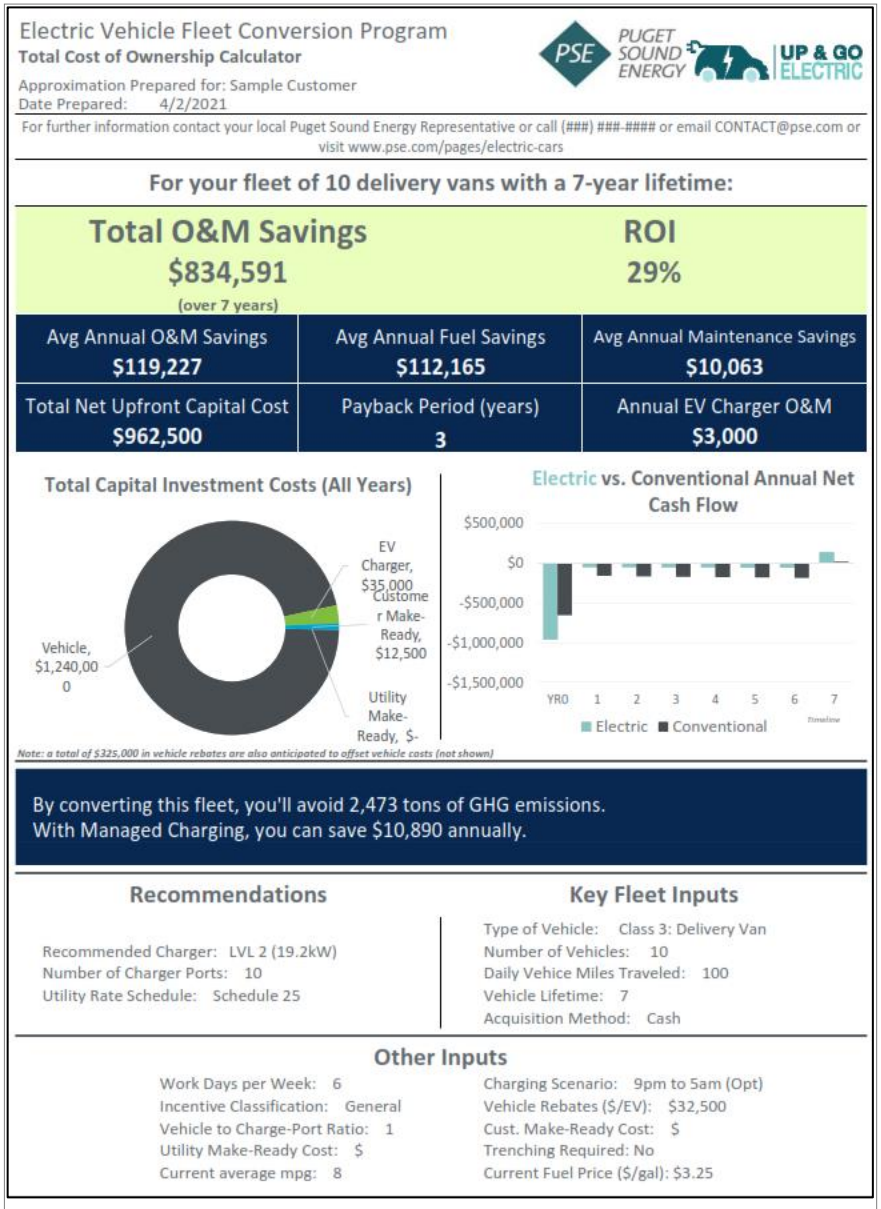
Ask your utility representative if they will:

- Look for site features that require additional panel, transformer, electrical distribution line, or substation level upgrades.
- Address applicable building codes and permitting processes.
- Discuss applicable TOU charges, demand charges, other fees or costs, and how to minimize them.
- Discuss your installation plans and layout.
- Provide insights about customer-side energy management, power sharing, operation, or ownership models that have worked at other public sites.
- Request specifics about future capacity limitations at the location, which can delay construction or add costs. For example, installing DCFC for fleets of medium- to heavy-duty vehicles may require significant upgrades, even a new substation, which could take the utility years to plan, finance, permit, and build. In such cases, the utility might help locate charging capacity in places that require fewer upgrades, resulting in potentially faster lead times or lower costs.
- Gather related costs and draft the installation timeline.

This is a good time to future-proof your organization's plans for EVs

When looking at the electrical capacity at a particular site, consider any future EV purchases at this location, including additional charging stations you might want to add in the next five to seven years. Discuss these possible plans with utility representatives to see if you can achieve cost savings by including work now that will be useful for future expansion.

At the end of this step, some electric utilities will be able to evaluate your EV charging needs in light of your current electrical capacity at the selected EVSE installation location(s). By combining your preliminary plans for EV purchases, charging stations, and electrical service with the expert assistance of your local utility, your team will be able to refine your plans and prepare realistic scopes of work, estimated timelines, and budgets. Whether completed by your team members or by your local utility, your team will have the data and documentation needed to prepare a business case that illustrates the likely benefits and costs of implementing your team's plans, as shown in this example.



Example of likely benefits and costs of implementing your team's fleet electrification plans (source: Puget Sound Energy)

Best Practices

- Establish a relationship with a utility representative who can help guide your plans.
- Identify any obstacles, additional costs, or needed upgrades.
- Continue to update the preliminary charging site layout, project budget, and timeline. Include the number of EVs that will be added to the fleet, and their makes and models.
- Sign up for any infrastructure support or incentives offered by the utility.

Step 6. Engage with Hardware Vendors and Contractors

Team Members: Fleet operator, facility manager, potential contractors, electrician or electrical engineers, construction and landscaping contractors

Goal

Discuss the EV charging plan with the vendors and possible contractors for the types of L2 or DCFC hardware you are targeting (see Appendix B). Refine this plan after consulting with potential contractors. Add itemized project scopes of work; a detailed budget for engineering, construction costs, and activities; and verified timelines for installation work.

Group decision

Establish criteria for choosing the EVSE installer. The EVSE provider may offer installation or recommend local contractors.

Local electrical contractors may offer insights about third-party EVSE providers. Some agencies will involve the utility for the installation.

Activities

Create an electrical upgrade plan

The electrician should combine work from your team and utility representative to finalize the electrical upgrades (see Appendix A). This is a good time to learn more about the different options from EVSE providers or from potential electrical contractors working with the equipment suppliers.

- Schedule a walk-through with potential suppliers or contractors to go over the information and documents you have gathered.
- A priority location may come at a high cost. A new location or design may reveal alternate and better locations.
- You might be able to use load management technology—software solution or networked sharing of existing capacity—to solve problems of insufficient electrical or facility capacity.
- Discuss with charging station providers if there are special requirements or scheduling considerations for EVSE installation.[3]

As you narrow the options or decide on specific equipment choices (see Appendix B), create the plan for the EVSE installation with the layout plan of the designated panel or meter locations.

Document required electrical upgrades based on hardware specifications and power insufficiencies.

Consult with potential suppliers and contractors to identify changes or upgrades to the layout that may be required, and to ensure the most cost-effective EVSE installation for the site.

Discuss the timeline and possible schedules for completing the project work.

Refine construction costs and considerations

- Compile construction specifics for facility, parking, or site work that is not included in the electrical design and planning.
- You may want to get local quotes for the non-electrical construction and any earthmoving and landscaping work

[3] *2021 BOMA Canada Electric Vehicle Infrastructure Guide*

- Consider if the work may be off property (transformer) or behind a secure gate, which might affect electrical or construction budgets.
- Identify if concrete curbing and parking bollards are needed, and ensure that signage and parking spot painting with a template is completed before charging begins.
- If parking is shared with the public, ensure compliance with federal ADA regulations and that the parking area has an acceptable parking flow after adding charging.

What type of contractor do you need?

In a smaller installation (fewer than four dual port L2 charging stations), your onsite electrician may be prepared to do this work.

For an installation of more L2 (240v) or high-voltage DCFC (480v three-phase) charging stations, you may prefer to subcontract certain work to a construction contractor, or landscape contractor to replant the area.

Best Practices

- Cost out the electrical upgrade work required: added wire, replacement or additional breakers on circuits, upgraded panels, cabinets, and other requirements for the electrical upgrade or new service.
- Finalize hardware and installation specifications. Consider placing wire/conduit to minimize distance from the electric panel to the EVSE and parking spots to reduce per-foot cost.
- Understand the full cost of materials for trenching through asphalt or poured concrete and restoring landscaping before finalizing the estimate.
- Avoid multiple concrete core drillings.
- Consider the additional cost of upgrading the utility service or adding a new meter pole or cabinet.
- If capacity is available, future-proof your EV fleet expansion by adding smaller gauge wire as part of burying the conduit so additional charging hardware can be added to the existing system.
- Clarify the permits required.[4]

Electrical one-line diagram

A one-line diagram is a simplified representation of a electrical distribution system with a simplified description in a single page document that represents a facilities electrical distribution infrastructure. Main components, such as transformers, switches, and breakers (and your new EVSE) are indicated by a standard graphic symbol.

[4] Follow NEC 2020- 625.40 EVSE. Typically, one L2 240 permit is required per 40 A breaker added.
Reference: NEC 625 2015, 2017, whichever may be approved by your jurisdiction, per King County RCC Code Collaboration Guidelines.

Step 7. Finalize Plans for Vehicles, EVSE, and Construction

Team Members: Fleet owner, facility and energy manager, parking enforcement, planning team, all stakeholders, top departmental *s*ign-off

Goal

Finalize your plan for adding the EVs and siting the EVSE. This plan is based on information the team has collected and recommendations of your local utility and potential vendors and contractors. The plan should include program scope and design for adding EVs, EVSE, and infrastructure construction; budget and funding mechanisms for each part of the plan; and timelines for each stage of implementation, including procurement of vehicles and EVSE, permitting, and infrastructure construction.

When these elements are established and documented, you will be in good shape to apply for grants to support your activities.

Activities

Meet with the electrification team to review, modify, and finalize the electrification plan for your organization:

- Verify the EVs targeted for procurement.
- Refine the map for fleet parking and add the fleet schematic electrical load profile analysis.
- Combine the preliminary layout, hardware specifications, and electrical specifications determined in working with the utility and equipment suppliers to prepare the budget. Include details about how your organization will fund the vehicles, EVSE hardware and software, and all installation costs. If you need grants or other support to make the program more viable, this should be included in the final packet.
- Use the information gathered from your utility and the vendors and contractors you have talked with to prepare a complete timeline, including time for procuring EVs and EVSE, permitting, and construction.
- Design the layout for installation work and include the electrical one-line diagram.

Best Practices

- Ensure you meet applicable EV readiness codes or ordinances.
- Familiarize yourself with permits required for electrical work and site construction.
- Add landscape costs for outdoor work.

Step 8. Complete Procurement Processes

Team Members: Fleet operator, procurement, finance, hardware provider, original equipment manufacturer or EV dealership

Goals

Complete the procurement process for EVs and EVSE.

Prepare the purchase orders or procurement requests based on the elements of your project packet and your organization's processes and policies. This may require separate documents for purchasing EVs, EVSE, and/or construction services. Include the vendor contact; EV quantity; specific L2 or DCFC hardware, warranty, and network requirements; electrical equiupment; and safety materials like paint, signs, and bollards.

Initiate the procurement process. If you have an approved estimate and your organization allows it, the next step may be a purchase order (PO). Some public fleet procurement processes may require requests for information (RFIs), qualifications (RFQs), proposals (RFPs), or bids (RFBs).

Activities

Prepare procurement documents

All procurement documents required by your organization should include specifics of the EVs, EVSE, and/or construction services as detailed in the planning undertaken in earlier steps. Discuss the timeline to learn when vehicles are scheduled to arrive (3 to 18 months). Installation of charging hardware may take up to 18 months, and it should be up and running before the vehicles arrive.

- Finalize the project timeline and circulate it to all team members for contract agreements.
- Recommend purchasing network annual or five-year warranty/maintenance package to ensure repair is provided by EVSE vendor when appropriate.
- Finalize repair contract with original equipment manufacturer or EV dealership for potential maintenance and support not covered by the vehicle warranty.
- Ensure fleet ownership of warranty or network costs replated to the vehicles and managed charging.
- Find resources online, consult with other state agencies that have completed this work, or refer to the State Vehicle Contract 04016 to avoid reinventing the wheel.
- Compare RFP hardware and construction cost thresholds with procurement on the State Vehicle Contract and with collaborative purchase agreements. Follow recommendations and approaches that are most familiar to the procurement team.

The procurement department may be aware of other cost-saving processes and have a good grasp on specific spending thresholds.

Grants and utility incentives

Ask about and look for state or federal grants that could support vehicle procurement or hardware installation. Have a scope, timeline, and budget ready to go if the right opportunity pops up. Also consider if your plan has innovative elements or features that would make it stand out in a grant competition, or if you can include any such element. As a team, discuss if you want or need to wait for grant support or if you can afford to proceed with your own budget and, thus, move ahead on your own timeline.

Best Practices

- Synchronize charging build-out with vehicle arrival. Timing matters: depending on the size, the project can take 3 to 36 months.
- Consider shared purchase collaborative or co-operative resources like Sourcewell or the Climate Mayors Electric Vehicle Purchasing Collaborative.
- Seek out expertise Washington state Department of Enterprise Services and the state contracts for EVSE (04016) and Motor Vehicles (05916)
- Grants, rebates, incentives: learn about available or special state financing opportunities with Washington state departments of Transportation, Commerce, or Ecology. Also see if federal incentives and opportunities are available from Federal Transit Administration, U.S. Department of Transportation, or U.S. Department of Energy.

Step 9. Installation

Team Members: Fleet operator, facilities manager, planning, parking management, contractors

Goal

Finalize and execute the installation and/or construction contracts.

Work with the installer/contractor to initiate and secure permits.

Activities

Create the installation contract

Create a contract and get approval to initiate construction and utility work.

- Include the planning and procurement documents with the make-ready work for installing EV charging stations.
- Ensure compliance with local building codes.
- Ensure permits are requested and approved.
- Post applicable zoning and parking rules, especially if the area is publicly accessible.

Permits

Your local jurisdiction or utility may offer streamlined permitting to prevent high costs across jurisdictions.

- Create a comprehensive list of permits (besides electrical) required by local building officials.
- Plan the permitting and inspection timeline.
- Track permit fees.

Best Practices

- Be flexible. Even with the best planning, you may need to change charging and EV parking locations.
- Innovation and effective communication are crucial.
- Be prepared to offer alternatives that may enable more affordable charging and parking locations.

Step 10. Implementation: Driver Engagement and O&M

Team Members: Fleet owner, fleet operations and maintenance, energy efficiency team, and those involved with employee and fleet driver engagement

Goal

Driver adoption of the new vehicles and charging procedures is paramount. Create or adopt programs to support successful employee and driver adoption of the EVs and EVSE. As with any new technology or organizational change, the new fleet vehicles will require your organization to change existing processes and add others to encourage driver engagement, operation and maintenance (O&M) support, and good data collection.

Activities

Implement tasks or policies that will lead to the greatest employee adoption and smooth operation of new fleet vehicles.

Plan for process changes that may occur once you have commissioned the charging stations and started using new vehicle parking.

Focus on changes that relate to the new type of vehicle, and plan programs around the new charging and parking processes. Note where processes that were not adopted may be helpful.

Once the charging stations are installed and you are gathering data, create a smooth and cost-effective O&M plan. This will also support any warranty with the vehicle manufacturer or dealership.

Take advantage of webinars and other training opportunities provided by the vendor or on the web.

Driver engagement

Here are a variety of activities that public fleets use to engage their employee drivers with new EVs:

- Offer a Ride & Drive to communicate the importatnce of adding EVs to the fleet.
- Publish a map illustrating parking changes, including bollards, signage, and parking spot painting.
- Let potential EV drivers check out the new EVs.
- Check out resources on the Green Transportation Program website on implementing a driver engagement program specific to these new cars.
- Highlight changes in parking rules or expectations, the vehicle check-out and drop-off process, and how to re-charge at work and at home.
- Ask the original equipment manufacturer to offer a driver training program for medium- and heavy-duty EVs.

Operations & maintenance: integrate EVs into the shop

Here are things to consider for training the maintenance team:

- Seek out local and workforce training opportunities. Ideally, this process will start as soon as the decision is made to electrify the fleet.
- Offer training to prepare employees to transition to EVs. Discuss any changes in employee roles.
- Train staff on using the charging stations and performing light technician work on the EVSE.
- Involve employees in repairing the charging station hardware and performing maintenance if you did not purchase a networked EV or warranty.

Track fleet carbon reduction improvements

Track the gains you expect; your data will tell the story of cost-savings and carbon reduction.

- Calculate the new TCO based on maintenance and power-source savings. Networked EVSE reporting typically offers way to capture low-carbon fuel standard data and greenhouse gas tracking.
- Document impacts on current car check-out or fueling programs. A networked EVSE may offer an opportunity to simplify departmental fuel chargeback, which may be a relief in shared parking/fleets.

TCO recovery

- From the time you begin the transition to expanding your progress in the future, you will want to track efficiency savings for all fleet improvements. This will improve your future TCO calculations.
- Report on the data collected and the findings, such as reductions in fuel and vehicle maintenance costs.

Future Steps: Future-Proofing!

Make plans for future deployments using your organization's lessons learned. Prepare shovel-ready projects for new funding opportunities.

Appendix A: Site Assessment

The data captured here will be used to complete a utility service request for fleet electrification, based on the new electric fleet's projected electric service needs. Include vendor specs on charging hardware, Include site layout plan or photo

Fleet Site Information	
Location of the site:	City: County:
Fleet Operation	Electrical Contractor: Name, email or phone:
Utility: Primary point of contact	Vendor or Hardware/Network Provider(s): Primary point of contact:
Electrical capacity capture for upgrade request	
Electrical capacity load profile: Fill facility, per panel (see layout and electrical one-line diagrahm)	
Charging load profile from Step 1: # of vehicles and battery size:	# of amps required per panel:
Utility service preferences for upgrade request	
Service upgrade:	#_____amps (ex: from _200 A to _600 A)
New service size	#_____amps (ex: 600 A)
Existing or separate meter service:	Will you (circle one): • Wire the charging hardware to an existing electrical panel? *or* • Dedicate a new electrical service for the new load?
Electrical Load Management	
For managed or networked charging: Are you scheduling or otherwise managing the vehicle charging at this location?	Circle one: Y/N If yes, add network name here
Is cell service Wi-Fi or Cat 5, available	Circle one: Y/N
Distributed energy, self-generation and storage	
Are you integrating on-site energy generation (e.g., solar, wind turbine) storage at this location? Are you adding solar or battery backup for resiliency?	Circle one: Y/N If yes, describe your approach: Circle one: Y/N

Appendix B: EV Charging Equipment Vendors

Many companies offer equipment for charging EVs. Vendors in this space are continually changing and evolving; the Green Transportation Program will do its best to keep this information updated. The state Department of Enterprise Services EVSE Contract 04016 has an approved list of full turnkey providers to assist your procurement needs.

ABB: DCFC hardware only. Also offers battery storage.

Blink: Provider of L2 and DCFC hardware with imbedded network (make sure data and dashboard are sufficient for needs). Also offers infrastructure as a service.

BTCPower: Exclusive hardware provider of DCFC on all Open Charge Point Protocol networks.

ChargePoint: Hardware provider of L2 and DCFC, as well as networked chargers. Good data dashboard. Also available as Infrastructure as a Service (IaaS), in which a vendor provides clients with pay-as-you-go access to storage, networking, servers and other cloud services.

Clipper Creek: L2 hardware provider. No network communication chip for load management.

Delta: Provider of L2 and DCFC hardware with Open Charge Point Protocol networks.

Efacec: DCFC provider with Open Charge Point Protocol networks.

Electrify America: Network provider, uses all types of DCFC and some L2, entirely infrastructure as a service provider.

EVBox: Hardware provider. L2 allows Open Charge Point Protocol networks. Associated with EV Connect network.

EVCS: Taking over existing networks (L2 and DCFC) and building additional stations for an infrastructure as a service model.

EVgo: Network provider, usually infrastructure as a service/membership model. DCFC and L2 Open Charge Point Protocol with dashboard.

FreeWire: Provider of L2 and DCFC hardwware. Also offers battery-supported and portable hardware.

Levitron: Provides fleet installation solutions using Chargepoint hardware and software.

OpConnect: Provider of hardware and Open Charge Point Protocol network.

Schneider Electric: Hardware provider, L2 and Open Charge Point Protocol network.

Sema Connect: Hardware provider, L2 commercial and fleet version. Typically with imbedded network (make sure data and dashboard are sufficient for data capture needs).

Siemens: Offers project development and installation for L2 and DCFC equipment.

Tesla: Propietary L2 and DCFC hardware with imbedded network to driver's car and cell phone app.

Volta: Advertising model. Volta installs non-networked systems as free charging in commercial spaces.

ZEF: Offers L2 and DCFC hardware and software solutions combining equipment from Clipper Creek and other providers.