

PUBLIC CHARGING ACCESS

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This focus area provides strategies to increase public access to electric vehicle (EV) charging by addressing topics that support the installation and use of EV infrastructure for all community members and the resulting impact on local economy. While most EV charging occurs at home or at work, access to and knowledge of available public charging stations can help residents feel more comfortable purchasing an EV. Range anxiety, or the fear of an EV running out of battery power before reaching a charging station or desired destination, is noted as one of the top barriers preventing people from purchasing EVs. As battery technologies continue to advance to support longer travel, and as public charging stations become more prevalent, range anxiety should become less of a concern.

Topics and strategies in this focus area can be important tools to ensure that all residents are able to take advantage of the direct and indirect benefits of EV adoption. While the strategies in this section are aimed at municipalities installing public EV charging stations, many of the same considerations would apply to local businesses interested in installing charging stations for customer use.

PHASED APPROACH

Beginning to plan and build your community's EV charging infrastructure can be a great way to lead by example and demonstrate commitment to advancing transportation electrification. Depending on where you are in the process, it can be challenging to know what steps to take next, or even where to begin. Consider the following phased approach to inform your first or next steps.

Phase 1 - Laying the groundwork

Preliminary research and evaluation are important first steps to help guide your community's EV charging infrastructure network. Locate existing EV chargers and promote them. Perform a gap analysis by identifying areas where the barriers to home charging might be high (e.g., multifamily residences or no home off-street parking access). Determine municipality role for owning and/or operating EV charging stations. Explore funding options and financing mechanisms, to inform the procurement, installation, and operating and maintenance of new charging infrastructure.

Phase 2 – Pilot public EV charging infrastructure sites

Once you've done some research, consider selecting one or two municipal locations to install EV charging stations. As determined from Phase 1, the municipality can procure and install an EV charger, or a public-private partnership can be developed where a third party can be contracted to install EV chargers. This can serve as a pilot project to inform future EV charging station chargers, utilization rates, locations, and pricing structure. Pilot stations can be in highly visible locations and used to create awareness and educate residents about EV charging stations.

Phase 3 – Community-wide public EV charging infrastructure

Use the information you collected in Phase 1 and lessons learned in Phase 2 to plan for a community-wide EV charging infrastructure buildout. Continue to add EV charging stations at publicly accessible municipal sites; educate and partner with businesses to install EV charging stations that are open to the public. Additionally, consider any necessary supporting strategies to ensure success. These strategies may include parking enforcement and community outreach and education.

Who Are the Target Audiences for Strategies Included in This Focus Area?

- Community residents who own or lease a light-duty vehicle for personal use
- Businesses that may install charging stations for customer use
- Local or regional transportation planning groups
- Municipal facilities, parking, transit, and other administrators

Key Messaging

- Ensure appropriate access to charging for residents of and visitors to the community
- Reduce the number of households with lack of adequate transportation options
- Improve community air quality
- Attract customers and showcase the community's or business' sustainability commitment
- Capitalize on the economic opportunities of widespread EV conversation
- Engage the utility early in the planning process

Typical Barriers

- Lack of knowledge of charging station benefits
- Infrastructure costs
- Policy and legislation lagging behind technology advancements
- Lack of knowledge for how to site the best location within a property to maximize utilization and electrical capacity
- Limited examples of tested business models for charging station operations

What Are the Most Effective Outreach Channels for These Strategies?

- Peer learning opportunities such as conferences
- One-on-one meetings with managers of parking facilities
- Chamber of Commerce or other business organizations

CHARGING STATIONS

Awareness of and access to EV charging stations is a major factor in encouraging residents to purchase an EV, according to a nationwide survey conducted by the National Renewable Energy Laboratory (National Renewable Energy Laboratory, 2017). Strategies in this topic area focus on ways communities can install charging infrastructure to ensure availability for residents and visitors. Local code and zoning ordinances can provide substantial benefits and support in increasing public access to charging stations. For more information on these strategies, see the section on [Policy](#).

Basic information

When choosing to install EV charging infrastructure in public spaces, a community should consider the following criteria:

1. **Charging Station Type:** In most cases, Level 2 charging is appropriate for public charging — especially at shopping centers, parking garages, public parking areas, or other locations where customers are likely to spend a few hours. Direct Current (DC) fast charging stations may be considered along transportation corridors to allow EV owners to extend their range with only a quick stop. For more information on charging station types, see [Appendix A: Electric Vehicles 101](#).
2. **Proximity to Amenities:** Often, an EV user will need to stop to recharge for several hours, so it is helpful to install public chargers next to restaurants, entertainment venues, or shopping amenities. See [Map Ideal Public Charging Station Locations](#) for more information.
3. **Location of Electrical Service:** The cost of installing a charging station is significantly impacted by the proximity to an existing electrical service such as a feeder or a substation that already has the capacity to add more load. It is essential to work with your local utility to understand the service available as well as the upgrade requirements at selected sites.
4. **Accessibility:** Apply Accessibility Standards to EV charging stations to ensure access to community members with disabilities. Requirements include adequate design standards for users with mobility aids and accessible communication features. Reference the [U.S. Access Board](#) for assistance in designing and installing accessible EV charging stations.
5. **Public Access:** Though 80% of charging occurs at home, lack of public access is often cited as a barrier to EV adoption (U.S. Department of Energy, 2019). Residents who lack off-street parking, renters, residents in multifamily housing, and households with lower incomes may rely solely on public charging because they don't have the space, authority, or financial means to install and use a personal EV charger.
6. **High-Traffic Location:** To ensure the charging station is available to the highest number of EV users, it should be located in a high-traffic area. Locations where drivers are likely to park for extended period of time, such as park-and-rides or downtown parking garages, are good options.
7. **Network Accessibility:** For many Level 2 and DC fast charging stations, access to a wireless or cellular network is required to enable payment options. This interconnectivity also allows additional functionality such as mapping of vacant versus in-use stations via manufacturer mobile apps
8. **Impact on Electricity Bill: Hosting Level 2 and DC fast charging stations can noticeably** impact demand charges. Separating out the charging station services from the main building services may be a beneficial way to receive different use rates or to identify costs specifically from the charger.

First Steps and Quick Wins

Supporting public charging through municipal resources can provide strategies that can be readily implemented with limited financial investment. These strategies can create a solid foundation for future charging infrastructure integration.

Evaluate Use Patterns of Existing Charging Stations

Understand the use patterns of existing charging stations to inform decision-making on future infrastructure investments. This can be as simple as interviewing or surveying residents who live or work near existing stations to get a qualitative assessment of how often they see the charging station being used. These interviews should include general awareness of the station and any recounts of how often and at what time of day the charging station is typically in use. Some Level 2 and DC fast charging stations have built-in submetering or other data logging that could be used to evaluate station use (if the station owner is willing to share the data). With this data, a more quantitative analysis of use patterns may be possible; however, this level of detail is often not necessary.

Promote Existing Charging Stations

List or map all charging stations on appropriate public websites or charging locator apps and include them in any community EV collateral or web content. Use standard signage at all charging stations and make sure it is visible from the main thoroughfares. Raising public awareness of public charging stations is a critical step in easing range anxiety among potential EV adopters.

Examples of tools and apps that allow EV users to search for public EV charging stations include:

- [Xcel Energy EV Charging Map](#)
- [U.S. Department of Energy Alternative Fuels Station Locator](#)
- [Google Maps](#)
- [Open Charge Map](#)
- [PlugShare](#)

Create an EV Charger Siting Guide

Establish rules for public charging stations, which could be in the form of recommended guidelines or required standards. Like many other capital expenditures projects run by a community, siting guides can be important to encourage developers and partners to follow consistent practices to meet project and municipal goals. For privately owned and operated charging stations, these guidelines would not be required but might still be helpful as a model. When creating guidelines, consider the following (not exhaustive) list of factors:

- Parking space dimensions
- Parking configurations (including charging station location in relation to the parking space as well as wheel stops, guard posts, and signage)
- Applicable technical standards
- Standardized signage
- Area lighting
- Vehicle and pedestrian clearances, including strategies for keeping charging cord clear of the pedestrian right-of-way and clear of plowing operations
- Additional considerations in flood zones
- Accessibility standards ([see equity strategy incorporating accessibility standards for community members with disabilities](#))

Examples:

- The [U.S. Department of Energy Clean Cities Coalition](#) developed [siting and design guidelines for charging stations](#).
- [CleanTechnica](#) and [GreenWay](#) produced the [Electric Vehicle Charging Infrastructure: Guidelines for Cities](#), that lists [critical design guidelines for charging stations](#).
- The [Tahoe Regional Planning Agency](#) in the Lake Tahoe, CA, area provides information for charging infrastructure on page 56 of its [Plug-In Plan](#).
- For more examples of siting regulations see the [Great Plains Institute](#) report [Summary of Best Practices in Electric Vehicle Ordinances](#)

Explore Grant Opportunities for Cost Sharing

Look for organizations promoting EV charging, and leverage grants and other funding from federal and state governmental agencies or local nonprofit groups. Charging infrastructure can cost from \$500 to more than \$150,000 depending on the type of charger, the amount of retrofitting and electric supply upgrades needed, and the desired software amenities for using and managing the charger. Find out more about the different types of chargers available in [Appendix A: Electric Vehicles 101](#). Often, grants and other cost-sharing programs can be used to help offset some of the up-front costs and to increase the ease of EV use within the community.

Further, grants can help fill gaps in funding and help existing partners and funds do more and go further. See [Appendix D: Funding Resources](#) for more information and suggested outlets for funding. Check with Xcel Energy about potential funding assistance as well.

Develop Guidelines for Installing Level 2 or DC Fast Chargers

Establish guidelines for determining where to install Level 2 versus DC fast chargers in the community. These guidelines should include considerations such as:

- **Type of destination.** The number of miles per hour of charge that a charging station can provide vary greatly. Level 2 chargers often offer 25-40 miles per hour of charge, while DC fast charging stations can provide up to 240 miles per hour of charge. The length of time an EV owner will spend at the location will define the appropriate amount of time charging should take. For instance, grocery stores are good candidates for DC fast charging stations, while movie theaters could host Level 2 chargers.
- **Regional partnerships.** DC fast charging stations are needed to facilitate regional use of EVs across travel corridors. Ideal locations for these chargers can be identified through regional planning and collaboration. See [Develop Charging Corridors](#) for more information regarding national efforts to link major thoroughfares across the country.

Example:

- The [U.S. Department of Energy](#) developed a [handbook](#) on hosting public charging stations, with suggested guidelines for installing Level 2 or DC fast charging stations.

Larger Efforts and In-Depth Studies

Long-term efforts to ensure ideal public access to the appropriate types of chargers for specific locations within the community will require additional planning, budget requests, and in-depth studies. These strategies will create a stable foundation for EV integration into the community.

Map Ideal Public Charging Station Locations

Review community demographics and travel corridors to identify locations where public charging would be most used. The produced maps can then be used in outreach to local businesses or in finding community-owned parking garages where public charging stations could be installed in the identified areas. EV drivers who rely on public charging infrastructure include people who rent, residents in multifamily housing, and long-distance travelers. See [Develop Charging Corridors](#) for more information regarding how to support long-distance EV travelers.

Drivers who can benefit greatly from public EV charging stations are residents who lack access to home charging. According to a study conducted by the International Council on Clean Transportation, 30%–80% of EV owners living in apartment buildings rely on public charging for vehicle use (Nicholas, Hall, & Lutsey, 2019). In areas where there is a high concentration of apartments and other multi-family housing, installation of public EV charging stations could have a higher impact than in other areas. Another option is to reach out to building owners about installing EV charging stations at their buildings. See the [Outreach and Education](#) focus area for more information on this strategy.

Examples:

- The [Boulder County Regional Transportation Electrification Plan](#) mapped housing characteristics to identify what type of EV programs and outreach would be best suited for that area (pages 6-7).
- Through Xcel Energy Partners in Energy, Denver developed a carshare suitability analysis to identify where carshare would be most appropriate based on land use, demographics, and other characteristics (see Figure 1).

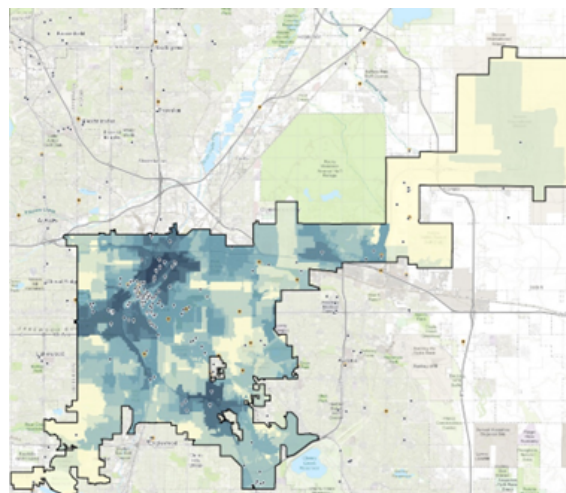


Figure 1: Denver Carshare Suitability Analysis Map

Rural EV Charging: Community and transportation differences in urban, suburban, and rural areas create different charging needs. Rural communities tend to have greater costs associated with travel, including longer drive time, higher fuel consumption, and internal combustion engine (ICE) maintenance. Transitioning to EVs, rural communities will benefit from reduced mobility costs and improved air quality. Transitioning rural communities to EVs means coordinating with the [U.S. Department of Transportation](#) to plan and implement EV infrastructure in their regions. To take advantage of EVs and begin the next steps towards adoption, reference the [Electrification Coalition - Electric Vehicles in Rural Communities](#).

- The Northglenn, CO [Electric Vehicle Action Plan](#) includes a DC Fast Charging Station Opportunity Map (page 30) that identifies apartments and existing charging infrastructure. This map can be used to inform outreach strategies for property owners and connecting them with funding and rebates.

Offer Charging Station Rebates and Incentives

Establish a rebate or grant program for businesses or organizations that choose to install publicly accessible EV charging stations. A survey that reviewed various community strategies for promoting EVs found that the availability of rebates for EV charging infrastructure correlated with significantly higher rates of EV market shares (Cattaneo, 2018). Visit [Xcel Energy's EV website](#) to learn more about EV charging infrastructure programs and incentives.

Examples:

- The [Colorado Energy Office](#) is offering [financial support](#) including: a rebate for up to 80% of the cost of a charging station; up to \$9,000 for a Level 2 dual-port station; and up to \$50,000 for a DC fast charging station. Enhanced incentives are available for eligible applicants.
- The [Pennsylvania Department of Environmental Protection \(DEP\)](#) offers [rebates](#) of up to \$4,000 per port for Level 2 EV charging stations; and up to \$250,000 for a DC fast charging station
- The [North Carolina Department of Environmental Quality \(DEQ\)](#) provides funding for Level 2 and DC fast charging stations through the [Zero-Emission Vehicle Infrastructure Programs](#). Eligibility in each program depends on the location and purpose of the chargers.

Explore DC Fast-Charging Options

Identify potential locations for different types of charging infrastructure. Level 2 charging stations serve a significant role in public access at lower installation costs; however, the strategic installation of DC fast charging stations can facilitate long distance EV travel through major travel corridors. DC fast charging stations offer a convenient option by providing at least an 80% battery recharge in less than 30 minutes, which allows travelers to substantially recharge their vehicle while they stop for a short break at local restaurants or shopping centers. However, DC fast charging stations can be detrimental to vehicle battery life if used too frequently. In many places, state and regional agencies are working together to ensure that there will be a complete charging network along regional interstates or other travel corridors. See [Develop Charging Corridors](#) for more information regarding travel corridors.

Charging Plazas: DC fast-charging plazas offer “banks” of multiple charging stations in centralized locations to accommodate charging of numerous electric vehicles quickly. Plazas can be especially beneficial for providing access to EV owners who have limited at-home charging options. For instance, DC fast-charging plazas can serve Transportation Network Company (TNC) fleets like Uber and Lyft. Lyft recently [committed to 100% EVs](#) in their fleet by 2030.

The Colorado Energy Office [DC Fast Charger Plazas program](#) is designed to increase access to high-speed charging across the State of Colorado through large banks of fast chargers.

Example:

- The [Marengo Charging Plaza](#) in Pasadena, CA offers drivers 44 charging plugs with 24 Superchargers installed by Tesla, as well as 20 additional fast chargers installed by the City of Pasadena.
- [National Renewable Energy Laboratory](#) developed [a report](#) that outlines opportunities for DC fast charging stations under a variety of EV adoption scenarios.
- The [State of Colorado](#) developed [an EV plan](#) that describes the Regional EV West Memorandum of Understanding, where eight western states are working together to install EV charging stations along established heavily traveled routes.
- [Evolve NY](#) is installing fast chargers throughout the state, and is part of New York State's broader goal to have at least 800 new EV fast charging stations installed through 2025 including [John F. Kennedy International Airport](#) operating the largest public fast charging station in the Northeast.
- The [U.S. Department of Energy](#) conducted an [EV infrastructure analysis](#) that outlines scenarios to develop a complete DC fast charging network across the nation.

Develop Charging Corridors

Work with regional and state partners to develop EV travel corridors. The 2021 Infrastructure Investment and Jobs Act created the [National Electric Vehicle Infrastructure \(NEVI\) Formula Program](#) that dedicates \$5 billion in funding over 5 years to states to strategically deploy EV charging infrastructure and establish an interconnected nationwide network of 500,000 EV chargers. Initially, funding under this program is directed to designated [Alternative Fuel Corridors](#) for electric vehicles to build out this national network, particularly along the Interstate Highway System. For a highway to be classified as an EV corridor, EV fast charging facilities must be installed at least every 50 miles.

Examples:

- All [50 states, the District of Columbia, and Puerto Rico](#) have approved plans for building out EV chargers across approximately 75,000 miles of highway throughout the country.
- [Northern Colorado Clean Cities](#) supports EV charging infrastructure along the [rural corridor in the intermountain west](#), with the intention of improving access to EV infrastructure for underserved and secluded areas of Colorado.
- The Great Plains Institute and Carbon Solutions developed the [U.S. EV Fast-Charging Corridor Road Map](#) that lays out what a national EV charging network could look like, consistent with NEVI requirements along with an [interactive map](#).

Leverage Public–Private Partnerships

Establish a public–private partnership to help build out early infrastructure required for public EV charging station deployment. A study by the International Council on Clean Transportation found that public–private partnerships were a successful mechanism to support national infrastructure programs in China and Japan. These strategies were found to be most successful when used to fund programs that addressed charging infrastructure in difficult market segments such as curbside charging stations, multi-unit dwellings, and inter-city fast charging (Hall & Lutsey, 2017).

Examples:

- The Town of Erie, CO developed a request for information from businesses and homeowners’ associations to create public-private partnerships for site hosts for electric vehicle chargers identifying roles and responsibilities.
- The [State of Washington](#) describes the criteria for which public–private partnerships are considered to be the lowest cost option in its [Transportation Resource Manual](#), which includes the [West Coast Electric Highway](#) as an example of a successful partnership.
- [Eversource](#), a utility in New England connected with the EV charging station manufacturer, [Greenspot](#), to provide the Massachusetts cities of [Newton](#) and [Brookline](#) EV charging stations through public–private partnerships in 2019.
- The [State of Florida](#) changed its [legislation](#) in 2019 to support and encourage [public–private partnerships](#) for developing public EV charging stations around the state.

Mobility Hubs: Low-income residents and communities of color often have the least access to clean and affordable mobility options. When identifying EV charging locations, consider partnering with transit agencies, car-sharing companies, and other mobility providers to develop mobility hubs in low-income neighborhoods and communities of color. Mobility hubs can include transit stops, bikeshare systems, EV carshare services, EV charging stations, bike parking, and ride-share drop offs. As an example, the [Metropolitan Transportation Commission](#) is partnering with the non-profit [Transform](#) to develop mobility hubs that include EV carshare services, e-bikes, free transit passes, and other transportation benefits to low-income residents based at three affordable housing sites.



Establish Budget for EV Charging Station Installation and Upkeep

Designate an annual line-item in the community budget for the installation and maintenance of public charging stations. Based on 2019 cost estimates from RSMeans, installation costs of Level 2 charging stations are between \$2,000 and \$8,500. These costs do not include any required electrical upgrades or conduit, which can double the cost. Additional budget should be allotted annually for regulation enforcement and management of payment systems (if the community will own and operate the charging stations). Many communities have found that it is more efficient and cost effective to contract with a third party to operate and manage its charging stations. In this case, the charging station manufacturer retains ownership of the station, with the terms of the agreement determined on a case-by-case basis. This may include the manufacturer renting the spot from the community, splitting the profits received from the station, or allowing use of the location in exchange for handling all planning, setup, and operations. For more information and examples, see the [Economics](#) topic area section.

Provide Charging Infrastructure for Shared Mobility Fleets

Shared mobility fleets, such as ride-hailing companies like Uber and Lyft, represent an opportunity to transition high-mileage fleets to EVs. However, many drivers may not have access to at-home charging or may need to charge on the road. Providing public charging infrastructure in key locations can accelerate the adoption of EVs in shared mobility applications. The Seattle Department of Transportation mapped key locations by prioritizing those 1) with less-established networks of EV chargers, 2) in areas of historical underinvestment and disproportionate air pollution burden, 3) at shared mobility hubs, and 4) in areas with poorly-connecting transit service. This mapping effort was part of the [EV Shared Mobility project](#) which provides case studies and other resources from cities that are testing electric and shared mobility interventions.

Pair the development of charging infrastructure with an outreach campaign to encourage rideshare drivers to transition to EVs. This outreach should be conducted in partnership with rideshare companies and at locations where drivers frequently gather, such as safety inspection sites and airport waiting lots. Work with rideshare companies to organize group buys, set up low-interest loans, and provide promotions or incentives for EV drivers.

Examples:

- [Uber has partnered with Hertz](#) to provide rideshare drivers with EVs.
- Across the county, Lyft drivers can access [charging discounts at EVgo stations](#).
- Lyft drivers can get a [discount on a Level 2 charger](#) and pre-negotiated rates for installation.
- Lyft offers drivers [1-7% cashback on public charging](#) with the Lyft Direct debit card.
- In California, Lyft drivers who currently have an EV are [eligible for an extra \\$150 per week](#), as long as they give at least 50 rides (good through 2024).

ELECTRIC SUPPLY

This topic area identifies key municipal, county, or state strategies to ensure appropriate short-term and long-term electrical supply for planned charging stations. Charging station planning should include electricity generation source, infrastructure planning, and utility coordination efforts.

Basic Information

As outlined in Figure 2, there are six steps in transporting the electricity produced at a utility scale to provide power to an EV.



Figure 2: Steps in Electricity Transportation and Delivery

Important factors to consider when reviewing the electrical supply for your charging stations at each step are:

- 1. Utility Distribution Network:** The network transports electricity from the generation source to local transformers. Understanding the fuel generation mix of electricity supplied on your local electric grid can help you identify GHG emissions reduction amounts from converting ICE vehicles to EVs. The U.S. Environmental Protection Agency estimates that the average ICE passenger vehicle emits 4.6 metric tons of GHG emissions per year (U.S. Environmental Protection Agency, 2018). Annual GHG emissions for EVs in 2017 and the associated reduction percentages compared to ICE passenger vehicles are shown in Table 2 based on Xcel Energy's CO₂e intensity factors listed in the [Energy and Carbon Emissions Reporting 2017 Summary](#). GHG savings will continue to increase as Xcel Energy works towards its goal of being 100% carbon free by 2050.

Table 2. 2017 Annual EV GHG emissions and percent reduction per Xcel Energy service area

	Upper Midwest (MI, MN, ND, SD, WI)	Colorado	Southwest (TX, NM)
Annual Emissions per EV (MT CO ₂ e)	0.94	1.49	1.42
Percent Reduction from Typical ICE vehicle	80%	68%	69%

The equation below can be used to estimate GHG emissions associated with EVs in your community. The estimation is based on average energy use by EVs, average annual vehicle miles traveled (VMT) per resident, and Xcel Energy's CO₂e emissions intensity factor. Currently, the average EV uses about 34 kilowatt-hours (kWh) per 100 miles (U.S. Department of Energy, 2019).

(Average energy use per EV)x(average annual VMT)x(CO₂ emissions intensity factor)

$$= \frac{34 \text{ kWh}}{100 \text{ mi}} \times \frac{X \text{ VMT}}{\text{avg resident}} \times \frac{X \text{ MT CO}_2\text{e}}{1000 \text{ kWh}}$$

2. **Utility Pad Mounted Transformer:** The size of the transformer serving the area determines the power available. EV charging stations with larger capacity than a Level 1 charger can have significant electrical demands. If you plan to install more than 3 Level 2 chargers or any DC fast chargers contact your Xcel Energy representative. It is important to understand whether the electrical service serving the proposed site can support the extra load. If the service must be upgraded, the costs of installation will increase substantially. Your Xcel Energy representative can help you understand the capacity of your existing service.
3. **Meter:** When installing an EV charging station, consider whether you would like to install a new meter to provide separate service to the charging stations or use the building meter. A separate meter will allow the EV charging stations to be on a different electric rate than the building. Be sure to consider the potential energy demand charges as well as the energy use rates. Such price adjustments could increase energy costs by 45% to 89% if not properly managed (Fathy & Carmichael, 2019). Your Xcel Energy representative can help you understand the most cost-effective scenario.
4. **Panel:** A panel is the beginning of the customer-owned equipment in a traditional utility model. If an existing meter is used, then you may be able to tie into the existing electrical panel. However, if the panel is at or near capacity, it may need to be upgraded. Work with an electrician to understand the available capacity on your existing panel.
5. **Conductor:** This is used to transmit electricity from the panel to the charging station and can be a significant variable in the cost of installing an EV charging station. The cost for installing the conductor will depend on the distance from the transformer to the charging station as well as the substrate through which the conductor must pass. For example, an installation requiring a trench to the conductor a few feet through a grassy lawn will be much cheaper than an installation that travels six stories through a concrete parking garage. This is a very important factor to consider when choosing locations for public charging stations.
6. **Charger:** The type of charger to be installed will determine the electrical capacity required. See [Appendix A: Electrics Vehicle 101](#) for more information on charger types.

First Steps and Quick Wins

Strategies in this section explain initial actions you could take to ensure appropriate electric supply stability for EV integration. These strategies can be quickly implemented with limited financial or time investment and will establish the groundwork for success.

Develop Utility Notification Protocol

Collaborate with Xcel Energy to develop protocols to communicate and share information about when and where EV chargers are being deployed as well as basic specification information such as if the charger is a Level 1, 2, or 3. This [Get Started Guide](#) will help you better understand who to contact, and when, during EV charging infrastructure planning and installation. This coordination would most likely require engaging your community's permitting and inspection division and will allow Xcel Energy to manage the potential grid impacts of charging EVs, ensuring a positive experience for all EV owners. It is a best practice to inform Xcel Energy as soon as possible about electrical upgrades planned to support public EV charging stations. Refer to [Working with Xcel Energy](#) to determine who at Xcel Energy to contact for support in your EV planning. If you are unsure or have questions, talk to your account representative.

Design for Future Charging Capacity

Consider projected demand for EV charging stations when installing public EV infrastructure. Installation might include expanded electrical panel capacity and raceways to facilitate additional stations in the future as demand increases. Depending on the location, upgrading or retrofitting the electrical panel and conduit that serve the charging station can cost significantly more than the charging station itself. The incremental cost of sizing the panel for future growth and installing additional conduit for future charging stations is relatively small, and it will save the community money in the long term and avoid significant construction activity, such as trenching for future charging stations. If near-term demand is expected to grow, initially installing multiple chargers may be more economical than adding in more chargers in the future. According to some hardware and installation companies, installing more than five chargers at a time can be economically beneficial because of the lower average pricing for the hardware in bulk and in terms of operations and maintenance support, especially if sourced through a third-party EVSE manufacturer. Two portions of the electrical service should be considered:

1. **Before the Meter:** This includes the transition and distribution infrastructure owned and operated by Xcel Energy. This equipment determines the total amount of power that can be delivered to a site. Work with your Xcel Energy representative to understand the available capacity at your site and the potential costs of any required upgrades.
2. **After the Meter:** This equipment includes the electrical panel and the raceway owned and installed by the property owner. An electrician can help you understand if electrical panel upgrades are required and the associated costs of installing additional electrical conduit for future EV charging stations. There could be limits to the capacity, so working with your utility and phasing projects are recommended.

Ensure New Construction is EV-Ready

Install additional capacity in electrical panels as well as the required conduit, to facilitate future installation of EV charging stations for new construction projects or major renovations. Projects of special interest include parking garages or public access buildings such as a courthouse. Making these investments at the time of new construction or renovation will save costs, as it is easier to install wiring during other construction; and, material costs can be shared across multiple purposes (e.g., wiring for EV chargers as well as on-site solar or HVAC equipment). This can save charging infrastructure projects as much as 75% compared to rewiring (Pike, Steuben, & Kamei, Plug-in Electric Vehicle Infrastructure Cost-Effectiveness Report for San Francisco, 2016). The community can also choose to require installation of EV-ready infrastructure in new construction through codes or zoning standards (see the [Policy](#) focus area section) or to establish an outreach campaign for businesses installing EV charging stations, encouraging them to prepare for future demand (see [Outreach and Education](#) focus area section).

Larger Efforts and In-Depth Studies

Strategies for long-term planning for the impacts EVs will have on the electric supply may require larger efforts, additional planning, and in-depth studies.

Determine Impacts on Electric Grid

Collaborate with Xcel Energy to understand the grid impacts of personal and public transport electrification. Communities that have aggressive transport electrification goals should reach out to Xcel Energy and start coordinating early on required service. This will allow the community to roll out electrification strategies on a timeline that is realistic and reliable for residents. It will also permit Xcel Energy to coordinate internally across other demand changes, development, and infrastructure projects in the community.

Example:

- The [City of Seattle](#) developed a [transportation electrification strategy](#) in collaboration with the [Rocky Mountain Institute](#) that evaluates the projected EV market expansion and associated impacts on the utility grid and proposes interventions to allow the utility to effectively manage the anticipated new loads.

Support Smart Grid Operations for EVs

Explore control features of available charging station models and make recommendations of features to include with installation of public charging infrastructure. The opportunity to adjust the timing of vehicle charging to help balance electric production and demand could be a powerful tool as EVs become more popular. Xcel Energy may provide competitive rates or other incentives to manage times for EV charging. This strategy will have the most impact when coordinating with Xcel Energy to ensure the recommended technology is compatible with existing or planned EV charging stations. As EVs become more prevalent, the controls technology and utility pricing structures will likely evolve. The community should be prepared to revise or update their recommendations and technology based on new information.

Examples:

- The [Regulatory Assistance Project](#) published a [report](#) that reviews the opportunities presented by smart charging technology.
- The [UCLA Smart Grid Energy Research Center](#) developed [WinSmart EV™](#), which is an example of a complete controls energy network.

Increase Renewable Electricity for EV Charging

Encourage charging station operators to pair their equipment with renewable energy sources. Although some EVs already offer zero tailpipe emissions as well as reduced lifecycle emissions compared to ICE vehicles, the magnitude of emissions reduction is dependent on the generation fuel mix of your local grid. Commercial, municipal, and residential customers can increase the benefits of their EVs by installing renewable energy on-site, such as solar to charge the vehicle, or purchasing renewable energy through Xcel Energy programs.

Examples:

- [Xcel Energy](#) offers several renewable energy options for [commercial](#) and [residential](#) customers.
- The [Minnesota Solar Energy Industries Association](#) (MnSEIA) joined the [National Renewable Energy Laboratory](#) (NREL) Solar Energy Innovation Network (SEIN) team in 2018 to research methods for improving the nation's electric grid and pairing EVs with PVs. The [solar potential analysis report](#) was completed in 2018.

Collaborate on Long-Term EV Infrastructure Plan

Work with Xcel Energy to detail planned infrastructure installations over the next 5–10 years. Community leaders can provide tentative charging station locations based on a needs analysis or other strategies, and Xcel Energy representatives can help the community understand the electrical supply at each location. Using this information, the team can work together to outline a plan to install EV charging infrastructure that will be efficient, effective, and economical.



ECONOMICS OF CHARGING

Strategies in this topic area address the financial considerations of installing public charging stations, including rate structure considerations, demand charge considerations, and payment infrastructure. These strategies are focused on communities who want to install public charging stations, but many of the same considerations would apply for private businesses who want to install stations for their customers.

Basic Information

There are two basic models of ownership for public charging stations. In the first, the community or property owner owns the station and is responsible for operations and maintenance, but also retains 100% of the revenue generated at the site. Many communities find that it takes more time and effort than they had anticipated to own and operate public charging stations, which has encouraged them to opt for the third-party management model.

The third-party management option means that the EVSE manufacturer retains ownership of the charging station. The terms of the agreement are determined on a case-by-case basis but may include the manufacturer renting the parking spot (or a broader area of land) from the community or property owner, splitting the profits from the station, or using the location in exchange of handling all planning, setup, and operations. For example, [EVgo](#) offers commercial, retail, and residential property owners the opportunity to host EV charging stations on their properties without any of the installation, maintenance, or operational responsibilities.

Additionally, EVgo works with local utilities to secure electricity for the site, promotes the location, and monitors energy use and station popularity.

Regardless of the ownership structure, there are generally fees associated with the use of Public charging stations. An owner can opt for one or a combination of the following fee structures:

- **Fixed Fee:** A flat rate for using the charging station regardless of how long it is used or how much energy is used. This is most appropriate in situations where vehicles have reserved parking spots, which allows the owner to disregard vehicle turnover rate.
- **Hourly Fee:** Under this model, the vehicle is billed for how long it is parked in the spot. This is most appropriate in areas with high vehicle turnover or hourly parking fees already established. This structure can be adjusted to a per-minute fee for DC fast charging stations.
- **Energy Fee:** In this case, the user is billed for the amount of energy used to charge the vehicle. This model is the easiest for building owners or station operators to match charging income with their operating expenses. Note: In some states, it is not legal for entities other than electric utilities to sell electricity. In those states, this fee structure is not an option.
- **No-Fee Pass Thru:** In some cases, communities and businesses allow users to charge for free or during certain hours. This trend may change as more people use chargers and the potential for demand fees goes up. While it may not be a long-term option, it offers drivers an incentive to purchase or use an EV and promotes early adoption.

Owners may also choose to provide a membership or frequent user pass that provides a discounted rate for regular visitors. Be sure you understand your electric rate and the impacts of EV charging before setting rates. Contact your Xcel Energy representative for help understanding the available rates.

First Steps and Quick Wins

Initial steps for improving the economic benefits of integrating EVs into the community include some strategies that can be implemented quickly with limited financial investment. The strategies in this section offer suggested methods for tracking and billing EV charging at public charging stations.

Educate Consumers about Public Charging Fees

Create outreach materials or a simple website where residents can learn about public charging stations and associated fees, as well as regulations including locations, use rates, time limits, or others. Having uniform fees and regulations at all charging structures across the community will help consumers feel more confident in finding and using public charging stations. See the [Policy](#) focus area section for more information.

Examples:

- The [City of Seattle](#) published a [public charging informational handout](#) addressing the basics of EV charging as well as how to find chargers and what to expect.
- [EVgo](#) has a [dedicated webpage](#) regarding what to expect when charging on their network, which includes EV fast charging etiquette.

Integrate EV Payment with Existing Payment System

Many communities have electronic, app-based public parking payment systems. This is common for on-street parking as well as in parking lots and ramps. Communities can also use these existing parking payment systems to collect fees for EV charging stations they own and operate. This allows customers to use a system they are already familiar with and reduces the overhead burden for the community to manage charging stations. Work with your IT department to understand the capabilities of the current system.

One example of a payment app used by many communities is [ParkMobile app](#), which has an integrated feature allowing users to pay for EV charging.

Conduct a Rate Study

Review existing utility rates available for planned EV charging station installations and determine the most beneficial billing method, based on the projected charging patterns. As the charging stations are being installed, Xcel Energy customers can contact their account manager to review the electricity rates available and the best option given the expected loads. Electric rates may be affected by the following factors:

1. **Time-of-Day:** Some electric rates provide cheaper electricity overnight when there is less electricity use on the grid.
2. **Electric Demand:** Electric demand is a function of the number and size of loads plugged in at any given time.
3. **Electricity Use:** This measures the amount of energy used during the billing period.

The rate study can be used by municipal staff to set rates for charging stations. Most municipalities choose to set the rates to recuperate the costs of owning and operating the charging station, but without the expectation of profiting from their use. This evaluation should be reviewed after the equipment is installed to ensure that the use patterns match what was predicted and that the most appropriate rate was chosen. It will be important to periodically reevaluate the use patterns and available electric rates, especially if new EV charging electric rates become available in your area.

Larger Efforts and In-Depth Studies

Larger efforts and in-depth studies can maximize the economic benefits of EVs in the community. However, these strategies may require additional planning, budget, and resources.

Conduct a Long-term Cost and Revenue Study

Review the cost and revenue by installing and studying some pilot charging stations. This data can be used along with vehicle projections and other community planning efforts to make long-term estimates of the costs of owning and operating charging stations. Many communities are providing charging to residents at low costs to encourage adoption of EVs. However, the community should consider the long-term vision of EV charging. Does the community own the infrastructure? Is it owned and managed by a third party? Do the charging fees cover expenses or are they a source of revenue? As EVs become more popular in the community, charging station pricing structures should be revisited. The community may also choose to transition public charging stations to third-party management to reduce time and expenses.

Examples:

- Research from the [UCLA Anderson School of Management](#) reviews potential EV charging models that will be more financially viable in their [Financial Viability of Non-Residential Electric Vehicle Charging Stations Report](#).
- The [Center for Climate and Energy Solutions](#) reviewed options to increase financial stability of public charging stations in Washington in the [Business Models for Financial Sustainability EV Charging Networks report](#).

PARKING, SIGNAGE, AND ENFORCEMENT

Strategies in this topic area focus on ensuring that EV parking and charging locations are clearly signed and have consistent parking enforcement to standardize the charging experience across the community. These strategies are important to building community confidence in the public charging station network.

Basic Information

The Federal Highway Administration (FHWA) designs standard signs for public highways and streets. The current [Manual on Uniform Traffic Control Devices \(MUTCD\)](#) was developed in 2009 and does not include EV signage. The FHWA has adopted interim designs for EV charging stations until the next update of the MUTCD. These designs are shown below and can be combined with arrows for wayfinding off major thoroughfares (U.S. Department of Energy, 2019). The guidelines outlined in the Chapter 2A, Part 2 of the MUTCD regarding sign placement and visibility apply to these signs.

Statewide Plans: The [Colorado EV Plan 2020](#) Commits to “develop and provide guidance on HB19-1298 Charging Station Parking Enforcement including signage recommendations and best practices by July 2020” (pg. 21)

[Accelerating Electric Vehicle Adoption: A Vision for Minnesota](#) highlights the importance of regional coordination in developing uniform EV signage and using wayfinding signage as published by the Manual on Uniform Traffic Control Devices (MUTCD).



First Steps and Quick Wins

These strategies are designed to be first steps for communities who want to establish consistent parking regulations for EV charging. These strategies can be implemented with minimal investment of capital and time.

Allow Right-Of-Way EV Charging

Allow EV charging and parking in right-of-way locations to increase opportunities for EV charging station installation. This shows preference for EVs by placing parking spaces in optimal locations and boosts visibility of EV-friendly infrastructure to residents and visitors.

Examples:

- The [Sierra Club](#) developed [sample legislation](#) for allowing EV charging in right-of-way locations.
- The [City of Seattle](#) created [a program](#) for EV charging in the public rights-of-way.

Establish and Enforce Parking Rules

Collaborate with private partners to establish and enforce consistent rules for EV parking spots and to develop signage. Having a consistent experience at charging stations across the community will help EV drivers feel more comfortable finding and using public charging options. Enforcement of these regulations should be paired with public outreach to help drivers understand the regulations. These regulations may include:

- **Time Limit:** How long an EV can use a charging location? Keep in mind the charging rate for the charging station when establishing time limits. Level 2 chargers will need at least two hours to provide a substantial charge, while Level 3 chargers only need about 30 minutes.
- **Charging Requirement:** Does an EV need to be actively charging to use the parking space or can any EV use the parking spot without using the charger?
- **Penalty:** What are the penalties for vehicles that are in violation of the regulations?

Examples:

- The [U.S. Department of Energy](#) provides interim standards for EV signage that have been approved by the Federal Highway Administration on the [Alternative Fuels Data Center](#).
- The [City of Atlanta](#) specifies EV charging space designs in its [EV readiness workbook](#).

Larger Efforts and In-Depth Studies

The following strategies are intended to promote EVs through parking opportunities and may require more capital or time investments. The resulting potential will have a greater or more lasting impact.

Provide Discounted Parking for EVs

Provide discounted or free parking passes at community-owned parking facilities for EVs. This strategy has the most impact in parking garages or other areas where community members purchase monthly or annual passes. Residents can apply for the pass through the standard permitting channels and provide vehicle registration or other proof of an EV to receive the discounted or free parking pass.

Examples:

- The [City of Aspen, CO](#) provides permits to EV users for [free parking](#) in residential areas.
- The [City of Sacramento, CA](#) provides special [monthly parking rates](#) for EVs in city-owned parking garages.
- The [City of New Haven, CT](#) provides a pass for [free parking](#) for EVs or alternative fuel vehicles that have a fuel efficiency rating greater than 35 mpg.

Resources

- The [U.S. Department of Energy](#) published the [handbook for charging station hosts](#) that includes information on ownership and payment models.
- The [Greenlining Institute](#) published an [equity toolkit](#) describing the benefits and strategies for focusing on under-served communities.

Regional Standards for Consistent EV Experience

Regional planning around parking, enforcement, and pricing policies and signage can provide a more consistent experience and ensure that EV drivers know what to expect at an EV charging station. Developing design and signage standards will create familiarity for community members, fostering a safer environment for EV drivers, charging, and educating community members who may not drive an EV.

