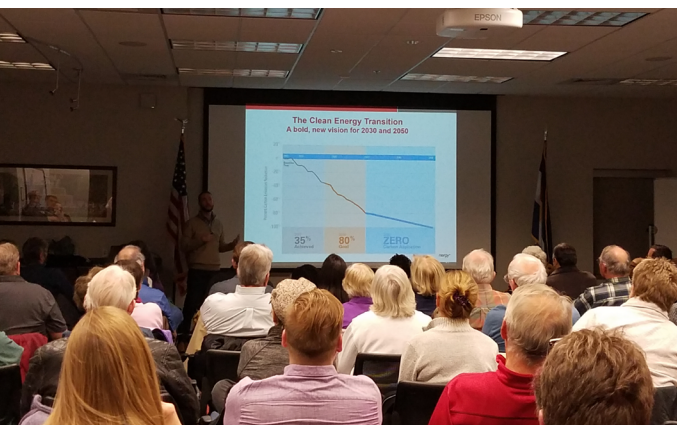
Xcel Energy®

PARTNERS IN ENERGY
An Xcel Energy Community Collaboration

ELECTRIC VEHICLE ROADMAP TOOLKIT



XCEL ENERGY'S PARTNERS IN ENERGY AND THE ROLE OF TOOLKITS

Xcel Energy's Partners in Energy provides communities in Minnesota, Wisconsin, and Colorado services to develop an energy plan and assistance in implementing that plan. Each community has its own unique electric vehicle needs and priorities, and Partners in Energy tailors its services to complement each community's vision. More and more communities are realizing that energy planning plays a critical role in helping them reach their goals. The benefits of wise energy choices are diverse. By working with citizens, businesses, and even their own government facilities, a community can shave dollars off utility bills, promote renewables, drive resource conservation, or contribute toward greenhouse gas (GHG) emission reduction goals. Partners in Energy helps address the challenge of identifying local priorities and structures a path that leverages all resources available. As part of this offering, we have developed several toolkits to help communities reach their energy goals.

For more information about available toolkits or to customize any of the resources with your community's unique brand identity, contact your Partners in Energy facilitator.

WHO IS THIS TOOLKIT FOR?

This toolkit is designed to support local government planners or other staff, nonprofit organizations, and volunteers in identifying electric vehicle (EV) priorities for their community and identifying the appropriate strategies to support this vision. These goals might involve engaging with local fleet operators, employers, policy makers, or residents.

TOOLKIT ORGANIZATION

This toolkit is divided into several sections that you may wish to reference while developing your EV roadmap. You can access any of these sections by clicking on the appropriate icons in the table of contents. The sections include:

1. **Planning Process:** This section walks you through the steps of conducting a facilitated process to gather input and create an EV roadmap for your community. If you do not have an existing EV roadmap, this is a good place to start.

2. **Focus Area Sections:** These sections contain a compilation of strategies and best practices used by communities around the country to encourage EV adoption. There are eight focus areas in this plan that you may choose to reference: 1) Funding; 2) Outreach and Education; 3) Public Charging Access; 4) Equity and Economic Development; 5) Light-Duty Fleets; 6) Medium-and Heavy-Duty Fleets; 7) Transit and School Buses; and 8) Policy. If you have an EV plan or EV goals in an existing Sustainability Plan, these sections can help you identify strategies to meet those goals.

3. **Appendices:** Since EVs are an emerging technology that is rapidly changing, it is important to ensure that everyone has a common baseline understanding of the technology and terminology involved. To that end, refer to Appendix A: Electric Vehicles 101 to get an overview of the basic vehicle and charging technologies commonly found on the market today. Appendix B: Glossary defines various terms and abbreviations found throughout the report. Appendix C: Planning Process Resources contains sample agendas for the kick-off meeting and workshops, as well as a stakeholder recruitment letter, report outline, and baseline survey. A summary of local and national incentives and policies available within Xcel Energy's service areas can be found in Appendix D: Funding Resources. Citations of all resources throughout the toolkit can be found in Appendix E: References.

Equity Considerations: Equity is often a critical cross-cutting theme for an EV initiative. In addition to providing a list of strategies in the Equity and Economic Development section, we have incorporated equity considerations throughout this toolkit. Look for the red handshake icon for equitable EV resources and best practices.

TABLE OF CONTENTS

Please note, this is an interactive document. Hyperlinks may take you to URLs or different sections within this document. This Table of Contents can be used to navigate to the respective sections.

WHERE TO START

SO, YOU WANT TO HELP YOUR COMMUNITY TRANSITION TO ELECTRIC VEHICLES (EVS)?

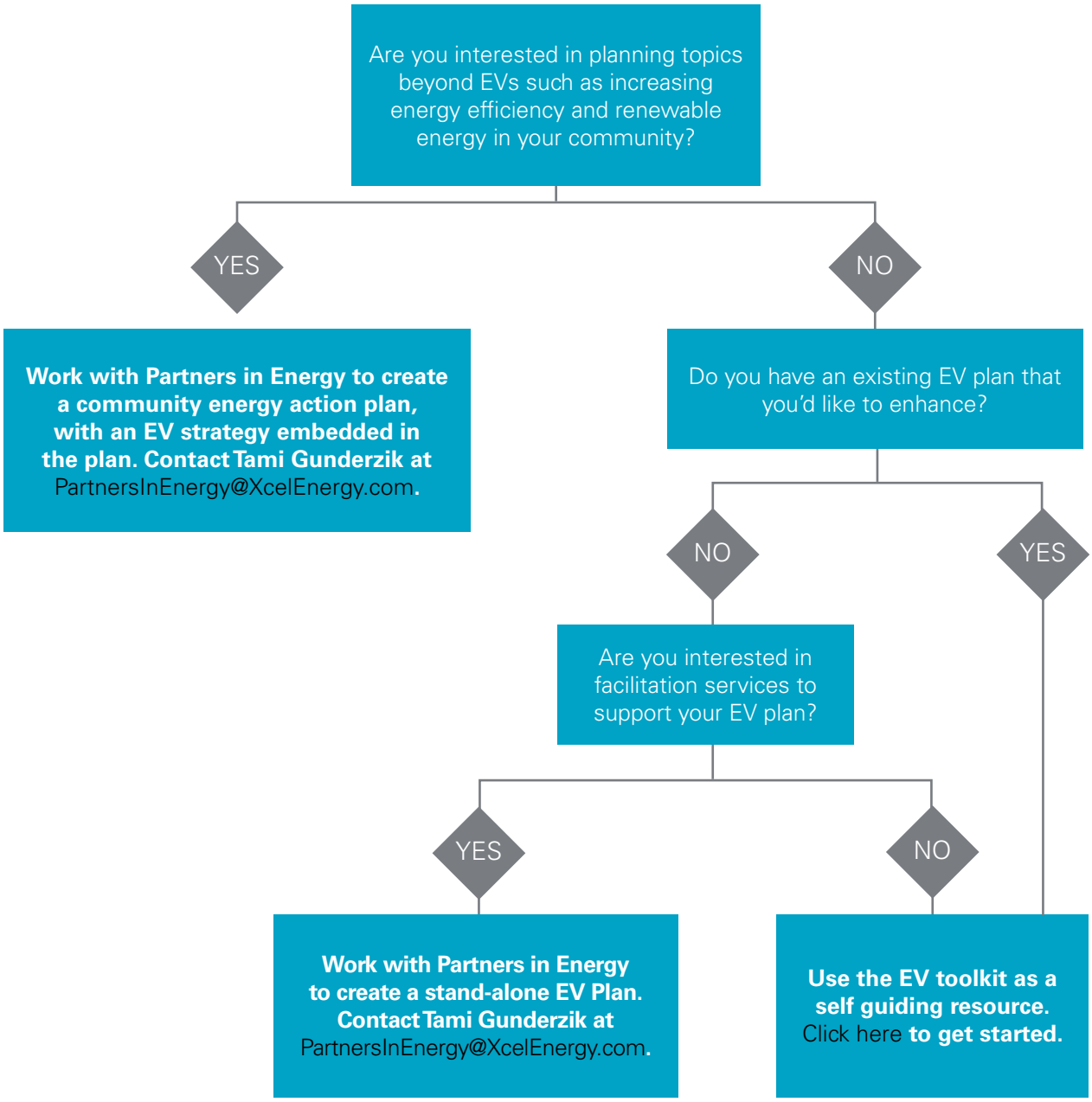
You've come to the right place. Whether you're completely new to Partners in Energy, or are an existing community in the planning, implementation, or graduate phase, we're excited to work with you in advancing your community's EV plans. This toolkit is designed to be a flexible resource to support communities at various stages of EV planning. There are three primary ways to use this toolkit:

1. Work with Partners in Energy facilitators to create an EV plan for your community, using this toolkit as a planning guide.
2. Create your own EV plan, using this toolkit as a planning guide.
3. Enhance your existing EV plan or sustainability plan with targeted focus areas, strategies and examples from this toolkit.

The Partners in Energy EV toolkit is free to use in any situation or regardless of the option you choose.

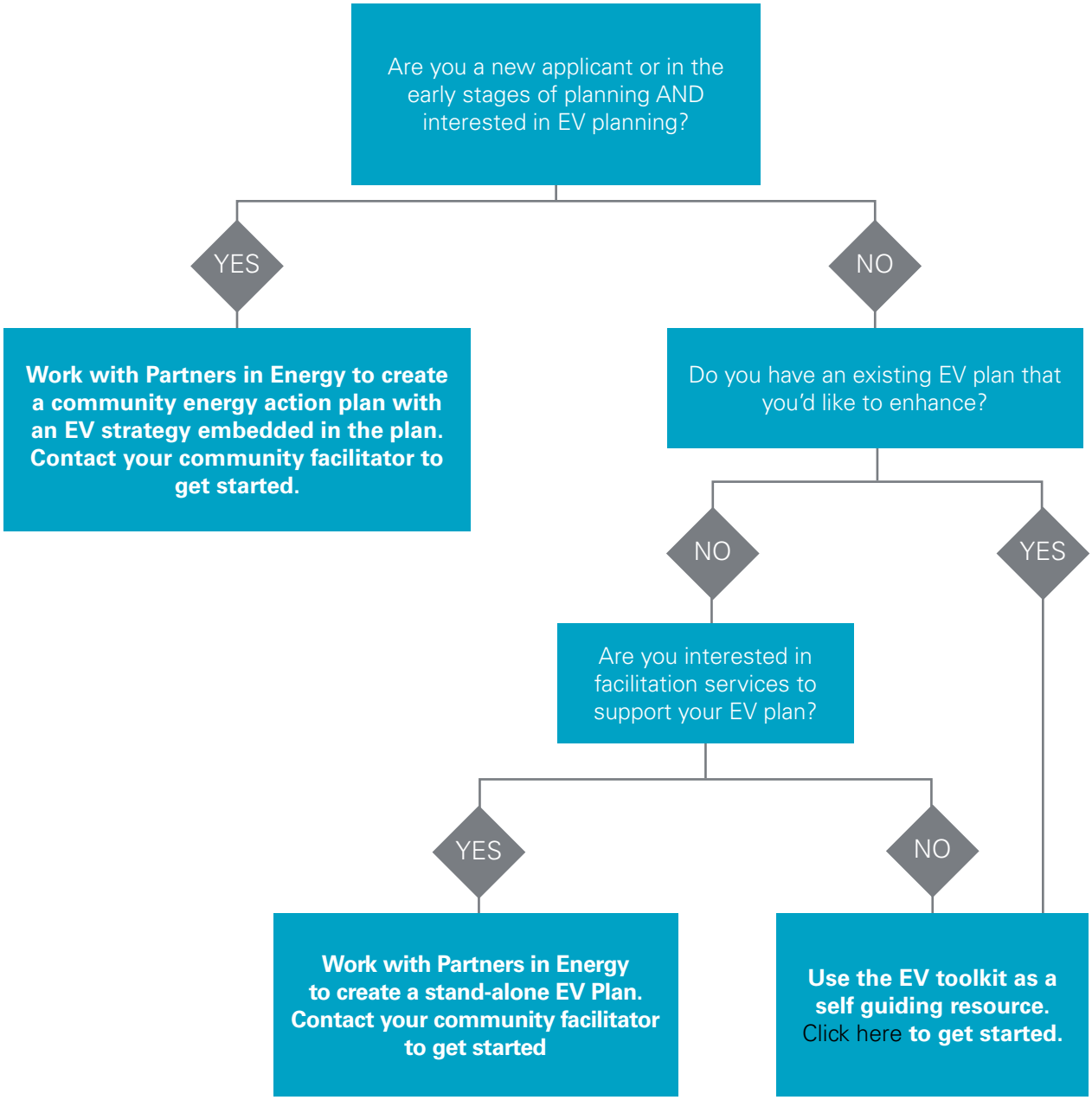
COMMUNITIES NEW TO PARTNERS IN ENERGY

If you're new to Partners in Energy, welcome! We're happy to support your EV planning needs as a stand-alone effort or in conjunction with a broader community energy action plan. The decision tree below provides guiding questions to help inform which approach might be best for your community.



EXISTING PARTNERS IN ENERGY COMMUNITIES

If you're an existing or returning Partners in Energy community, welcome back! We're excited to build on our energy partnership by collaborating on EV planning. The decision tree below provides some guiding questions to help inform which approach might be best for your community.



WORKING WITH XCEL ENERGY

There are key points in electric vehicle (EV) planning where good communication with your utility is an important step to successful strategy planning and implementation. Not only will this ensure the utility is ready to support you, but it will also help you get the most out of your utility's programs and services. For more information on how Xcel Energy can support your EV transition, please contact:

1. Learn more online:
    A. Visit ev.xcelenergy.com for information on residential programs and tools residents choose to help in their decision to purchase EVs for personal use.
    B. Visit the website for information on programs for businesses, including fleet electrification, business, and multifamily programs and incentives.
2. Email: ElectricVehicles@xcelenergy.com
3. Call your Xcel Energy customer service representative:
    - Residential customers: 800-895-4999
    - Small businesses: 800-481-4700
    - Municipalities, institutions, large businesses and other large energy users can contact their account representative. If you don't know who your account manager is, call 800-481-4700 to find out.

Xcel Energy EV Vision

Xcel Energy's EV vision is to power **1.5 million EVs in its communities by 2030**. Through new EV customer programs and charging infrastructure, Xcel Energy will expand its clean energy leadership to transportation - developing innovative partnerships with communities, customers and other stakeholders while saving customers money.

- Customers would save nearly $1 billion on fuel each year by 2030.
- Customers will be able to charge EVs at home for $1 or less per gallon equivalent with low off-peak electricity prices.
- EVs will deliver cleaner air and help cut nearly 5 million tons of carbon emissions annually by 2030.
- Xcel Energy is actively working with partners to increase EV access while developing plans that focus on equity and accessibility, allowing everyone to benefit from EVs.

XCEL ENERGY EV OFFERINGS

Residential Outreach and Education

Xcel Energy has a variety of tools, to help educate community members about EVs and residential EV charging, that can be used when planning residential outreach and education events. Resources are available at ev.xcelenergy.com and include:

1. **EV 101:** Residents can learn about key benefits of driving electric, including cost savings, environmental benefits, convenient charging, and the fun factor; this section also includes FAQs.
2. **EV Catalog:** This interactive tool allows residents to compare EVs by range, price, or a personalized Match Score. Residents can then view EV details, including total cost compared to a similar gasoline powered vehicle.
3. **Incentives:** Residents can discover tax credits, rebates, and other incentives specific to their location.
4. **Qualified Dealers:** This interactive map shows local auto dealerships that are knowledgeable about EVs.
5. **Charging:** This section includes an interactive map of nearby public charging stations, information about residential EV charging programs, information about different charging levels, and other charging FAQs.

Your Xcel Energy representative can provide support for your tabling events and other residential outreach efforts. This support may include EV program collateral, tabling kits, and interactive learning opportunities.

Income-Qualified and Higher Emissions Communities Rebates

Making EVs and EV charging infrastructure accessible to everyone is important to ensure the benefits of EVs accrue to communities.

1. **Income-Qualified Organizations (CO):** Xcel Energy offers rebates for eligible income qualified organizations that reduce up-front charging infrastructure costs for community charging hubs, fleets, multifamily properties, workplaces, and small businesses. Rebate amounts are determined by the organization type as well as the level and number of chargers installed. To learn more about these programs visit https://co.my.xcelenergy.com/s/business/ev/equity.
2. **Higher Emissions Communities (HECs) (CO):** A Higher Emissions Community is a community within an area that is disproportionately affected by vehicle emissions related air quality concerns. These communities may also be impacted by income inequality. Xcel Energy offers rebates for eligible organizations in HECs that reduce up-front that reduce up-front charging infrastructure costs for community charging hubs, fleets, multifamily properties, workplaces, and small businesses. Rebate amounts vary based on project application and the type and number of chargers installed. To learn more about these programs visit https://co.my.xcelenergy.com/s/business/ev/equity.
3. **Income-Qualified Electric Vehicle Rebate (CO):** Income-qualified customers can receive $3,000 off a used or $5,500 off a new EV when buying or leasing from a Colorado-based car dealer. More details can be found at https://ev.xcelenergy.com/ev-rebate-co.

Commercial Charging Infrastructure Planning

Any charging station other than level 1 should be installed by a licensed electrician, and you should work with an Xcel Energy account representative to ensure that your existing electrical service can support the additional load. For typical electrical service requirements for each charger type see Appendix A: Electric Vehicles 101. If a service upgrade is required, your account representative can help you understand the additional costs that may be associated with that upgrade and help you navigate the process. For fleet-specific infrastructure, see Fleet Transition Planning. Resources available to help expand your EV infrastructure can be found at https://my.xcelenergy.com/s/business/ev/fleet and include:

1. **Electric Vehicle Supply Infrastructure (EVSI) (CO, MN, WI):** EVSI offers no-cost advisory and turnkey services including design and construction of EVSI, not including the chargers, for various commercial customers.

2. **Multifamily New Construction (CO):** Earn a rebate for every parking spot you enable with EV charging. Xcel Energy will provide up to $2,000 for EV Ready, EV Capable, or EV Installed ports that are in excess of applicable building code.

3. **Developers Get Started Guide:** This Get Started Guide will help you better understand who to contact, and when, during EV charging infrastructure planning and installation.

4. **Charger Service (CO, MN, WI):** If your business is ready to add Level 2 charging, Xcel Energy offers you an option to install an Xcel Energy-owned Level 2 charger for a monthly fee. In Colorado, the program is available for public, workplace, fleet, and multifamily charging. In Minnesota, the program is available as a fleet pilot and for multifamily charging. In Wisconsin the program is available for fleet and public charging.

Utility Rate Analysis

It is important to understand what electricity rates are available and would be most advantageous, based on the anticipated vehicle charging patterns. First, you will need to determine if the EV charging station is going to be included in the electricity use of the building where it is installed or if it will be metered separately. This decision will determine what electricity rates are potentially available, which can have significant impact on your EV fuel costs.

1. **EV Critical Peak Pricing (CO):** Critical Peak Pricing uses price signals to encourage customers to reduce electricity load during certain periods. By charging EVs during off-peak periods, customers can save up to 5%-10% on their annual electric bills. Learn more here.

2. **Charging your Electric Vehicle (CO, MN, WI):** Over 80% of EV charging happens at home. Learn more about available charging programs and electric pricing plans here.

Fleet Transition Planning

For vehicle fleet operations, finding innovative ways to manage costs, performance, and reliability is a priority. Fleet electrification is one way that organizations can save money while also reducing greenhouse emissions. Xcel Energy offers advisory services to guide customers through the fleet electrification process. For more information on applicable programs, incentives, or rates, reach out to your account representative or email ElectricVehicles@xcelenergy.com to schedule a meeting with the Xcel Energy EV fleet team. Resources available to help expand EV infrastructure can be found at xcelenergy.com/CommercialEVs and include:

1. **Fleet Electrification Advisory Program (FEAP) (CO, MN, NM, WI):** Xcel Energy's FEAP begins with an analysis that helps determine the best course of action for fleet electrification. Analytics provider, Sawatch Labs, will help fleet operators assess individual vehicles to determine if their needs can be met with an EV. Additionally, participants will receive a charging-site suitability analysis and estimates for the cost of infrastructure installation. Finally, Xcel Energy helps advise on rate plans and pilot programs - to lower costs. For more information, visit https://my.xcelenergy.com/s/business/ev/fleet, email ElectricVehicles@xcelenergy.com, or reach out to your account representative to schedule a meeting with the Xcel Energy EV fleet team.

2. **Electric Vehicle Supply Infrastructure (EVSI) (CO, MN, WI):** EVSI offers no-cost advisory and turnkey services including design and construction of EVSI, not including the chargers, for various commercial customers.

3. **Charger Service (CO, MN, WI):** If your business is ready to add Level 2 charging, Xcel Energy offers you an option install an Xcel Energy-owned Level 2 charger for a monthly fee. In Colorado the program is available for public charging, workplace and fleet charging, and multifamily charging. In Minnesota, the program is available as a fleet pilot and multifamily charging. In Wisconsin the program is available for fleet and public charging.

Heavy Duty Fleet Transitions Planning

When considering transitioning heavy duty fleets to EVs, it is very important to include your account representative early in the planning process. Charging large vehicles can generate a significant electrical load, especially if multiple vehicles are charged at the same location. So it is important to understand the service upgrades that may be required to accommodate these chargers. Opportunities may exist for time-of-day charging rates or controls. Xcel Energy's fleet transition also includes their heavy-duty vehicles, so there may be some lessons learned that can apply to your transition. For more information, reach out to your account representative or email the EV team at ElectricVehicles@xcelenergy.com.

PLANNING PROCESS – ROLES AND TASKS

STEP 1: DETERMINE STAKEHOLDERS AND ENGAGE

Based on your community's topic areas of interest, determine the key stakeholders that should be included in the planning process. Stakeholders should include both local government staff and community members who will be instrumental in implementation of identified strategies, as well as key community voices. Suggestions about who to engage as stakeholders by focus area are listed in Table 1. Keep in mind that a larger stakeholder group will often have more diverse ideas and better represent the whole community, while smaller groups of experts and key stakeholders can move more quickly through the planning process. Once you have identified stakeholders, invite the team to a kick-off meeting.

Resources

- Sample Kick-off Meeting Agenda
- Example Stakeholder Recruitment Letter

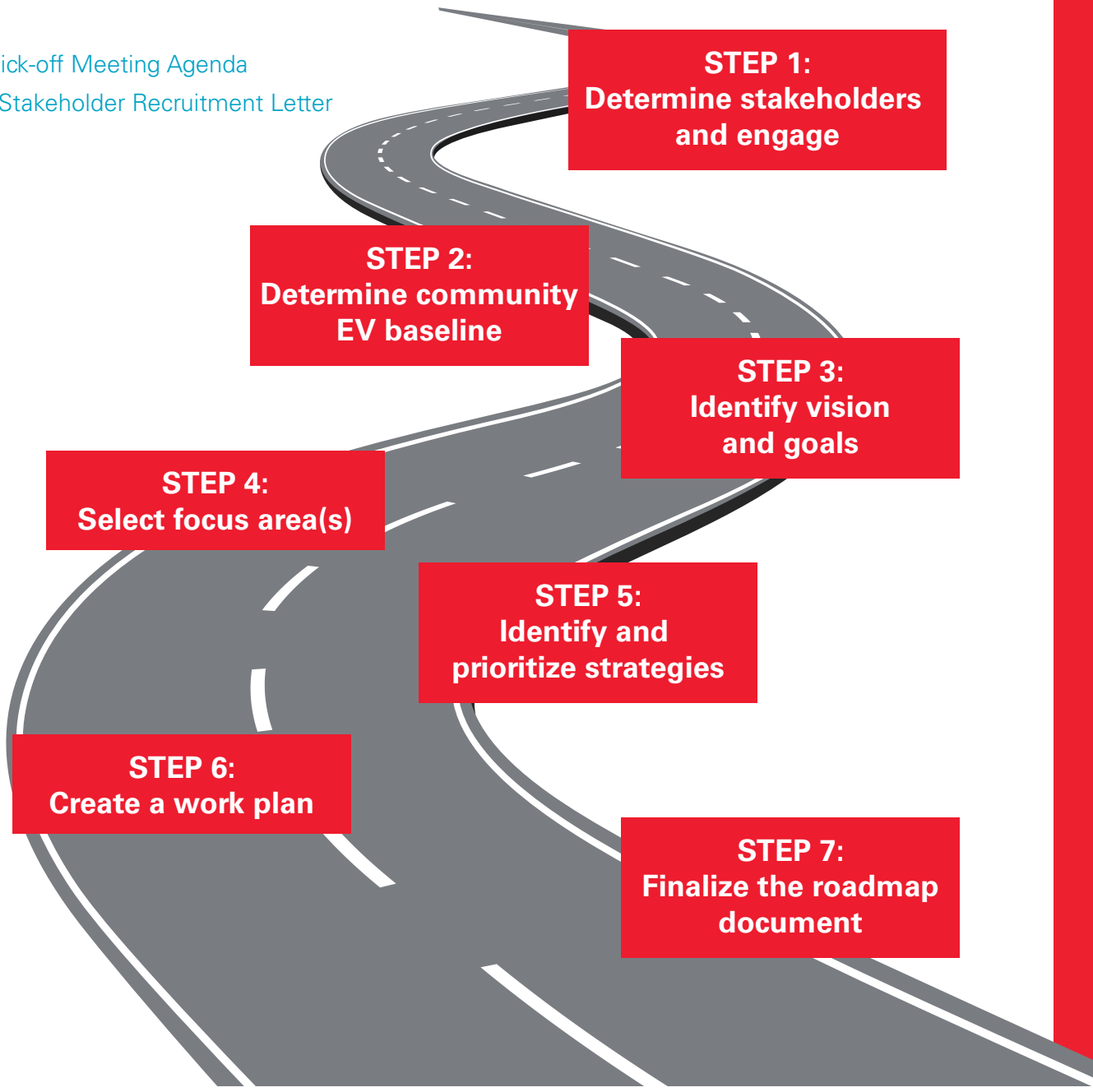


Table 1: Suggested Stakeholders by Focus Area

	Community Outreach and Education	Public Charing Access and Equity and Economic Development	Light-Duty Fleets	Transit and School Buses and Medium- and Heavy-Duty Fleets	Policy
COMMUNITY MEMBERS					
Utility Representative	X	X	X	X	X
Local Nonprofits	X	X			X
HOA Representatives	X				
Business Owners		X	X		
Multi-family Building Owners	X				
Large Employers	X		X		
Local Dealerships	X		X		
Business Fleet Managers			X		
Community-Based Organizations	X	X		X	X
School Boards				X	
Community/Technical Colleges		X			
School District Staff				X	
Transit Operators				X	
Transportation Network Companies	X	X			
Developers	X	X			X
Other Engaged Community Members	X	X	X	X	X
COMMUNITY STAFF OR ELECTED OFFICIALS					
Economic Development Staff		X			
Public Communications Staff	X	X			X
Maintenance Staff		X			
Air Quality Staff		X			
Health Department Staff		X			
Mechanics			X		
Facilities Staff			X		
Fleet Managers			X		
City Department Heads			X		
Motor Pool Staff			X		
Employee Training Coordinator			X		
Elected Officials		X		X	X
New Building Permitting Staff					X

STEP 2: DETERMINE COMMUNITY EV BASELINE

Develop a common understanding among stakeholders regarding current EV technology (both vehicles and charging stations), the benefits of EV adoption, the real or perceived barriers to widespread adoption, and local, state, or national trends on EV use.

EV 101

It is important to build a common understanding among stakeholders around EV terminology and technology to facilitate conversation about strategies at the workshops. This handout can be shared with stakeholders in advance of the first workshop.

National EV Trends

1. Increasing battery range: By 2030, average driving range for electric vehicles will average between 200-250 miles (International Energy Agency, 2020)
2. The U.S. Department of Energy forecasts that under a medium scenario, there will be 14 million EVs on the road in the U.S. by 2030, representing a 5 percent market share (U.S. DRIVE, 2019).
3. Increased load on electric grid: If expansion happens as projected, EV charging could represent 13%-15% of the national electricity demand by 2050 (Myers, 2019).

Local EV Trends

To understand the local EV market, gather information about local EV market penetration. This information should include:

1. **Community Characteristics:** Collect data from the U.S. Census and other publicly available data sources. By understanding the size of the community, as well as its projected growth and housing characteristics, you can better target strategies to the population.
2. **Vehicle Number and Type:** Since most EV models currently available are light-duty passenger vehicles, it is important to understand the number of vehicles on the road by type to estimate the integration potential. Break down this data by fuel type to determine the number of EVs currently in the community. Atlas Hub is a great resource for understanding EV trends, such as EV market share in your region, state, county, or zip-code using EV registration data.
3. **Electricity Emissions Factor:** GHG emissions benefits gained from conversion to EVs will vary based on your local electricity emissions factor. Your local utility may be able to provide an emissions factor. For Xcel Energy emissions factors, refer to this information sheet. If not, use the regional eGrid factor developed by the U.S. Environmental Protection Agency.
4. **Air Pollution Disparities:** The American Lung Association has found that low-income neighborhoods and communities of color often face higher exposure to air pollutants and are more susceptible to health threats. To understand which neighborhoods in your community are disproportionately impacted, map air pollutants alongside income and race.
5. **Existing Charging Infrastructure:** To understand the prevalence of EV charging infrastructure in your community, conduct a survey of existing public infrastructure.This information is publicly available through Google Maps; just search for "Electric Vehicle Charging" in the area you are analyzing. PlugShare is another great resource for understanding EV infrastructure in your region. PlugShare allows you to filter by charger type, minimum power, network, and more. If possible, catalog the number of residential or commercial private chargers. One potential source for this data is your city's building permit department.
6. **Current Policy and Other Efforts:** Conduct a survey of your community's existing policies and other efforts, to identify focus areas where there is already significant progress or momentum as well as areas where additional effort is required. Use the survey in Appendix C: Planning Process Resources, adapted from Plug-In Electric Vehicle Community Readiness Scorecard, or targeted interviews to collect this information.
7. **Relevant State and National Incentives:** A variety of local and national programs are available that promote the adoption of EVs and the installation of charging stations and charging infrastructure through policy and financial incentives. For a full list of resources available in your state, visit the list of tax credits and other incentives published by the U.S. Department of Energy. Resources applicable to states within the Xcel Energy service territory (CO, MN, WI) are available in Appendix D: Funding Resources.

STEP 3: IDENTIFY VISION AND GOALS

Meet with stakeholders to understand what the future of EVs in your community will look like. Develop a vision statement to guide your planning process. When there are questions about prioritization of resources, come back to this vision statement and determine whether the activity moves your community closer to its stated vision. Also, state how this vision might tie into your Energy Action Plan developed through Partners in Energy or into other existing community sustainability and planning efforts.

A vision statement should answer the question: Where do you want to go? It should also:

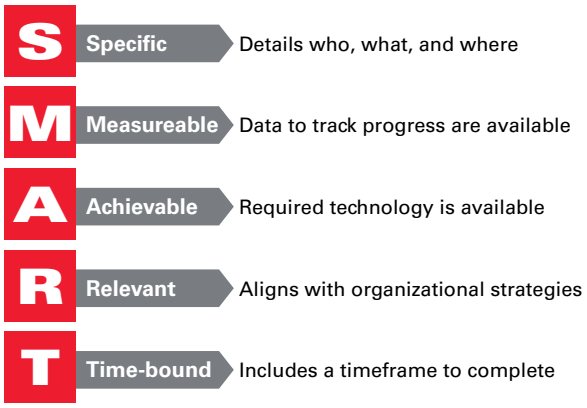
1. Determine what core value you want to uphold – bolded in examples below.
2. Define what success looks like – blue in examples below.

Example Vision Statements

1. Aspen Community Electric Vehicle Readiness Plan: The Aspen Community Electric Vehicle Readiness Plan envisions a future with drastically reduced greenhouse gas (GHG) emissions and improved local air quality — and where, if a vehicle is necessary, it is powered by clean, renewably-sourced electricity rather than fossil fuels. Community members and visitors are knowledgeable and comfortable with this technology, and utility providers and businesses are prepared for its presence and expansion.
2. Fort Collins Electric Vehicle Readiness Roadmap: Fort Collins will be a leader and innovator in supporting the use of EVs within the community's sustainable transportation system. Residents, businesses, and visitors to Fort Collins will choose EVs over conventional-fuel vehicles.

To support this vision, develop one or more goals to track progress of implementing EVs in your community. Make sure that the goals developed directly support your vision statement and that they are SMART goals.

You also need to understand what indicators will be used to track progress toward the community's goals. Ensure that the data identified are readily available.



Example Goal

1. Increase EVs in the city fleet by making 100% of light-duty vehicle purchases plug-in electric by 2025 and incorporating battery electric transit buses, subject to the availability of suitable technology.

Equity Indicators: To understand how your plan is impacting low-income residents and communities of color, you can embed equity indicators into your plan goals. The Greenlining Mobility Equity Framework identifies twelve separate indicators that advance goals related to increasing access to high- quality mobility options, reducing air pollution, and increasing economic opportunities.

STEP 4: SELECT FOCUS AREA(S)

Work with stakeholders to identify the focus areas for this plan. A focus area helps inform stakeholders and plan readers about the main topics that will be covered in the roadmap. To determine the focus areas that make sense for your community, consider the following factors:

- Available resources
- Political will
- Community support

Options for focus areas are shown in the navigation graphic of this toolkit. The focus area(s) can be customized for your community. Be sure that the focus areas help to succinctly communicate what topics are included in the roadmap.

Example Focus Area(s)

Here are some examples of focus area structures used by other EV roadmaps:

1. Accelerating Electric Vehicle Adoption: A Vision for Minnesota: The State of Minnesota chose to develop a comprehensive plan to promote EV use and chose four focus areas to organize their strategies.
   a. Accelerate Sales and Use
   b. Build Out Charging Infrastructure
   c. Coordinate on Regional and National Initiatives
   d. Prioritize Renewable Energy to Charge Electric Vehicles
2. Opportunities for Vehicle Electrification in the Denver Metro Area and Across Colorado: The City of Denver chose to further specify their focus. In their plan, they have one focus area — access to EV charging infrastructure — which they broke into two topic areas: 1) DC Fast Charging and 2) Multi-family Charging.

STEP 5: IDENTIFY AND PRIORITIZE STRATEGIES

For each focus area identified in Step 4, work with stakeholders to identify strategies to reach the goals within the chosen focus area. Strategies should be action sentences that describe what the community will do (e.g., "Educate residents about the economic and environmental benefits of EV ownership").

Identifying strategies is a three-step process:

1. **Identify Barriers to Adoption:** It is important to determine why the desired action is not already happening. Some barriers of EV adoption as identified by a national survey are available in Appendix A: Electric Vehicles 101. Local barriers should also be specified.
2. **Strategy Brainstorming:** Use brainstorming exercises to gather as many strategy ideas as possible. Strategies outlined in this toolkit can be used to facilitate brainstorming.
3. **Strategy Prioritization:** Review the identified strategies and choose the most impactful options. Using the vision and goals established in Step 3, identify the strategies that will have the largest impact (considering limitations on community resources [e.g., money, time, political will]).

Example Strategies

Under each of the focus area sections in this toolkit, you will find example strategies and best practices from communities around the country. Here are a couple examples from the Outreach and Education focus area:

1. **Maintain an Up-to-Date Website:** Develop and maintain a comprehensive EV website that allows residents, businesses, and visitors to easily access EV-specific information.
2. **Recognize/Highlight Local Businesses with Workplace Charging:** Encourage local businesses to install EV charging stations by recognizing and highlighting these efforts through local green business programs or other local business recognition programs.

STEP 6: CREATE A WORK PLAN

Use the priority strategies developed in Step 5 to create a work plan outlining how each strategy will be implemented. Through this exercise with stakeholders, you should identify:

1. Specific targets for each strategy to track progress
2. Specific activities you want to encourage
3. Benefits of target behaviors
4. Specific outreach channels
5. Parties responsible for implementation
6. Resources required for implementation
7. Timeline for implementation and key milestones

These work plans can be used to inform budget requests, guide staff and community efforts, and evaluate success. Compare the success of each strategy to the target and determine whether those strategies should be continued or if different ones should be prioritized.

STEP 7: FINALIZE THE ROADMAP DOCUMENT

The easiest way to develop the roadmap document is to complete the relevant sections during the planning process. Once the planning process is complete, review and revise the draft as needed. A template has been provided to facilitate the roadmap development process. Be sure you understand your community's approval process. Will you use the document to guide internal staff efforts or will you share it publicly? Will it need approval from a local governing body? Will it need to be available for a public comment period?

Example EV Roadmap Document

Here are some examples of community EV roadmaps:

1. Eau Claire (WI) Electric Vehicle Roadmap: This plan was developed as a pilot project to demonstrate the process outlined in this toolkit. Explore Eau Claire's plan to see how they address municipal electrification, expansion of public charging infrastructure, and community education and awareness - to increase EV adoption in their community.
2. Electric Vehicle Readiness: Energy Efficiency through Regional Planning: This plan was developed by the Des Moines Area Metropolitan Planning Organization. It is targeted to local government staff, which means it is more technical and direct and less graphically rich than other plans.
3. Electric Vehicle Readiness Roadmap: This plan was developed by the City of Fort Collins and is targeted for public communication as well as internal coordination. To this end, it is a detailed implementation plan as well as a simple, graphically rich communications piece.

A sample outline of an EV roadmap is provided in Appendix C: Planning Process Resources.

FUNDING

FUNDING EV EFFORTS

Whether you are considering a feasibility study, fleet electrification, or an infrastructure project, funding will likely be a crucial component of your EV efforts.

Identify your community's vision, goals, and potential strategies before considering which funding sources to explore. In most cases, having a clear plan in place, or project identified, is either prerequisite to the funding opportunity (e.g., grants, budget requests) or helpful in identifying the best funding opportunity to help you achieve your desired outcome (e.g., incentives, creative funding approaches).

Types of funding opportunities

There are several types of funding opportunities to help you meet your EV goals. Select the right funding opportunities by considering your EV goal or objective. For some funding opportunities, such as grants, you will also need to familiarize yourself with any project constraints, how easy or difficult the funding source is to secure, and whether there are any commitments – financial or otherwise – associated with the funding opportunity.

GRANTS

Grants are available to support a wide range of EV projects, including EV planning, the purchase of EVs and the purchase of EV infrastructure. When looking for grants to support EV projects, some considerations include:

- Eligibility: does you/your organization qualify for the funding available?
- Project Criteria: is your project a good fit for the funding available?
- Matching funds: does the grant require a matching fund and, if so, how will you pay for that matching fund?
- Terms and conditions: are the legal requirements of the grant acceptable to you/your organization?

INCENTIVES

Incentives are any funding mechanism that lowers the cost of purchasing an EV or EV infrastructure. The following list is a sample of various types of incentives:

- **Discounts**: Money off the initial cost of an EV or EV infrastructure at the point of sale. For instance, dealerships sometimes participate in "group buy" programs, offering discounts on the purchase price of EVs when vehicles are bought in bulk quantities.
- **Tax Credits**: A tax refund provided to an individual or organization upon purchase of an EV or EV infrastructure. Tax credits indirectly lower the upfront cost of the purchase, but the individual or organization isn't refunded the amount at the point of sale. National and state tax incentives are available. It is important to research and understand eligibility requirements, as the incentive amount may differ depending on the details of the purchase or the purchaser (e.g., incentive amounts may vary based on income).
- **Exemptions**: Special privileges provided, such as the ability to forgo an emission inspection.
- **Vouchers**: Vouchers are a special type of discount that act like "cash in hand", lowering the upfront cost of the car upon purchase. Vouchers can be used to target specific members of a community or may be provided on a first-come-first-served basis.

Equity Consideration: Identifying the right funding sources is a critical component of providing equitable access to EVs and EV infrastructure. Some funding sources, such as grant programs, prioritize projects designed to improve equity of access. For instance, the Charge Ahead Colorado grant program prioritizes fleet and infrastructure projects for businesses and multifamily buildings.

EV vouchers are a creative financing mechanism that can enhance equity. According to the Greenlining Institute, EV vouchers can be especially effective for improving access low-income drivers because they produce more-affordable financing scenarios. Unlike rebates or tax credits, vouchers act like "cash in hand" by lowering the upfront cost of the car upon purchase. Targeting vouchers exclusively to low-income drivers can further improve equitable access. For Example, California's Enhanced Fleet Modernization Program offers vouchers to low-income residents if they scrap their existing, polluting vehicles. In some cases, vouchers may exceed the resale value of a low mileage used EV that is still under warranty.

FINANCING MECHANISMS

As with any infrastructure project, there are several types of financing that can facilitate the purchase of EVs and EV infrastructure.

- **Loans**: Loans lower barriers associated with the initial cost of purchasing EVs or EV infrastructure by amortizing cost over time.
- **Leasing**: Leasing EVs or even EV infrastructure has become a common practice. As with any type of infrastructure, leasing allows the user to reap the benefits of current technology at a lower cost. It also allows users to remain flexible and adopt newer technologies as they come out, without incurring the long-term costs of maintaining owned infrastructure.
- **EV funds**: Similar to an energy performance contract, EV funds allow governments and organizations to leverage realized or anticipated fuel savings to cover the initial purchase of an electric vehicle.
- **Budgeting Processes**: Budgeting processes that prioritize sustainability criteria and/or incorporate life-cycle costs into budget considerations can facilitate the purchase of EVs or EV infrastructure. In many cases, funding to cover the upfront cost of vehicles and to cover fuel costs come from separate budgeting sources. In these cases, budgeting processes may need to be amended or to accommodate life-cycle considerations.

EV funds: City of Fitchburg in Wisconsin allocates a portion of the gasoline savings associated with the purchase of hybrid and electric vehicles to help pay for future electric vehicles. Like a revolving loan, this mechanism allows the City to use future savings to fund projects that will produce additional savings - a cycle that could continue indefinitely. The City can spend up to $20,000 of unallocated gasoline budget to cover the upfront cost of new hybrid or electric vehicles.

EV FUNDING DECISION TREE

Use the table below to determine which funding opportunity is right for your organization or community. Then, review the available programs in your state and either follow the links provided or contact your community facilitator to learn more and accelerate your EV transition through external funding.

Funding Recipient by Sector: Residential Government Commercial

I want to…	Funding Source	Availability in CO, MN, WI	Funding Recipient by Sector	Other Considerations
Purchase an EV	Tax Incentives	• All – federal tax credit • CO – state tax credit		• Used EVs are eligible for federal tax credits; certain models may not apply
	Discounts/Group Buys	• All – varies by dealership • Public fleets – EV purchasing collaborative through Sourcewell		• Can be coordinated through any interested individual dealership
	Utility Rebates/Programs	• CO – Xcel Energy rebates for income-qualified customers • CO – Other utility rebates		
	Insurance Company Discounts	• All - varies by insurance company		
	Grants	• All – federal grants for freight vehicles, public transportation, airport vehicles, fleet vehicles • CO – state grants for heavy-duty vehicles and public fleet vehicles • MN – state grants for school buses • WI – state grants for heavy-duty transit buses and diesel vehicles		• Grants require an application; most grants require matching fundsur and other timing constraints
	Loans	• All – varies by financial institution		
	Leasing	• All – varies by dealership		

	Performance Contracting/EV Funds	• All – varies by organization • CO – state program for funding and implementing capital improvement upgrades		• The Southwest Energy Efficiency Project (SWEEP) provides information on financing EVs through performance contracting
	Exemptions	• CO – EVs are exempt from emissions testing, but are required to pay an annual EV registration fee • WI – tax exemption for alternative fuel vehicles		
Install a charging station at home	Loans	• All – varies by financial institution		
	Utility Rebates/Programs	• CO – Xcel Energy rebates for home wiring and charging stations • CO – Other utility rebates • MN – Xcel Energy home charging programs • MN – Other utility rebates • NM – Xcel Energy rebates for home wiring and charging stations • WI – Xcel Energy home charging programs		
Install charging stations at a workplace, multifamily property, or public location	Grants	• All – federal grants distributed by state departments of transportation for projects that improve air quality, including public charging stations • CO – state grants for Level 2 and DCFC stations		• Grants require an application; most grants require matching funds
	Loans	• All – varies by financial institution		

	Utility Rebates/Programs	• CO – Xcel Energy program providing public charging infrastructure • CO – Xcel Energy program for small businesses to install charging infrastructure • CO – Xcel Energy program for providing workplace charging infrastructure • CO – Xcel Energy program for providing multifamily charging infrastructure • CO – Xcel Energy rebates for charging infrastructure in new multifamily construction • CO – Other utility rebates • MN – Xcel Energy program for providing multifamily charging infrastructure • MN – Other utility rebates • WI – Xcel Energy program providing public charging infrastructure • WI – Other utility rebates		
Install charging stations for fleet vehicles	Grants	• All – federal grants distributed by state departments of transportation for projects, including public charging stations, that improve air quality • All – federal grants for charging infrastructure to support freight, public transportation, and airport fleets • CO – state grants • MN – state grants • WI – state grants		• Grants require an application; most grants require matching funds

	Loans	• All – varies by financial institution		
	Utility Rebates/Programs	• CO – Xcel Energy program providing fleet charging infrastructure • CO – Xcel Energy program for small businesses to install charging infrastructure • CO – Xcel Energy enhanced rebates for charging stations at small businesses in income qualified and high emissions communities • CO – Other utility rebates • MN – Xcel Energy program providing fleet charging infrastructure • MN – Other utility rebates • WI – Xcel Energy program providing fleet charging infrastructure • WI – Other utility rebates		
Conduct a fleet EV study	Utility Rebates/Programs	• CO – Xcel Energy Fleet Electrification Advisory Program • MN – Xcel Energy Fleet Electrification Advisory Program • NM – Xcel Energy Fleet Electrification Advisory Program • WI – Xcel Energy Fleet Electrification Advisory Program		
	EV Advising Programs	• CO – Northern Colorado Clean Cities and Drive Clean Colorado • MN – Twin Cities Clean Cities Coalition • MN - Great Plains Institute EV Smart Cities • MN - Drive Electric MN • WI – Wisconsin Clean Cities		

OUTREACH AND EDUCATION

OUTREACH AND EDUCATION

The Outreach and Education focus area addresses EV adoption by community members, with the emphasis on transitioning personal light-duty commuter vehicles to EVs and the necessary EV supply equipment (EVSE). Community outreach and education efforts on their own are not enough to significantly affect EV adoption. They are, however, pivotal in building support for regulatory or code updates, EV rebates, fleet adoption, and voluntary programs across all levels. Outreach and education efforts are also an essential step to providing community members with a basic introduction to EVs, raising community awareness about the purpose and importance of establishing a comprehensive EV program, and showing the public how transportation initiatives are related to other community issues like air quality, carbon reduction, and other specific energy goals.

This focus area and the associated toolkit topic areas can be a good reference for communities that want to initiate dialog with their stakeholders as well as to support and prepare community members for longer-term efforts. This approach may be helpful in communities with limited budget or limited political support for larger EV efforts. As community needs or public support increase, the community can expand its planning efforts to address engagement around other EV focus areas and topics.

The Clean Cities Coalition Network is a great resource for initiating outreach and education in communities nationwide. Clean Cities provides technical assistance, information resources, and connects local stakeholders — to advance the prevalence of alternative fuels in the transportation sector. Clean Cities Coalition partners include the Twin Cities (MN), Northern Colorado, Denver (CO) Metro, and Southern Colorado Clean Cities Coalitions.

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
- Large employers and other businesses that could install charging stations for use by employees
- Multi-family residence building owners whose tenants are interested in EV charging at home
- Builders involved in new construction of residences and businesses
- Local dealerships selling or considering selling EVs

Key Messaging

- Reduced transportation costs from fuel savings and lower maintenance costs
- Improved air quality in community
- Attract residents or employees (multi-family and employers)
- Reduced GHG emissions (especially when paired with renewable energy)
- May be part of other planning efforts around climate and energy

Typical Barriers

- Up-front costs of vehicle or charging infrastructure
- Access to charging stations, especially for renters or residents in multi-family dwellings
- Exposure to and knowledge of EVs
- Difficulty navigating information and resources, sometimes caused by conflicting messaging and duplication of resources by multiple entities
- Accessibility of vehicles or vehicle types
- Range anxiety

What Are the Most Effective Outreach Channels for These Strategies?

- Websites
- Public meetings
- Social media campaigns
- Co-hosted events
- Co-branded campaigns with utilities or other platforms

Remote Engagement During COVID-19: Physical distancing doesn't mean you can't reach your community members in meaningful ways. By using remote engagement tools and techniques, you can connect with individuals in different locations and with varying access to resources. From creative social media marketing strategies to virtual Ride-and-Drives, there are many ways you can reach your community while staying safe. Explore the Partners in Energy Remote Engagement Toolkit to help you build your remote engagement strategy.

VEHICLES

Outreach strategies in this topic area focus on encouraging community members to learn about, purchase, and drive EVs for personal use. When community members switch to EVs, they reduce carbon emissions by about one-third, save money on fuel and maintenance costs, and improve local air quality (Xcel Energy, 2019).

Basic Information

There are three different types of EVs with varying levels of dependence on internal combustion engines (ICEs): 1) battery-electric vehicles (BEVs); 2) plug-in hybrid electric vehicles (PHEVs); and 3) hybrid electric vehicles (HEVs). The environmental and economic benefits of switching from a traditional ICE vehicle to an EV tend to be greater in BEVs than HEVs since BEVs do not use any fossil fuel — but the initial cost of a BEV is also typically higher. Battery cost is usually the main driver of EV price. BEVs have larger batteries than PHEVs or HEVs. As technological improvements continue, EV battery costs are decreasing. This could bring down up-front EV costs, making them comparable to ICE vehicles (Next 10, 2018). For more information on vehicle types and benefits of transitioning to EVs, see Appendix A: Electric Vehicles 101.

First Steps and Quick Wins

Below are some low-effort initial strategies that you can use to encourage residents to learn about and purchase EVs. Strategies in this section can be implemented quickly and with limited financial investment.

Maintain an Up-to-Date Website

Develop and maintain a comprehensive EV website that allows residents, businesses, and visitors to easily access EV-specific information. The website should provide information about local public charging options, permitting for installation of residential and public charging stations, relevant building codes, and other local considerations or incentives (ICF, 2018). The website can also connect customers to external resources such as Xcel Energy for general EV information, the U.S. Department of Energy (DOE) for federal and state tax credit information, and additional resource tools.

Examples:

- Xcel Energy maintains an EV website that provides up-to-date information on available models, incentives, and charging stations.
- The Tahoe Regional Planning Agency in the Lake Tahoe, CA, area hosts the Tahoe Alternative Fuels website.
- A multi-agency collaboration in the State of Oregon runs the Go Electric Oregon website.
- The New England nonprofit Green Energy Consumers offers the Drive Green website.

Support Ride-and-Drive Events

Organize, facilitate, or host ride-and-drive events to offer customers an opportunity to get behind the wheel of an EV to personally experience the similarities and differences to typical ICE vehicles. According to Drive Electric Northern Colorado, 85% of customers who participate in ride-and-drive events have never driven an EV prior to the event and are 15% more likely to purchase an EV after the event (DENC, 2013).

Drive Electric is an existing program that helps arrange ride-and-drive events for businesses across the country. Independent programs are offered in Colorado and Minnesota, as well as nationally.

- Drive Electric Northern Colorado offers workplace ride-and-drive events.
- Drive Electric Minnesota organizes both private and public ride-and-drive events.
- Drive Electric National coordinates a national annual celebration and outreach week for EVs.

Table at Local Events

Promote, facilitate, and attend local events to educate the community about types of vehicles, how and where to charge an EV, rebates, and resources by participating in or hosting a community event with tabling opportunities. Tabling events can range from community festivals and farmers markets to EV-specific events like the ride-and-drive events mentioned previously or community EV informational sessions. Distribute materials such as manufacturer information and utility rebate program details, as well as available state and national tax incentives. Contact Xcel Energy for materials or support.

Trusted Partners: Many minority and immigrant communities face limited English skills, cultural isolation, and a distrust of government; and, any of these issues can be barriers to engagement. To overcome these barriers, partner with local, trusted community groups that can help share the information in culturally relevant and accessible formats. For more guidance, reference The Equity for All: EV Toolkit published by the Greenlining Institute.

Examples:

- The Denver Department of Public Health and Environment has an education and outreach campaign called Denver Pass Gas to provide residents information and exposure to EVs.
- Sample content about understanding EVs that you can use in developing flyers and handouts are available through Xcel Energy.

Outreach to Dealerships

The first point of contact for many drivers seeking guidance to make the transition from traditional ICE vehicles to EVs is dealership sales staff. Ensuring local? sales staff are knowledgeable about EVs – including special features, information on charging (both at home and in public), and their benefits – can help dealerships increase sales and put customers at ease and ensure they are aware of available purchasing incentives and resources. In-person outreach is typically the most effective way to introduce dealerships to EV opportunities and resources, including:

- EV sales staff training
- Ride and Drive coordination
- Group Buy partnerships
- Xcel Energy's EV Trade Partners Network

Examples:

- PlugStar offers in-person and web-based EV dealer training for a fee in partnership with James Madison University.
- Northern Colorado Clean Cities conducts direct outreach to dealerships to share EV information and resources and to coordinate EV group buys.
- Dealerships who participate in the Xcel Energy EV Trade Network receive access to promotional support, EV training for sales staff, and other resources.

Larger Efforts and In-Depth Studies

The following strategies can be used to encourage vehicle procurement in your community through long-term efforts. These strategies may require additional planning, budget, or in-depth studies and collaboration.

Incentivize EV Purchases

Offering community-specific rebates, in addition to available tax credits and rebates, can help overcome the barrier of the high up-front costs for EVs. Communities can choose to target low-income households to help alleviate transportation burden or neighborhoods disproportionately affected by poor air quality. These programs can be beneficial for increasing participation in EV ownership through reasonable pricing.

Equitable Incentives:
To ensure that EV incentives are distributed equitably, the TransitCenter foundation recommends structuring incentives to prioritize 1) low-income households, 2) households in rural and suburban areas that are less well-served by transit, and 3) smaller vehicles that consume less energy and reduce risks for pedestrians, especially children on neighborhood streets.

Examples:

- Riverside, CA, provides a rebate to residents who purchase a BEV, through the Alternative Fuel Rebate Program.
- The Sierra Club and Plug-in America have developed a sample rebate legislation template for vehicle purchase rebates.

Organize a Group Buy

Partner with local dealerships to offer limited-time discounted pricing on EVs though a group buy. Group buys have been found to significantly boost EV sales, and the programs are seen as "an important tool for building momentum and accelerating market growth from the early adoption to the majority adoption phase, beyond which EVs will transition from the fringe to the mainstream" (Frommer, Toor, & Salisbury, 2018). Group buys are arrangements between communities or local organizations with local dealerships to offer discounts on vehicles — the community or organization is responsible for the outreach and promotion of the program in the community to encourage participation.

Examples:

- The City of Fort Collins partnered up with Drive Electric Northern Colorado to organize a public group buy event in 2019.
- Wisconsin Clean Cities partnered with Nissan North America and statewide utilities to promote a group buy discount from August 2, 2016, to September 30, 2017.
- Boulder County's Sustainability Office offers residents seasonal discount programs on EVs.

Conduct an EV Owners' Demographic Study

Conduct a demographic study of existing EV owners based on U.S. Census data to characterize the typical owner of an EV. This data can be used to identify those likely to purchase EVs within a county based on residential census blocks and to target outreach campaigns or plan infrastructure projects. Research shows that personal experience with EVs significantly increases a consumer's willingness to consider an EV for their next vehicle purchase (National Renewable Energy Laboratory, 2017).

Examples:

- The Sacramento Clean Cities Coalition developed the Sacramento Electric Vehicle Readiness and Infrastructure Plan in 2017, which provides typical characteristics of PEV owners in the community. (See page 15, along with a neighborhood map on page 16.)
- The Colorado Energy Office released an EV Awareness Market Research report to understand EV adoption beliefs, fears, barriers, needs for information, current sources of EV information, plans for EV purchases, and preferred vehicle types. The report helps CEO match messaging with different consumer segments to build awareness and support EV adoption.

SINGLE FAMILY RESIDENTIAL CHARGING INFRASTRUCTURE

Community strategies in this topic area focus on supporting residents installing chargers at home for use with personal vehicles. The U.S. DOE estimates that 80% of EV charging occurs at home, so encouraging installation of charging stations in single-family homes is a good first step to accelerate adoption of EVs for personal commuting (U.S. Department of Energy, 2019).

Basic Information

Single-family residents who buy an EV typically choose to install Level 1 or Level 2 vehicle charging stations in their homes depending on their patterns of vehicle use. For more information on charging types, see Appendix A: Electric Vehicles 101. Homeowners should contact a licensed electrician to determine whether the existing electrical service can support vehicle charging or to identify what changes would be needed to safely install new outlets or home charging stations. The electrician may be required to get a building permit to complete any electrical upgrades. Homeowners can also choose to pair their EV charging with renewable energy options for emissions-free transportation. For more information on charging, visit: ev.xcelenergy.com/charging-101.

First Steps and Quick Wins

Listed below are some community strategies that can be used to immediately promote the installation of residential charging for use with personal EVs. Strategies in this section can be implemented quickly and with limited financial investment.

Outreach to Homeowners

Use existing outreach channels to provide homeowners information on the installation of EV charging stations in their homes. This information might include:

- How easy it is to charge at home
- How to choose the best charger for your needs
  - Level 1: Best for drivers who don't want to install additional infrastructure, don't drive long distances regularly, and can charge their vehicle at work or a nearby public charging station. Drivers can plug their EV directly into a standard household outlet and receive about 5 miles of range per hour (Valderrama, Madhur, Statler-Alum, & Garcia, 2019).
  - Level 2: Best for drivers who drive long distances regularly and don't have access to nearby public or workplace charging stations. Drivers can install a Level 2 charger for a cost, though some utilities may offer rebate, and receive about 25 miles of range per hour (Valderrama, Madhur, Statler-Alum, & Garcia, 2019).
- Expected increase in electricity costs due to EV charging
  - How does this compare to gasoline fuel costs?
  - What utility electricity rates are available to homeowners, and which are most advantageous for homes with EV charging?
- Local electricians familiar with EV charging installation
- Permitting process and anticipated costs

This information can be shared electronically through the community's website and social media or through handouts at community events or ride-and-drive events. For more information on charging, visit: ev.xcelenergy.com/charging-101.

Examples:

- Xcel Energy provides basic information about charger types and how to get started with a charging station installation at home.
- U.S. DOE offers homeowners information on types of chargers and expected costs.
- The City of Atlanta provides a one-page handout outlining the permitting process for installing a charging station at home that could be adapted for your community.
- Georgia Power provides a handout that lays out a three-step process for installing a charging station at home (including identifying chargers needed, installing the station, and choosing the appropriate electricity rate).

Simplify Permitting

Encourage homeowners to install EV charging at home by simplifying the permitting process and reducing the cost for home installation. Best practices for streamlining the permitting process are outlined below (Center for Sustainable Energy, 2016).

1. Clear and consistent website information including clearly defined permit requirements in simple language
2. Simple applications that can be filled out and submitted online
3. Process checklists, used by both permit staff and applicants, that include:
    a. Clear timelines for review process
    b. Responsible party at each step
    c. Standard fee
    d. Single point of contact for applicants
4. List of common errors and resolutions to help ensure permit applications are approved on first submission
5. Online permitting platforms that allow the applicant to track the permitting process
6. User-friendly inspection scheduling

Examples:

- In the EV readiness plan by the City of Fort Collins a strategy to develop a residential EV charging permit process notification mechanism is described.
- The City of San Diego offers a fact sheet that outlines the process and expected fees.
- The City of Atlanta provides a flowchart that illustrates the permitting process.

Connect with Contractors

Provide outreach and training to local electricians to ensure that residents who want to install EV charging stations receive consistent and accurate information. This training may include (Electric Vehicle Infrastructure Training Program, 2019):

- Utility interconnect policies and requirements
- Charging station fundamentals
- Service-level assessments and upgrade implementation
- Integration of EV charging with distributed generation
- Internet Protocol networking and controls
- National Electrical Code standards and requirements
- National Fire Protection Association 70E and OSHA regulations
- National Electrical Installation Standards for EV equipment
- Troubleshooting, repair, and commissioning

These trainings may be conducted by qualified local government staff, a local higher education entity, or a third party. The community can invite electricians to complete the training and maintain a list of certified electricians on their website or in EV education and outreach materials. Check with Xcel Energy for potential training support.

Examples:

- The Electric Vehicle Infrastructure Training Program (EVITP) provides training across the United States and Canada.
- U.S. DOE provides a handbook for electrical contractors.

Larger Efforts and In-Depth Studies

Some residential charging strategies require additional planning, budget requests, or in-depth studies and could provide more traction and sustained growth and support.

Incentivize At-Home EV Charger Purchases

Offering community-specific rebates can help overcome the barrier of the high up-front costs for at-home EV chargers. Communities can choose to target low-income households to help alleviate the transportation burden since the cost of electricity needed to charge an EV can be one-third the cost of gasoline needed to fuel a similar ICE vehicle. Encouraging residents to install at-home chargers will increase EV ownership as more people will have reliable access to charging infrastructure.

Conduct an At-Home EV Charger Demographic Study

Overlay the existing EV owner demographic information with residential housing types and household income to identify those likely to install at-home EV chargers. With this information, develop targeted outreach campaigns or plan infrastructure projects in these areas.

MULTI-FAMILY CHARGING INFRASTRUCTURE

Community strategies in this topic area are focused on educating, encouraging, and supporting multi-family building owners and property managers around installing EV chargers to provide residents with access to personal vehicle charging. Multi-family buildings include condominiums, apartments, and housing cooperatives with five or more units.

As noted in the Single Family Residential Changing Infrastructure, from 2012 to 2014, 80% to 90% of EV charging occurred at home (Idaho National Laboratory, 2015). About 40% of U.S. residents live in rental complexes with five or more units (United States Census Bureau, 2017). For these residents, the choice to install EV charging equipment is often not theirs to make. Unlike single-family homes, owners and managers of multi-family buildings must weigh unique considerations when installing EV charging equipment to attract and retain residents (Office of Energy Efficiency and Renewable Energy, 2019). Multi-family property owners and managers need to decide not only what type of chargers to install, but also if or how they will recover the cost of the investment or charging costs.

Basic Info

There are two types of chargers that multi-family building owners may choose to install on their properties: Level 1 or Level 2. (See Appendix A: Electric Vehicles 101 for more information on charger types.) Property owners and managers should contact a licensed electrician to determine whether the existing electrical service can support vehicle charging or to identify what changes would be needed to safely install new outlets or charging stations. They may also be required to get a building permit to complete any electric upgrades required. Installation of charging stations will have to comply with the National Electrical Code, which has minimum requirements for safe installation of chargers in commercial buildings and large multi-family buildings across the nation (National Fire Protection Association, 2019).

In addition to considering what type of charging equipment to install (Level 1 or 2), property owners and managers must also consider charging station locations and fuel fee structures.

1. **Access**: Is the parking spot and charging infrastructure in a location and designed in a way that will allow people with physical disabilities to use the charging station?
2. **Charging Station Locations:** A property owner can choose to provide charging to residents at their designated parking stalls or allocate a section of the parking area for EV charging. If the charging is provided in their designated stalls, the residents will not have to compete for charging time. If the property owner chooses to select two or more spots for EV charging open to all residents, EV charging infrastructure costs can be reduced by choosing dual-head chargers, by locating the charging stations near existing electrical service, and by installing EV-ready infrastructure during construction or re-surfacing of parking lots. Codes, requirements, and preferences for locations of EV charging station in multi-family developments vary by community and should be followed.

3. **Fuel Fee Structure:** There are three options for property managers to collect fees for electricity use at charging stations (Kukkonen, 2019):
    a. **Flat Fee:** In this case, the EV owner purchases an EV parking pass that has an added flat fee to pay for the anticipated energy use. This is the simplest option but can lead to significant overcharging or undercharging tenants for electricity use.
    b. **Submetering:** Many Level 2 chargers have Wi-Fi enabled controls that could let a property manager monitor the energy use of each charging station and charge the resident accordingly for designated parking stall charging. In the case of a shared charging area, third-party services can be used to facilitate payment on a per-charge basis (ChargePoint, 2019).
    c. **Pay as you go:** Multi-family building owners could also choose to partner with a third-party EV charging station supplier that provides at-the-station payment options, similar to public charging stations.

First Steps and Quick Wins

Listed below are some community strategies that can be used to provide education and promote installation of EV chargers in multi-family buildings for personal vehicle charging. Strategies in this section can be implemented quickly and with limited financial investment.

Outreach to Property Owners and Managers

Encouraging multi-family property owners and managers to install charging stations can be done through training, demonstration projects, market research, awareness building campaigns, and sharing of case studies. Of 1,000 multi-family housing residents surveyed across U.S. metropolitan areas, 24% of residents indicated a preference for properties with EV charging stations. Further, 17% of residents reported willingness to pay more for a dwelling that provided charging options (Advanced Energy, 2014). While property owners and managers stand to benefit from providing EV charging options, understanding these benefits, the market, and the decision-making process for installing chargers can be difficult to navigate.

Leveraging existing networks of property owners and managers, such as local multi-family housing associations, is a best practice for communicating EV charging options and benefits to residents. This network can also help identify and proliferate local case studies as well as help increase the speed at which success stories and lessons learned are shared. This information could be delivered through informational flyers, lunch-and-learn events, case study sharing meetings, or on a city or community website. Some EV service companies offer content for such learning events (e.g., SemaConnect, ChargePoint, Clipper Creek).

Examples:

- In 2020, Northern Colorado Clean Cities hosted free EV Ride & Drive events and Know Before You Go Electric workshops for workplace, apartments, and condo organizations.
- MultiHousingCharging.com compiled a case study of infrastructure installation at Live Green Apartments in St. Paul, MN.
- Austin Energy offers information regarding outreach to multi-family properties including benefits, rebates, steps for charging station installation, and a local case study.
- Advanced Energy developed a multi-family housing charging station handbook that reviews common barriers to adoption, benefits of charging stations to building owners, and steps for installing charging stations.

Target Renters

Provide renters with tips and resources to approach their landlords about EV charging installations, much in the same way they advocate for building efficiency improvements. Most multi-family housing is composed of rental units, making up over 43 million households, or 36% of total household types in the United States. (National Multifamily Housing Council, 2019). As EVs gain popularity, more residents of multi-family buildings will be interested in owning EVs. Since these residents best understand their own driving patterns and charging needs, they can communicate effectively with their landlords or property management companies and accelerate the process of EV charging installations.

Examples:

- California Plug-in Vehicle Collaborative provides residents a guide for talking to their landlords about installing charging stations.
- Advanced Energy created a step-by-step guide for North Carolina residents to encourage the installation of charging stations at their buildings and includes charging station benefits as well as responses to common concerns.

Encourage EV-Ready Construction

Encourage building owners and developers to prepare for EV charging stations early by making parking spaces conduit-ready during construction. Making these investments at the time of construction or renovation will save money for property owners and managers, because it is easier to install wires and share material costs across multiple purposes (e.g., wiring for EV chargers as well as on-site solar or other new building HVAC equipment). This can save charging infrastructure projects as much as 75% compared to rewiring (Pike, Steuben, & Kamei, 2016). An education and outreach campaign is a good strategy in communities where there are no charging station standards.

EV-ready construction can also be mandated or encouraged through city codes or zoning ordinances. If EV-ready construction cannot be incorporated into city codes, it can be mandated in associate with requested exceptions or financing with a focus on benefits of planning for eventual usage levels. For more information on this strategy, see the Policy focus area section.

Examples:

- An EVSE cost-effectiveness report was developed for the City and County of San Francisco by Energy Solution regarding the costs and benefits of encouraging developers to install charging stations during initial construction rather than retrofitting later.

Larger Efforts and In-Depth Studies

To support long-term success for multi-family charging infrastructure, some outreach and education strategies may require additional planning, budget, or in-depth studies such as methods for combining charging with solar energy.

Integrate EV Charging and On-Site Solar

Encourage building owners to integrate solar photovoltaic (PV) energy with EV charging, which can complement the benefits of both technologies. First, solar PV can reduce the cost of charging vehicles by generating energy on-site. Second, the GHG emissions related to driving an EV depend on which resources are generating the electricity, such as natural gas or wind. Therefore, using solar PV to charge a vehicle can have a significant reduction in GHG emissions. Lastly, another benefit of pairing solar PV with EV charging is that it can reduce strain on the grid during hours of peak use. Depending on the structure of the time-of-day rates in your area, these benefits may be compounded further if users are not penalized with higher electric costs for daytime charging. The ability to take advantage of on-site solar, time-of-use rates, or other services vary by state.

Examples:

- The National Renewable Energy Laboratory developed the REOpt Tool to help size an on-site solar PV installation that incorporates EV charging loads and building electricity loads.
- Great Plains Institute published an article regarding the benefits of combining solar and EV charging.

EMPLOYER CHARGING INFRASTRUCTURE

Strategies in this topic area focus on supporting businesses to pursue installation of EV chargers for employees' personal vehicles, as well as for customers, visitors, and the broader public. For information on benefits of converting business fleet vehicles to electric, see the section on the Light-Duty Fleets focus area.

Basic Information

The workplace is the second most common place for EV owners to charge their vehicles, surpassed only by at-home charging. Some employers choose to install EV charging infrastructure to provide a benefit to employees, accommodate the needs of visiting clients, and demonstrate environmental commitment. When installing charging stations, employers must balance the costs with time, capital improvement budget, operating budget, and lease considerations.

When an employer is deciding if they should offer workplace charging for employees, there are several things they should consider.

1. **Access**: Is the charging infrastructure for employees only or is it accessible to the general public and visitors as well? Is the parking spot associated with the charging station available for non-EV users if it is not in use? Is the parking spot and charging infrastructure in a location and designed in a way that will allow people with physical disabilities to use the charging station?
2. **Charger Type:** Typically, Level 2 chargers are the most suitable for a workplace, but Level 1 chargers may be appropriate for employees that will be plugged in for a full shift. For more information on charger types, see Appendix A: Electric Vehicles 101.
3. **Price Structure:** A survey of 200 organizations across the country showed that 70% of workplace EV charging is provided as a free benefit to employees (U.S. Department of Energy, 2015). The employer could also choose to charge for use of the stations. This may be a more appropriate choice if the charging station is also available to visitors and the general public.
4. **Security:** When choosing the location for the charging station, the employer should ensure that proper security is in place to prevent vandalism and unauthorized use.
5. **Signage and Enforcement:** Signage should clearly state who can use the charging station, any applicable fees, and time limits. The employer should also be prepared to enforce these rules.
6. **Managing Access:** The company should also consider how it will manage access to the charging station if there are more employees wishing to take advantage of workplace charging than there are available charging stations. Examples of options employers have used include:
    a. **Valet**: A parking attendant will move cars when the car has been charged or after a set amount of time.
    b. **Assignment**: The charging station is assigned to multiple employees who coordinate sharing of the infrastructure.
    c. **Reservation System:** An internal calendar can be set up and employees can sign up to use the charging station for specific time periods.
    d. **Time Limit:** Use of each charging station is limited to four hours, allowing another employee to use the station for the second half of a standard work day.
    e. **Employee Managed:** A listserv or email group is set up and EV owners manage access to charging among themselves. This can be a good option for a small company with limited resources for parking enforcement.

First Steps and Quick Wins

This section's strategies to support education and outreach for employer-sponsored charging infrastructure can be implemented quickly and with limited financial investment.

Outreach to Large Businesses

Develop an outreach campaign to encourage large employers to install charging stations as a benefit to employees. Large businesses and employers often have more staff and resources to focus on energy projects than smaller businesses and employers do. Moreover, some large businesses are part of a greater enterprise that is striving to meet corporate sustainability goals. For these reasons, installing EV charging infrastructure may appeal to large employers that occupy high-performing buildings and want stay on the leading edge of technology. For example, if these employers seek certification through LEED or other voluntary sustainable construction standards, designating parking for EVs and providing charging stations can help them earn certification points (U.S. Green Building Council, 2019).

Target industries may include hospitality, medical, and tourism sectors. As EVs continue to enter the market, hotels, hospitals, and local attractions can gain a competitive edge by offering patrons a place to charge their vehicles. For these types of employers as well as others, it is important to determine the appropriate type of charging equipment for the user. If charging equipment is intended for visitors, Level 2 or Level 3 chargers are often the preferred options, given the limited time for charging. If charging equipment is intended for employees, who also have access to charging at home, a Level 1 charger is likely enough (Gorzelany, 2018).

Examples:

- The Minnesota Pollution Control Agency published a guide for expanding workplace EV charging infrastructure that includes steps to start a workplace charging program, key benefits for employers and employees, and steps for installing charging stations.
- Cal Start developed a report that includes information on how to install charging stations at a workplace and also provides local case studies.
- The New York State Energy Research and Development Authority developed a brochure that outlines the benefits of workplace charging and describes how to install charging stations, including guidance on signage and payment structure.

Facilitate Peer-To-Peer Information Exchange

Engage local chamber of commerce, business associations, or other trusted networks for employers to share information with one another about EV charging programs. As with most emerging technologies, an initial skepticism must be overcome before a product can achieve widespread market adoption. One way to overcome perceived barriers is to share positive stories and anecdotal evidence. To encourage workplace charging, a community case study could be developed that highlights a group willing to share their experience with other employers and to possibly assist other interested businesses in navigating the decision-making process. These case studies can be captured and shared at in-person events, written as case study flyers, and featured online.

Going a step further, a local chamber of commerce, business association, or city could help facilitate a demonstration project that supports businesses in the charging station investment and the decision-making process. A demonstration project would provide hands-on experience for those who participate, as well as the opportunity to create a local case study that could be shared more broadly.

Examples:

- Drive Electric Northern Colorado offered a workplace charging challenge launch and workshop in 2015.
- Drive Electric Minnesota promotes electric vehicle adoption by providing workshops to inform stakeholders and promote sharing experiences across communities in Minnesota.

Recognize Local Businesses that have Workplace Charging

Encourage local businesses to install EV charging stations by recognizing their efforts through local green business programs or other local business recognition programs. This is a low-cost opportunity to promote the installation of EV charging stations. Case studies can be developed about local businesses who have installed charging stations to help encourage other businesses to follow suit.

Examples:

- The City and County of Denver offers the Certifiably Green Denver program to local businesses that implement sustainable practices.
- The City of Winter Park, CO, promotes sustainable businesses through its Winter Park Green Business Recognition Program.
- The City of Saint Paul, MN, has the Energize Saint Paul program, which provides resources as well as recognition for businesses that are taking energy actions.

Encourage EV-Ready Construction

Encourage businesses to prepare for EV charging stations early in the process by making parking spaces EV-ready during construction. Making these investments at the time of construction or renovation will save money for business owners and property managers, because it is easier to install wires and share material costs across multiple purposes (e.g., wiring for EV chargers with on-site solar or other new building HVAC equipment). This can save charging infrastructure projects as much as 75% for commercial applications compared to rewiring (Pike, Steuben, & Kamei, 2016).

Provide information on the benefits of EV-ready construction to local designers and builders to encourage them to include EV charging infrastructure in new construction or major renovation projects. This information can also be provided to building owners to encourage them to ask their contractors about possible upgrades.

EV-ready construction can also be mandated or encouraged through city code or zoning ordinances. For more information on this strategy, see the Policy focus area section.

Larger Efforts and In-Depth Studies

Educating employees about car sharing programs and on-site solar energy use are strategies that will result in more long-term efforts and may require additional planning, budget, or in-depth studies.

Promote Employee EV Car Sharing

Encourage large employers to host EV car sharing, which allows cars to be borrowed or rented by employees by the hour or day. This will help increase exposure to EVs, which is often a key precursor to EV purchase. This also offers convenience to employees who take public transit to work and lowers the carbon footprint of employees' vehicle miles traveled for work.

Examples:

- Envoy offers EV public car sharing opportunities in California and New York.
- Maven provides a range of car sharing options, including EVs, and can be found in cities in California and Michigan.
- Hour Car supports car sharing in Minneapolis–Saint Paul, MN.
- ZipCar can be found across the country and supplies a mix of vehicle options.
- eGo CarShare serves the Denver–Boulder metropolitan area in Colorado and has been integrating electrification into its fleet since 2018.

Integrate EV Charging and On-Site Solar PV

Encourage employers to integrate solar photovoltaic (PV) energy with EV charging, which can complement the benefits of both technologies. First, solar PV can reduce the cost of charging vehicles by generating energy on-site. Second, the GHG emissions related to

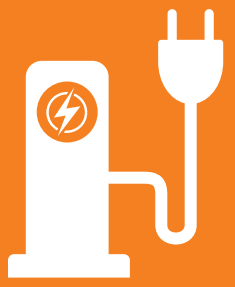
driving an EV depend on which resources are generating the electricity, such as natural gas or wind. Therefore, using solar PV to charge a vehicle can have a significant influence on GHG emissions. Lastly, another benefit of pairing solar PV with EV charging is that it can reduce strain on the grid during hours of peak use. Depending on the structure of the time-of-day rates in your area, these benefits may be compounded further if users are not penalized with higher electric costs for daytime charging. The ability to take advantage of on-site solar, time-of-use rates, or other "make-ready" services may vary by state.

Examples:

- The National Renewable Energy Laboratory developed the REOpt Tool to help size an on-site solar PV installation that incorporates EV charging loads and building electricity loads.
- Great Plains Institute published an article regarding the benefits of combining solar and EV charging.

Resources

- Xcel Energy lists suggested steps for installing EVSE for building owners.
- Xcel Energy provides EV tools and resources to help educate and inform the EV curious with data and information on EV options, savings and support.
- The U.S. Department of Energy published a workplace charging handbook for hosting charging stations at places of work.
- Alternative Fuels Data Center was developed by the U.S. Department of Energy and offers calculators, interactive maps, and data searches to aid in decision-making.
- The Regional Air Quality Council and Colorado Energy Office offer businesses financial support for installing Level 2 and Level 3 charging stations.
- Advanced Energy created the Residential Charging Station Installation Handbook and the Multifamily Housing Charging Station Handbook for single and multi-family homeowners and renters.
- Great Plains Institute provides information about how to make a city EV-ready through permitting, policies, and codes.
- MultiHousingCharging.com offers decision-making tools to guide multi-family property owners.
- Plug In America is a nonprofit advocacy organization that offers informational material and guidance for customers interested in learning about purchasing EVs.
- Charge Point offers informational tools that show incentives and special electric rates that may lower charging costs by state, vehicle, and infrastructure.
- Colorado Energy Office's ReCharge Colorado program provides coaching services in every county in Colorado, to advance the adoption of EVs by connecting participants with resources, grant opportunities, and more.
- The Clean Cities Coalition Network provides education and outreach support, nationwide, to encourage electric vehicle adoption. Connect with your local coalition to identify upcoming events or opportunities for partnership.



PUBLIC CHARGING ACCESS

PUBLIC CHARGING ACCESS

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 or 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.

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.

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).

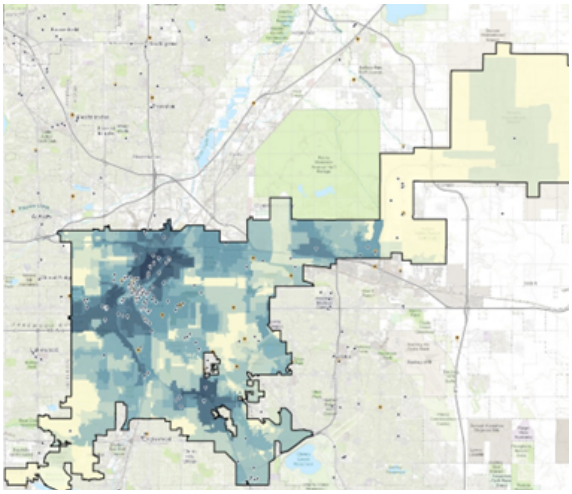


Figure 1: Denver Carshare Suitability Analysis Map

- 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 500,00 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_2e)	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).

$$\text{(Average energy use per EV)x(average annual VMT)x(CO2 emissions intensity factor)}$$

$$= \frac{34\ \text{kWh}}{100\ \text{mi}} \times \frac{X\ \text{VMT}}{\text{avg resident}} \times \frac{X\ \text{MT}\ CO_2e}{1000\ \text{kWh}}$$

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.

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).

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.

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-serviced 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.

EQUITY AND ECONOMIC DEVELOPMENT

EQUITY AND ECONOMIC DEVELOPMENT

EQUITY

Strategies in this topic area work to ensure that EVs are accessible to underserved communities including low-income residents, communities of color, residents with disabilities, residents that speak a language other than English, and communities most impacted by poor air quality.

Equitable Electrification: Providing equitable access to public charging stations continues to challenge communities across the nation. The Greenlining Institute developed Electric Vehicles for All: An Equity Toolkit to provide clear guidance for making an equitable transition toward transportation electrification. The toolkit includes a section on "Making EVs Practical and Accessible", which covers addressing specific mobility needs and equitable charging infrastructure.

Basic Information

Although the perception is that EVs are not available to low-income consumers due to significantly higher base prices and historically low availability in the used car market, new and used EVs are becoming more affordable and more common, and, therefore, more accessible. The Greenlining Institute suggests that promoting EVs in underserved communities should include aspects that are (The Greenlining Institute, 2019):

- **Relatable:** Outreach materials and tactics must target the community in question. It is good practice to partner with community-based nonprofits or other community navigators who have already earned the trust of the community.
- **Accessible:** Accessibility starts with outreach materials. Ensure that they are provided in the appropriate languages and that the level of technical content and references are appropriate for the community. Next, ensure that the cost to purchase, lease, or rent the vehicle is appropriate based on the income level of the community. Finally, ensure that several options are available for providing payment or completing the proper paperwork, in order to avoid technology or banking access barriers.
- **Practical:** Make sure the EV options presented to the community are appropriate for their mobility needs and abilities, as well as presented in a safe and convenient location.

As each community is unique, there is no one solution for increasing EV transportation accessibility in underserved communities. Be sure to identify the unique barriers of the target communities before developing strategies.

First Steps and Quick Wins

Initial strategies for incorporating equity into EV integration discussed in this section can be quickly implemented with limited financial or time investment. These strategies will help ensure that all community members are being considered throughout the planning process.

Define EV Equity in Your Community

Work with local stakeholders to define what equity means in your community as it relates to EV access. Start by identifying neighborhoods or populations that face substantial barriers to driving an EV (such as cost for low-income communities) or that have been excluded from previous outreach efforts (such as communities that speak English as a second language). A community may also choose to reach out to populations that have carried a disproportionate burden of air quality impacts from ICE vehicles. You can use the U.S. Environmental Protection Agency's EJScreen mapping tool to help you identify these populations.

Once you have identified the target population, engage representatives from these communities to help you define EV equity. It is important to also include these community representatives in the development of plans, messaging, and outreach. It may make sense to incorporate these outreach efforts into other broader programs and efforts. It often takes concerted efforts at the municipal and stakeholder level to counteract institutional barriers, implicit biases, and language or knowledge barriers that prevent many of these underserved communities from considering or using EVs. Messaging platforms, communication strategies, key locations, and important leverage points are all different in underserved populations and usually must be addressed with different strategies than traditional outreach and education. The key messaging will also vary between underserved communities, so it is important to work with each identified community representative to understand how to best reach a specific community.

Examples:

- Colorado's EV Equity Study identifies barriers to EV access and addresses opportunities for a more equity-centered approach to transportation electrification and stakeholder engagement in Colorado through the development of a few tools.
- The Puget Sound Clean Air Agency conducted a feasibility study to evaluate options for encouraging EV use among low-income residents.

Establish an Equity Checklist

Work with representatives from underserved populations in your community to create a checklist of criteria to consider, as strategies are developed, to ensure equity in projects. The checklist could be for initiatives specific to EVs or as a more general checklist for broader sustainability initiatives. The checklist should be designed to help ensure that strategies to promote EVs do not exclude underserved populations. Some considerations include:

- **Language:** Ensure that the language used to communicate the strategies is easily understood by all. This may include translating for populations where English is not the primary language and/or using common words and phrases.
- **Accountability:** What data or metrics will be used to identify disparities among populations and to track progress of removing those disparities?
- **Inclusive Engagement:** How have community members participated in the development of strategies or implementation plans in the past? Are there opportunities to expand this engagement to underserved populations such as low-income residents or communities of color?
- **Economic Opportunity:** If economic opportunity is available through the implementation of the strategies, are there opportunities to support low-income populations or communities of color through workforce development? Are there rebates available through the local utility or local government programs?

- **Disproportionate Impacts:** What populations will benefit from the identified strategy? Does this promote equity within the community?

These criteria are adapted from the racial equity tool developed by the City of Cleveland in conjunction with their climate action plan to evaluate identified strategies. The Adaptation Clearinghouse also provides an equity checklist for all projects.

Adopt an EV Driver Bill of Rights

Establish an EV driver bill of rights outlining the rights of drivers as it relates to EV purchasing, charging, and ownership - to help ensure a positive experience for all residents choosing to transition to EVs. This document can be drafted by community staff with specific local consideration, or more general versions can be provided by groups promoting EV adoption.

Examples:

- The Sierra Club includes a sample bill of rights as part of their policy toolkit.
- California House Resolution No. 117 is an example of an EV driver bill of rights that has been adopted.

Encourage or Establish an EV Car-Share Program

Communities can collaborate with ride-hailing companies, such as Uber and Lyft, and carsharing companies, such as Zipcar, to provide exposure of EVs to residents who might not be able to afford an EV. Car-sharing programs are growing in popularity as a way for more people to be comfortably car-free by allowing people to rent a vehicle for a short period of time to run errands or other intermediate needs. Often, these cars are parked on a campus or at a community center where residents can check them out using a cell phone app or other method. EVs are a good fit for this use since such vehicles have designated parking spots and could be charged in those spots. Selected EVs should have the appropriate battery range for typical use. Additionally, renters should be provided appropriate information about how to operate the vehicle and how to find charging stations as needed. Plug-in hybrid electric vehicles (PHEVs) may be a better fit for these services in order to prevent range anxiety.

Examples:

- The Greenlining Institute compiled considerations for EV car sharing in underserved Communities, with recommendations for incorporating EVs into ridesharing programs in low-income communities.
- Forth Mobility published a report describing their pilot for affordable EV car sharing in a neighborhood in northeast Portland.
- HourCar, a car sharing service based in Saint Paul, MN, operates Evie, an all-electric, free-floating carshare for trips around Minneapolis and Saint Paul, MN. Evie Community Carshare aims to address environmental, social, and racial inequities in the transportation system. It will achieve this by aiming to have 50% of total use by Black, Indigenous, and people of color members (BIPOC), providing 40% of total trips by very low-income members, and 20% of total use by very low-income BIPOC members.

- BlueLA powered by Blink Mobility: The all-electric car-sharing service, operated by Blink Charging, began in 2018 when the City of Los Angeles received a grant to pilot EV car-sharing in low-income communities. Project implementation and outreach efforts are supported by the LA Mayor's Office of Sustainability, Shared Use Mobility Center, and a committee of community-based organizations. Income-qualified members can receive discounts.

Incorporate ADA Compliance into Siting Requirements

Establish Americans with Disabilities Act (ADA) requirements for charging station installation. The U.S. Access Board, provides a technical assistance document to assist in the design and construction of EV charging stations that are accessible to and usable by people with disabilities. The ADA and Architectural Barriers Act (ABA) Accessibility Standards include many requirements applicable to EV charging stations, to ensure accessible and operable EV charging stations and associated buildings. The community should also consider whether to require EV charging stations to be installed in parking spaces with appropriate clearance and near entrances.

Examples:

- The U.S. Department of Energy developed guidance in complying with ADA requirements for workplace charging installation.
- The City of Atlanta outlines accessibility requirements for EV charging on page 18 of its EV Readiness Workbook.
- Clean Fuels Ohio and Virginia Clean Cities released a report, EV Charging for Persons with Disabilities, with resources on proper ways to install charging stations with access for all users, including those with disabilities.
- The California Building Officials non-profit corporation supported a compilation of recommendations regarding accessibility to EVs and appropriate signage for charging infrastructure.

Larger Efforts and In-Depth Studies

Including equity in EV planning may involve additional planning, budget, and in-depth research. These larger efforts will promote long-term success and involvement throughout the community.

Conduct a Community Mobility Needs Assessment

Conduct a mobility needs assessment to evaluate the daily travel needs and transportation modes of target populations, to identify opportunities to incorporate EVs. This evaluation can be conducted through focus groups, interviews with community navigators, or community surveys. Be sure to understand the residents' mode(s) of transportation, typical trip lengths and timing, as well as any barriers to EV use, such as lack of driver's licenses. This assessment could be included in a larger community needs assessment, which would save time and money.

Examples:

- Community Tool Box provides a guide for developing a local needs assessment that could be applied to mobility needs.
- Boulder County, CO developed a comprehensive mobility needs assessment and action plan. One EV strategy identified in the assessment is Colorado CarShare.

Enact Low-Income Financing Mechanisms

Create a grant or special financing for EV purchases to help spur EV adoption in low-income neighborhoods. Since cost is often the most substantial barrier to EV adoption, especially in low-income communities, this is an important strategy and can often be stacked with existing utility or state funding for income-qualified individuals. Low-income neighborhoods are likely to be most greatly impacted by air pollution and stand to benefit significantly from cleaner vehicles. Additionally, public charging infrastructure should be implemented in parallel to support those low-income neighborhoods.

Examples:

- The California Air Resources Board has established a rebate for income-qualified residents who lease or buy EVs through the Clean Vehicle Rebate Project.
- The State of Oregon offers a clean vehicle rebate program with an additional incentive for income-qualified individuals.

ECONOMIC DEVELOPMENT

A community's transition to EVs has the potential to spur significant economic development. Strategies in this topic area focus on capitalizing on the benefits of the transition.

Basic Information

The potential macroeconomic benefits from the transition to EVs include:

- **Alleviation of Transportation Burden:** An average American household spends about 20% of its income on transportation, while low-income households spend up to 30% (Vaidyanathan, 2016). By reducing operations and maintenance costs through transition to EVs, funds are freed up for households to spend on food and medical expenses, improving the health and well-being of those in the household.
- **Reinvestment of Fuel Savings:** Studies have found that EV drivers save "hundreds to thousands of dollars per vehicle annually", compared to ICE vehicles, through fuel savings (Energy and Environmental Research Associates, LLC, 2017). This allows residents to reinvest in the local economy and improve their quality of life.
- **Vehicle and Battery Manufacturing Jobs:** EVs offer an increased opportunity for more vehicle manufacturing in the United States. A nationwide study found that the transition to EVs between 2015 and 2040 could increase economic output by $20 billion and generate a net 147,000 jobs (Energy and Environmental Research Associates, LLC, 2017). With more EV production coming to the U.S., battery cell production is also coming to the country.
- **Mitigating Oil Price Shock Effects:** If the transportation sector can largely transition to electricity, it is less likely that there will be significant swings in the impact of fuel prices, as electricity prices are much more stable than those of petroleum. The economic impacts of transitioning to EVs are likely to vary by community, but understanding the opportunities early, a community can plan to take advantage of them by pursuing key strategies.

First Steps and Quick Wins

Create an EV Industry Cluster Map

New businesses may capitalize on the significant opportunities presented by the emerging EV market. To help your community benefit from these emerging businesses, you can build an industry cluster map showing the relationship of businesses to increased EV use. A sample of this kind of mapping is shown in Figure 3 (ICF International, 2014). This map can be used by the community's economic development department to attract businesses or industry that support the EV transition as well as to promote general community economic development.

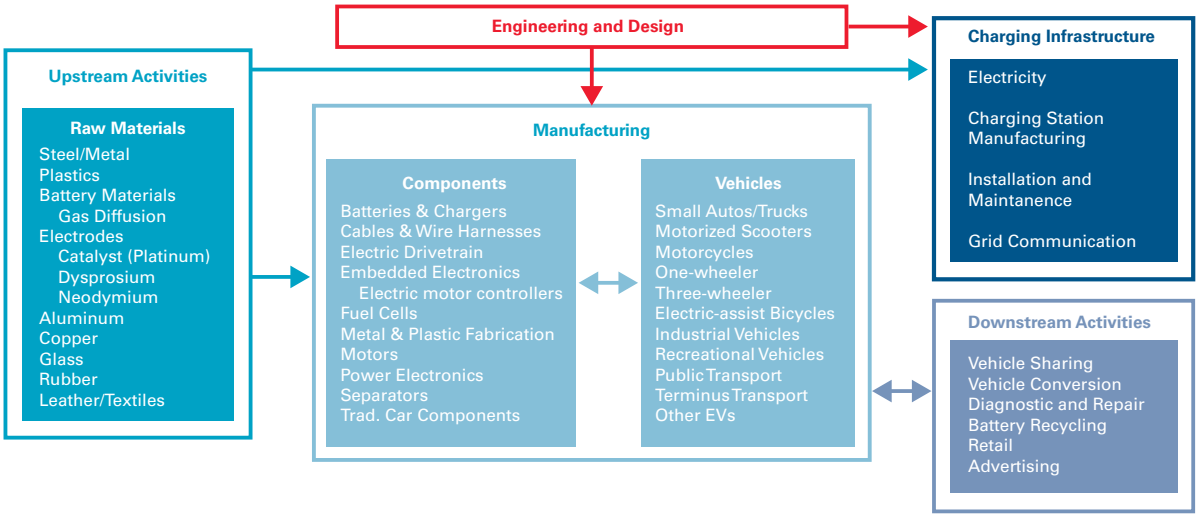


Figure 3: EV Industry Cluster Map **Source Adopted from NERC2013**

Larger Efforts and In-Depth Studies

Larger efforts in economic development will include in-depth studies and a unified understanding of EVs in the community's workforce. The following strategies could result in long-term success of EVs within the community's economic development and may require additional planning, budget, and resources.

Conduct a Local Economic Development Impact Assessment

Evaluate the anticipated local economic impact of EVs. This assessment will allow the community to make a more informed decision around financial investments to promote EV transitions. Transitioning to EVs will mean that less household income will be spent on gasoline and could be spent instead at local businesses. Money spent on household expenses rather than fossil fuels has been found to create 16 times more jobs in the local economy (Salisbury, 2014). Significant local economic opportunities are also created through the design, manufacturing, and maintenance of EVs.

Equitable Workforce Development: As new EV-related jobs become available in your community, ensure that these high-quality job are accessible to underserved community members.The Greenlining Institute recommends targeted and local hiring policies, developing career pathway jobs, and removing barriers to employment (e.g.,employer discrimination).

Examples:

- The Southwest Energy Efficiency Project completed a study of the economic and air quality benefits of EVs in Nevada in 2014.

Develop Goals and Incentives for New and Existing EV Businesses

Based on an EV industry cluster map, set goals and create a plan to attract and retain new businesses to allow the community to benefit from the EV market growth. This can be a collaboration between the community's economic development department and local businesses. Once goals are identified, community staff members can work together to identify strategies. The strategies might link economic development zone activities to tax credits or incentives, focus on retention in addition to recruitment, or emphasize subsets of industry clusters to target for expansion and relocation.

Examples:

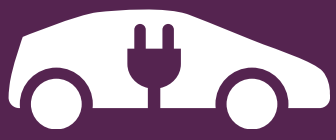
- Coachella Valley Association of Governments outlined strategies for economic development on pages 45–48 of their EV readiness plan.
- The State of California Office of Planning and Research published a guidebook, for communities to become EV-ready, that includes details about economic development strategies and goals.

Establish and Promote EV Workforce Pipeline and Training

Develop a plan to promote green-collar jobs that support EVs and the associated infrastructure. These jobs may include mechanics and electricians who specialize in EVs and charging infrastructure. This strategy can be used to help provide job training to underserved communities or workers displaced by the shift away from fossil fuels. The U.S. Department of Transportation developed a checklist that includes three components for a strong transportation workforce and labor program. A full list of all green-collar jobs associated with EVs can be found at the Bureau of Labor Statistics.

Examples:

- The Twin Cities EV Spot Network is a project focused on developing a network of charging hubs throughout the Twin Cities (Saint Paul and Minneapolis, MN). Additionally, this project will launch an EV car-sharing service to improve EV access to community members in the Twin Cities. The project is a collaboration between the City of Saint Paul, MN the City of Minneapolis, MN, HOURCAR, and Xcel Energy.
- The Ella Baker Center for Human Rights developed a report that recommends steps for developing green-collar job training.
- Xcel Energy Partners in Energy provides a workforce development toolkit outlining simple steps to help your community provide underserved and disadvantaged groups with job training and resources.



LIGHT-DUTY FLEETS

LIGHT-DUTY FLEETS

Municipal, utility, and commercial light-duty fleets are poised to be a crucial tool for spurring the adoption of electric vehicles (EVs) by making EV use more visible within a community. Currently available models of EVs include sedans, SUVs, light-duty trucks, and vans, all of which are often found in light-duty fleets. Fleet vehicles that take short trips and return to a designated parking location are ideal EV candidates, due to the predictability of use for battery range planning and charging infrastructure siting.

New EV goals and programs from federal, state, and local governments, as well as commitments from auto manufacturers to stop manufacturing ICE vehicles indicate that fleet managers need to begin planning for fleet electrification immediately. For many organizations, this means restructuring procurement, budgeting, long-term capital project planning, and operations. It will require more proactive involvement with local utilities and local building and planning authorities. By integrating EVs into commercial and municipal fleets, organizations can significantly reduce operational costs and greenhouse gas (GHG) emissions. EV topics and strategies around light-duty fleets include considerations for internal processes and support for EV fleet integration. While most strategies in this focus area discuss municipal fleets specifically, most of the information is applicable to commercial fleets as well.

Key Considerations for Fleet Managers Getting Started (Daniels & Nelder, 2021)

- Plan and install charging infrastructure before purchasing EVs.
- Engage with your electric utility to plan for charging infrastructure; be realistic about what types of chargers are necessary.
- Engage your electric utility to understand rate structures and minimize costs.
- Consider charging as a service, to effectively manage the charging of vehicles at scale.
- Prepare for grid power disruptions, including backup power.
- Address internal budget processes to incorporate the true cost of ownership.
- Collect data on your fleet, through telematics, to inform which vehicles make sense to electrify.
- Scale up purchasing of different models gradually; some vehicle types may not have a satisfactory EV replacement for several more years.
- Consider leasing vehicles to manage uncertainty.

PHASED APPROACH

Electrifying your community's fleet vehicles can be a great way to lead by example and demonstrate commitment to advancing transportation electrification overall. 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 fleet electrification process. Evaluate your fleet to better understand which vehicles might be eligible for replacement soon, and which vehicles would be good candidates for electrification. Research vehicle types and charging infrastructure to understand options for converting a few or many fleet vehicles. Explore funding options and financing mechanisms, to inform the procurement of new vehicles and any necessary charging infrastructure.

Phase 2 - Pilot Vehicles

Once you've done some research, consider selecting one or two vehicles to electrify. This can serve as a pilot project to inform future electrification efforts. Pilot vehicles can be "low hanging fruit" - vehicles that are very well suited for electrification and ready for replacement. Pilot vehicles can also be used to demonstrate the value of electrifying ahead of typical replacement schedules, or even to test the electrification of medium and heavy-duty vehicles, or vehicles with special uses, such as police vehicles.

Phase 3 - Full Fleet Electrification

Use the information you collected in Phase 1 and lessons learned in Phase 2 to plan for electrifying a larger portion of your fleet. Basic components of a full or partial electrification plan may include a goal, a vehicle replacement plan, and a charging infrastructure plan. Additionally, consider any necessary supporting strategies to ensure success. These strategies may include developing signage, employee education and training, and even community outreach and education.

Community Outreach and Education: Community outreach and education can be an important part of all phases of municipal fleet electrification. Sharing progress, successes, and lessons learned can help show your commitment to transportation electrification. Further, it can be both an inspiration and a learning opportunity for other community members, such as large employers, who might be interested in electrifying their own fleet.

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

- Community fleet managers
- Community sustainability professionals
- Motor pool managers
- Fleet managers from local businesses
- Fleet maintenance staff

Key Messaging

- Cost savings
- Lead by example
- Prepare for the future
- Central parking facilities, as well as predictable routes and use, facilitate EV conversion

Typical Barriers

- Budget limitations
- Up-front cost of charging infrastructure
- Maintenance staff and other employees lack familiarity with EVs
- Limited EV offerings among SUVs and light-duty trucks in current market

What Are the Most Effective Outreach Channels for These Strategies?

- Internal city working groups
- Business peer organizations
- Local advocacy groups
- Pilots and demonstrations

VEHICLES

The strategies in this topic area focus on identifying vehicles in a municipal fleet that are good candidates for EV conversion, as well as selecting appropriate EV models to meet fleet needs. Choosing vehicles for a light-duty fleet is one of the most important decisions in exploring transition to an electric fleet overall. There are many factors to consider when choosing the most suitable vehicles for the job, including: use patterns, operating environments, safety, and maintenance. Light-duty fleets often consist of a range of passenger sedans, SUVs, light-duty pickup trucks, and vans.

Basic Information

Some fleet vehicles are a better fit for electrification than others based on patterns of use and current EV model type availability. Light-duty vehicles (Class 1–2) are generally viewed as being ready for EV adoption now. Medium-duty vehicles (Class 3–6) are expected to become available over the next 5–10 years. According to a survey of fleet managers, most believe that manufacturers will need to accelerate their production plans for heavy-duty vehicles (Class 7–8) and some of the heavier medium-duty vehicles for fleets to be able to meet their electrification targets by 2040 (Daniels & Nelder, 2021).

As a general rule, vehicles that travel short distances and return to the same location each night are good candidates for EV replacements. These vehicles can be fully charged each night. Low-range EV models are typically more affordable, which often makes them the most feasible EV fleet option.

First Steps and Quick Wins

The following are lower-cost strategies that can be implemented relatively quickly, for fleet managers who are ready to start incorporating EVs into their fleets.

Purchase a Pilot Vehicle

To start exploring how to best incorporate EVs into your municipal fleet, first choose a nonessential vehicle that is available for use by multiple staff members and replace it with an EV. Providing one vehicle that community staff members can check out is a good place to start. Be sure to introduce staff to the vehicle and provide basic EV training that includes:

1. **Appropriate Trip Type:** Based on the battery range of the pilot EV, provide guidance on the length of trips that are most appropriate.
2. **Available Charging Infrastructure:** Show staff members how to find public charging infrastructure, should it be necessary, and provide guidance on how to pay for charging (based on your community's expense and reimbursement policy).
3. **Basic Vehicle Operation:** Show staff how to use the vehicle including how to plug in the charger appropriately.

By way of introduction, you can host an internal ride-and-drive event where staff can test drive the vehicle and ask questions about how to use it. Provide an avenue for staff members to give feedback about their experience and offer suggestions for other vehicles that might be a good fit for EV conversion.

Maintain an EV Feasibility Inventory

EV feasibility inventories or studies can help inform electrification without the need for advanced, sometimes expensive telematics data. To start, develop and maintain an inventory of all vehicles currently in the light-duty fleet. Keep track of as much basic vehicle and usage data as is feasible, including metrics for daily travel like typical occupancy and trip duration. These categories can provide valuable insight about the how a vehicle is typically used, which is a major factor in the feasibility of electrifying fleet vehicles. Keep in mind that some vehicles may have unusual uses that can make electrification challenging. For example, a survey of fleet managers found that some trash trucks may be expected to act as snowplows during severe winter storms (Daniels & Nelder, 2021). Fleet managers may find a suitable EV for the primary use that doesn't meet the needs of the secondary use (e.g., snowplowing) because of the charging time required. This example demonstrates that the EV transition may require creative changes in operations to achieve full fleet electrification.

Once data has been collected, identify fleet vehicles that could be replaced by an EV and still fulfill the fleet's overall needs. Rank or prioritize the replacement of each vehicle. Other considerations include vehicle replacement plans, vehicle procurement processes, and budget cycles and availability.

Examples of internal feasibility studies include:

- The City of Minneapolis in Minnesota organized a fleet study in 2017.
- The Cities Charging Ahead! initiative included 28 cities across Minnesota under the leadership of Great Plains Institute and Clean Energy Resources Teams (CERTs) to receive technical assistance such as feasibility studies regarding EV fleet adoption.

Identify EV Models

Identify a specific, currently available EV model that could best replace current vehicles, based on typical use patterns. Several aftermarket offerings in the SUV and light-duty truck categories are regularly being added to original equipment manufacturer lineups, which means that your specifications will need to be updated semiannually. Characteristics that should be considered when choosing replacement models include:

- **Vehicle Type:** Does the community want to convert to fully electric battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), or some of each? Greater maintenance savings and emissions-reduction savings are found in BEVs; therefore, many communities are targeting transitioning to these vehicles to support carbon-reduction goals. PHEVs can be a good choice for communities that have not fully built out the required charging infrastructure or that use fleet vehicles for trips that exceed the range currently offered by BEV models.
- **Vehicle Range:** Be sure that the EV's battery range is consistent with the trip types required for the vehicle. If occasional longer trips are required, consider whether there are public charging options available along the route.
- **Payload:** Determine the hauling capacity needed for tools or other supplies and whether the vehicle will be used to transport multiple people to decide whether a passenger sedan, SUV, or truck is most appropriate. Be cautious about simply replacing like for like, as vehicle use may have changed since the vehicle was purchased and a different vehicle type may now be more appropriate.
- **Warranty:** Many communities are concerned about the potentially significant maintenance costs required if vehicle batteries start to lose capacity and need to be replaced. When selecting fleet vehicles, research the various manufacturer warranties.

EVAdoption maintains a list of PHEVs and BEVs currently available in the United States as well as EV models for other vehicles that are anticipated in the near future.

Larger Efforts and In-Depth Studies

The following are longer-term strategies for fleet managers who want to do a complete or near complete transition of their fleet to EVs.

Develop a Vehicle Replacement Plan

Incorporate EV transitions into fleet vehicle replacement plans. Every ICE vehicle procured today represents a 5- to 10-year delay in achieving full fleet electrification. A survey of fleet managers found that where EV substitutes are available today, some fleets plan to wait until their existing ICE vehicles reach their planned retirement point before replacing them, while others plan to retire existing ICE vehicles early in order to capture operational savings from BEV replacements. Most fleet managers surveyed aim to replace a vehicle after six years or around 60,000 miles, to avoid expensive repairs and procure a reasonable amount of residual value through auction. Note that maximizing the residual value from EVs may not be as lucrative since there is a greater risk of technology obsolescence. Other fleet managers surveyed replaced vehicles after eight to ten years. Vehicles like police cruisers that are used nearly 24 hours a day are replaced more often (Daniels & Nelder, 2021).

By determining which vehicles are due to be replaced over the next 5–10 years, the community can identify opportunities to incorporate EVs, the required infrastructure to support EVs, and the budget needed for vehicle replacement and installation of charging stations. EVs currently have a higher up-front cost, which is typically offset by fuel and maintenance savings over the lifetime of the vehicle. Some opportunities may allow communities to use the money saved from reduced fuel costs to help cover the up-front costs of the vehicle.

Conduct an In-Depth Fleet Study

Conduct a fleet study to help to identify opportunities for trips that can be taken with EVs and ways to maximize the fleet's EV miles traveled. The study can also identify ways to optimize charging to reduce fleet operation costs. Fleet studies can be conducted internally or through a third-party consultant. Internal audits can be completed on a regular basis to ensure accurate data of fleet vehicle use and performance. External fleet studies can offer long-term analysis and planning support. Information that should be gathered and analyzed in a fleet study includes (Fleet Financials, 2007):

- Fleet and corporate policies regarding vehicle specifications, performance reviews, etc.
- Policy compliance including expense reports, driver assessments, and other fleet-related policy activities
- Records and documentation of all fleet vehicle registrations, titles, maintenance, repairs, and operations — this also includes any accident reports or other large expense reports for each vehicle.
- Records of all fleet vehicle trips, drivers, mileage, etc. — this data can also be collected using additional hardware such as GPS and other tracking equipment.

Xcel Energy's Fleet Electrification Advisory Program (FEAP) assists qualifying customers with an in-depth fleet study. The program begins with an analysis to help determine the best course of action for fleet electrification. In partnership with Sawatch Labs, participating in FEAP allows fleet operators to assess individual vehicles to determine if the vehicle's driving needs could be met with an electric vehicle (EV). Additionally, FEAP assesses charging site suitability and estimates the cost of infrastructure installation. Finally, FEAP helps advise on rate plans, pilots and programs to lower costs. At this time, FEAP is a pilot program, but may expand in future years. For more information visit: https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates/electric_vehicles/fleet_electric_vehicles.

You can contract third-party companies to review fleet use and make recommendations about EV transition. These studies include installing telematic devices on select fleet vehicles that track data in real-time, including idle time, acceleration patterns, and daily miles. After multiple months of data collection, summaries of the data and an accompanying analysis report regarding feasibility for EV transitions are compiled for the fleet manager. This work provides insight about the potential performance and cost-benefits of EVs in your fleet. While all communities are different, some major takeaways from fleet studies in Minnesota found that (Cella, 2019):

- The correlation between average daily miles driven and dollars saved by switching to EVs is the most significant of all metrics. However, this is limited by the battery range of EVs. As battery technology continues to improve, the cost savings potential with EVs on longer distances will also improve.
- Vehicles that take many short trips are ideal candidates for EV conversion and result in quick savings.
- Vehicles that spend a lot of time idling are also ideal candidates for EVs, as they reduce the amount of fuel being wasted and the amount of tailpipe emissions being released during idling.

Examples:

- The City of Westminster in Colorado completed an EV Action Plan in 2020. Preliminary strategies include conducting an in-depth fleet study, which will help the City update their vehicle replacement plan to include additional EVs.
- In partnership with Sawatch Labs, North Carolina conducted a 2019 Electric Vehicle Suitability Assessment to identify recommendations for electrifying vehicles in North Carolina's fleet vehicles, which are distributed in dozens of communities across the state.
- In 2019, NREL conducted a multi-jurisdictional fleet study that included Louisiana, Connecticut, Rhode Island, Colorado, and Florida Power and Light. This study pulled data from smartphone and traditional telematics to identify barriers and opportunities for electrification in each jurisdiction. The study found that smartphone telematics are a convenient, low-cost method of data collection, but are not as robust as traditional telematics.
- The City of Minneapolis in Minnesota organized a fleet study in 2017.

CHARGING EQUIPMENT

These strategies are designed to help understand and plan for the infrastructure requirements associated with light-duty fleet electrification.

Basic Information

In order to keep an EV fleet in motion, charging equipment must be available. How often a vehicle needs to be charged depends on its range, use, and other factors. Most vehicles will need to be charged on a semi-daily basis. For more information on vehicle and charging types, see Appendix A: Electric Vehicles 101.

Working with Your Utility

Electric utilities play an important role in many of the decisions regarding use and installation of charging stations for a light-duty fleet. Coordinating with Xcel Energy can help you streamline your transition to an electric fleet. Specifically, Xcel Energy can help you navigate electric rates, metering, and fleet studies. For more information see the working with your utility section. Also, sign up for Xcel Energy's newsletter to receive information regarding available programs and services.

- **Electric Rates:** One of the most important things to consider when installing EV charging equipment is the electric rates that will apply to the energy used by the chargers and the fleet. Electric rates may include time-of-day rates, electric demand rates, and electric use rates. See Appendix A: Electric Vehicles 101 for more information on each component. Consider potential energy demand charges and energy use rates, as 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 your options to pursue the most cost-effective scenario. Share with your account representative your expected use patterns including number of charging stations, timing and frequency of expected charging, and any charging controls such as programmable schedules or external intervention controls. Vehicle use pattern studies can be used to help inform these conversations.
- **Metering:** Another consideration associated with supplying electricity to EV charging stations is the metering structure. Many fleet managers opt to meter EV charging separate from the electric use of the facility that supplies the fleet. This can yield a better understanding of the energy use and operating costs of the fleet and allow customers to take advantage of electric rates specific to EV charging applications. Work with Xcel Energy to understand the additional costs of installing a separate meter or ensuring that the charging stations have the ability to directly track energy use.
- **Fleet Studies:** Fleet studies can provide valuable insight into opportunities to save energy and money with EVs. Your utility is a good place to start when considering a fleet study as they may have funding or other support available. Contact Xcel Energy first to identify your available options.

Charging Station Placement

The location of EV chargers can have a significant impact on installation cost. When installing Level 2 and Level 3 charging stations, consider:

- **Supply breaker panel and grid capacity:** If the existing breaker panel does not have capacity to accommodate the new demand of the charging equipment, a new panel will need to be installed. This will significantly increase the overall installation cost of a charging station. If a significant amount of charging capacity is being installed, the utility infrastructure on the grid side of the electric meter may not be adequate. Adding grid capacity is potentially costly as well.
- **Distance from supply panel:** Electrical conduits must run from the supply panel to the charging station. For curbside installs, these conduits are typically buried underground. In parking garages, concrete boring may be required to route conduit to the charger location. Both trenching and boring costs as well as conduit material costs can become more expensive as the required distance increases. To minimize costs, locate EV charging stations as close as is safely possible to electrical supply panels.
- **Maintenance facilities:** Fleet maintenance facilities are sometimes overlooked when installing charging equipment for a light-duty fleet. EVs often need to be plugged in during maintenance operations. Engage maintenance staff to determine available supply capacities within maintenance facilities.
- **ADA accommodations:** Consider accessibility when installing EV charging stations, including equipment placement height and setback from existing curbs or parking spaces. The City of Atlanta in Georgia adapted ADA 2010 guidelines for EV purposes. The City's report includes drawings and dimensions that allow for easy access to charging stations.

Security

Security of and access to charging stations is another important decision you must make. Many fleets choose to install charging equipment in a private location to guarantee availability for fleet vehicles. This approach is a good way to prioritize fleet use, but it prevents the public from using charging stations when fleet vehicles are not using the equipment. Consider feasibility and usability goals of the charging stations to determine the location and security level of the stations.

Signage

You must also consider signage for charging stations. For publicly available charging facilities, the Federal Highway Administration (FHWA) has set minimum signage standards. These requirements are laid out by the U.S. Department of Energy and can be found in the Alternative Fuels Data Center. Some more examples of signs can be found in the Plug-In Ready Michigan from Michigan's Clean Energy Coalition.

First Steps and Quick Wins

These strategies can be implemented with minimal time or capital investment and are a good place to start for communities that want to better understand what EV charging infrastructure will be required to support an all-electric fleet.

Develop an Inventory of Potential Charging Sites

Use data about current fleet vehicle use (from a fleet study or another data source) to identify potential siting for EV charging stations. Use information about where fleet vehicles are kept when not in use and information about frequently visited locations to develop a preliminary inventory of potential charging sites. These sites can be checked against the location of electric equipment to narrow your list of potential sites. Contact your utility about possible programs to support charging station installation.

Develop a Time-of-Use Charging Plan

Where possible, enable charging controls to manage the time(s) of day at which vehicles charge. Optimize EV operations to take advantage of time-of-use electric rates by charging during off-peak hours, which can keep energy costs low. Many utilities, including Xcel Energy, base their electric rates on many factors, including energy use, peak demand, and time of use. Understanding these factors and the charges associated with each is essential to optimizing the way your EV fleet operates.

Many municipalities choose to use charging station controls, which allow charging to be managed from a central location. Furthermore, charging station controls do not interfere with the vehicle's ability to charge midday as needed. Software tools to help fleet operators manage charging costs are available from organizations such as ChargePoint and AMPLY. Also consider opportunities for staggering EV charging so all vehicles are not charging at the same time.

Your Xcel Energy account manager can help you understand available rates and determine the most cost-effective option for your charging your fleet.

Larger Efforts and In-Depth Studies

The following charging equipment strategies may require additional planning, budget, and in-depth studies to help facilitate successful selection and installation of charging stations for light-duty fleet use.

Develop a Detailed Implementation Plan

Create an implementation plan that details specific steps that will be taken to install EV charging stations and infrastructure for your light-duty EV fleet. This can be included as part of a larger implementation plan for community-wide fleet electrification or can be produced separately. The plan should cover siting considerations and decisions, equipment choices, grid infrastructure needs, metering, contractor selection, and a timeline and schedule. You could evaluate new construction projects such as public parking, garages, maintenance facilities, and transit centers and ensure they are designed for current and future EV demand. Note that existing parking structures may require additional cost and effort to retrofit due to post-construction boring and conduit costs.

As you determine where and how much charging infrastructure to build, take a long-term view in order to reduce the total cost of the infrastructure. A survey of fleet managers found that only the largest organizations are taking a long-term, comprehensive approach to charging infrastructure. Most organizations are only adding a few EVs, and a few chargers to support them, incrementally each year. This is the most expensive way to develop a fleet's charging infrastructure and can lengthen the amount of time it takes to recover costs. Before you begin infrastructure planning, identify how many EVs you expect in your fleet, along with estimated charging requirements for those vehicles. Once you have developed this forecast, research from RMI recommends the following future- proofing techniques (Daniels & Nelder, 2021):

- Control electricity costs by managing the overall charging load.
- Consider your long-term vehicle replacement plan, to optimize the charger-to-vehicle ratio.
- Centralize high-powered chargers at a single location.
- Where possible, install the capacity for charging infrastructure (e.g., conduit, panel space) during initial construction to enable future expansion.
- Build charging infrastructure under a single master contract to ensure equipment and platform interoperability.

Coordination with your electric utility while developing this plan is vital to understand the full costs of installing charging infrastructure, which will alsohelp inform site choice and prioritization. Some key points of coordination include

1. **Required Service Upgrades:** Your utility account manager can help you understand, based on anticipated number and size of charging stations to be installed, if service upgrades will be required to cover the additional electric load and what the associated costs may be. If service upgrades are required, it may be a good opportunity to install EV charging on a separate meter to take advantage of special EV charging rates that may be available.

2. **Utility Rate Analysis:** Coordinate with your electric utility to understand the rate implications of the proposed infrastructure. The anticipated size and timing of electric load will help determine if it is most cost effective to add the charging equipment to the building meter of it should be sub-metered.

3. **Available Resources:** Many utilities are starting to provide incentives for the installation of fleet infrastructure. In some cases, the utility will install, own, and operate the infrastructure up to and possibly including the charging station significantly reducing the costs of installation. For specific Xcel Energy programs see Working with Xcel Energy or visit the Xcel Energy website.

Charging as a service: Charging-as-a-service (CaaS) providers can help you manage the complexity of planning for and operating charging infrastructure, and shifts the risk from the fleet manager onto the CaaS provider. CaaS services can include all or a mix of the following services:

- Procuring and installing chargers
- Planning for future expansion
- Coordinating with the electric utility
- Managing charging, to minimize utility bills and ensure vehicles are charged when needed
- Maintenance and billing

Examples:

- The U.S. Department of Energy funded the Aggregated Alternative Technology Alliance to publish an EV fleet procurement guide in 2014 regarding municipal fleet electrification.
- The Bay Area Climate Collaborative compiled an EV fleet deployment strategy guide in 2015 to help municipalities in the San Francisco Bay Area transition to EV fleets.

Install Charging for Municipal Fleets

Work with local contractors to install the required charging infrastructure for your fleet. For many communities, installing EV charging stations is often the first big step toward an electric fleet. Use the location inventory you developed to select specific sites to install charging station. Once specific locations have been selected, obtain quotes from electrical contractors.

Work with your Xcel Energy account representative to upgrade electric services or install new meters as applicable. **Engaging Xcel Energy early in the planning process is important for timely progress.**

EMPLOYEE ENGAGEMENT

EVs can be an exciting new addition to municipal fleets for many employees. However, a lack of understanding can lead to misuse or avoidance of new electric fleet vehicles. Employee engagement is an important consideration that is often overlooked by fleet managers. For electric fleets to be used effectively, employees must understand the new technology and become familiar with using it. Employees must feel comfortable using an EV instead of an internal combustion engine (ICE) vehicle. Employees should also know how to maximize the benefits of EV use.

First Steps and Quick Wins

Strategies in this section can be easily and inexpensively implemented to encourage employees to understand and use the EV fleet.

Include EV Use Training in Employee Onboarding Process

Add training on how to use the EV fleet in the employee onboarding process as an easy way to boost exposure to and engagement with EVs. This training should include general information on EVs and the charging infrastructure used by the community, as well as relevant procedures on how to check out, use, and charge the employer's EVs.

Example:

- The U.S. General Services Administration developed example training series material in 2016.

Host a Ride-and-Drive Event with Fleet EVs

Ensuring that employees are comfortable using EVs is crucial to the effectiveness of the new technology. A great way to facilitate this is by exposing employees to the vehicles in a relaxed, no-pressure environment. Ride-and-drive events with fleet vehicles is a great way to accomplish this goal. These events can be a fun way to build excitement around EVs and bring them into the culture of the organization. Like community ride-and-drive events, employees can test drive EVs in the fleet and ask any questions they have about using them.

Examples:

- The New York Department of Environmental Conservation hosts Green Your Commute Days to help employees become familiar with EVs.

Involve Enforcement Personnel in Development of EV Policy

Ensure that your EV charging station policies are effectively enforced. This will help prevent unauthorized use or blockage of charging equipment. By involving local law enforcement or private security staff in the development of EV charging station regulations, enforcement personnel will be prepared to monitor the charging stations.

Establish Avenues for EV Feedback

Successful transition to an EV fleet requires employee buy-in. Strong two-way communication channels between the fleet manager and staff can help employees feeling involved in the process. Open and honest communication will help ensure that the transition to an all-electric fleet is as smooth as possible. The communication channel may vary based on the type of communication required. Some examples are provided below.

- **Constructive Criticism:** Feedback in this category might include correcting employee behavior around inappropriate use of charging or aggressive driving in company vehicles. These types of behavior are generally best handled on a one-on-one basis. Ideally, there would be a face-to-face conversation, but if that is not feasible, a personal phone call is likely most appropriate.
- **Personal or Group Praise:** This type of feedback can involve a group reaching their goal for EV use or other related milestones. This feedback is most effective when shared publicly. A community could set up an EV message board to share goals and successes with staff members.
- **General Information:** Updates about EV policy, charging station use procedures, or information on how to check out an EV from the vehicle pool should be shared periodically. A community could include a webpage on their internally facing website where staff members can access up-to-date information, or they could create a monthly informational email with any pertinent updates.
- **Anonymous Feedback:** Be sure to set up a mechanism for staff members to provide feedback on what is working and what could be improved. This could be a suggestion box in the break room or an anonymous survey.

Larger Efforts and In-Depth Studies

The following strategies seek to involve employees in the transition to an electric light-duty fleet. These strategies can result in long-term success and may require additional time and funding.

Develop EV Training for Maintenance Staff

Support employee professional development by providing training to fleet mechanics on EV maintenance and repair. Maintenance staff may need additional certifications to be qualified to work on EVs. Coordinate with fleet maintenance staff to determine if EV maintenance will take place in-house or if outside training will be required. Local community or technical colleges may offer courses in EV maintenance and may be good options for staff professional development.

Example:

- The Clean Tech Institute offers a certified EV technician training program.

Involve Employees in Planning Process

Involve employees that are the most likely to use the EVs in the planning and procurement process. These employees could offer input about vehicle preferences as well as insight into which models will most effectively meet the needs of the fleet. Employees could participate in EV planning workshops or working groups to provide feedback on fleet use. Including employees on road tests will aid in the selection and procurement of vehicles, boost interest in the new vehicles, and help employees feel comfortable using the electrified fleet.

PROCUREMENT

Strategies in this topic area focus on helping fleet managers procure light-duty EVs.

Basic Information

Up-front costs for purchasing EVs and charging stations are currently considerably higher than ICE vehicles. However, due to the cheaper and more consistent price of electricity compared to petroleum, as well as the lack of certain routine maintenance (such as oil changes), the lifetime costs of EVs are typically significantly lower than ICE vehicles. Additionally, reduced GHGs can result in healthier communities, which means fewer resources being used to treat pollution-related illnesses. Communities can apply for grants and other funding sources to transition to an all-electric light-duty fleet. For more information about costs and benefits of EVs, see Appendix A: Electric Vehicle 101.

Common Barriers to EV Procurement: A report from Rocky Mountain Institute (RMI) identified common procurement policies that can act as barriers *(Daniels & Nelder, 2021)*:

- Buying from a bid list or through long-term purchase agreements that doesn't enable procuring from new manufacturers or dealers who are selling models that reflect rapidly evolving EV technology
- A combination of local dealer and two bid requirements means there needs to be two local options that may not offer new EV models
- Special process requirements for vehicles not pre-approved
- RFP and/or excessive quotes
- Centralized vehicle replacement fund that doesn't not factor in the total cost of ownership

EV charging stations can either be owned and operated by the community, or the manufacturer can retain ownership and operations of the charging station. Community-owned and operated charging stations may be the ideal option if intended for fleet vehicle use only. For charging stations that are available to employee personal vehicles, fleet vehicles, and the general public, many communities have learned that it takes more time and effort than they anticipated to own and operate these multi-use charging stations; therefore, many communities have shifted to a third-party management model.

The third-party management option means that the charging station manufacturer retains ownership of the station. The terms of the agreement are determined on a case-by-case basis but may include the manufacturer renting the spot from the community, splitting the profits generated by the station, or using the location in exchange for handling all planning, setup, and operations.

First Steps and Quick Wins

Strategies in this section are starting points to help communities pursue an all-electric light-duty fleet. These strategies can be quickly implemented with limited financial investment.

Refresh Procurement Guidelines

Add procurement guidelines for your community that require staff to justify the purchase of a non-EV option. You can also include a requirement that fuel consumption and GHG be considered as economic factors when making vehicle purchases. This will require procurement processes to capture all benefits of EVs and consider them as a part of the decision criteria.

Example:

- The Pan-Canadian Framework on Clean Growth and Climate Change developed procurement methodology as part of the 2018 Greening Government Fleets report.

Track Available Incentives

Monitor grants, rebates, and other financial incentives for EV or EV charging infrastructure to help inform purchasing decisions. These resources can also be beneficial for reducing some of the financial obstacles for transitioning light-duty fleets to EVs. Maintaining an updated list of actively running group-buy and other purchasing programs in areas near your community will help you keep up to date on new purchasing programs as they become available and help fleet operators take advantage of programs before they expire. For more information about resources that may be available in your area see the Appendix D: Funding Resources.

Larger Efforts and In-Depth Studies

The following strategies are larger efforts and in-depth studies for integrating EVs into community procurement planning. The benefits from these strategies can provide long-term foundational support for electrifying light-duty fleets.

Plan EV Purchases

Develop and execute a plan to purchase EVs to replace ICE fleet vehicles. This plan should include vehicles identified for replacement, timeline, targeted EV models to be purchased, and any available rebates, grants, or other incentives. The plan should also outline the procurement process, including all of the typical procurement process steps as well as any additional steps needed to take advantage of EV purchasing programs.

Examples:

- Drive EV Fleets is a resource provided by the Climate Mayors that is designed to help municipalities electrify their fleets and offers a purchasing collaborative.
- The Pan-Canadian Framework on Clean Growth and Climate Change included EV purchase planning as part of the 2018 Greening Government Fleets report.

- Inductive chargers: These chargers provide power without making a physical connection to the vehicle. Typically, inductive chargers are installed in the pavement, and power is supplied wirelessly to receiving pads on the bus.

Develop a Group Buy Program

Developing a group-buy program can help to ease procurement obstacles if no other funding programs are currently available. Establishing a new group-buy program can also benefit other members of the community interested in purchasing an EV.

Example:

- The Southwest Energy Efficiency Project, in partnership with the Colorado Energy Office, developed a group-buy program handbook to help spread information about the benefits of group-buy programs and how to effectively develop one.

Explore Innovative Funding Solutions

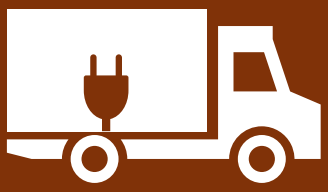
A wide variety of incentives, grants, purchasing programs, and innovative funding mechanisms are available for EV fleets and charging equipment. These options are constantly changing, and it can be a challenge to stay up to date. However, it is good practice to periodically explore available incentives and funding options.

Example:

- The U.S. Department of Energy maintains a database of federal and state tax credits and other incentives that can help municipalities and companies reduce the overall cost of deploying EV fleets.

Resources

- Xcel Energy offers online support regarding how to select the right EV, understanding the benefits, and installing charging stations.
- The U.S. Department of Energy published a handbook for fleet managers regarding the integration of EVs into the fleet.
- The Climate Mayors Electric Vehicle Purchasing Collaborative is working to accelerate the conversion of public fleets to EVs across U.S. cities.
- The Electrification Coalition developed a roadmap in 2010 explaining the benefits and methods for electrifying fleets.



MEDIUM- AND HEAVY-DUTY FLEETS

MEDIUM- AND HEAVY-DUTY FLEETS

This chapter outlines the benefits, barriers, and pathways to medium- and heavy-duty municipal and commercial fleet electrification. This chapter's primary audience is fleet managers of local and regional fleets. While all medium- and heavy-duty vehicle classes are addressed, it does not include special considerations (e.g., charging) for long-haul trucking. Additionally, because the electric transit and school bus markets are progressing rapidly, we've dedicated a separate section of this toolkit to those vehicle types (see Transit and School Buses).

As presented in the light-duty section, taking a phased approach to electrification is recommended. Fleet managers overseeing fleets with light- and heavy-duty assets may consider reviewing the strategies here in conjunction with those presented in the light-duty section. However, despite synergies with light-duty fleet electrification, medium- and heavy-duty fleet electrification presents a distinct set of barriers, opportunities, and considerations. For instance, while a robust market for light-duty vehicles already exists, several medium- and heavy-duty vehicles are still in development and testing stages. Similarly, many light-duty EV offerings have already achieved cost and performance parity with their combustion counterparts. Parity for medium- and heavy-duty vehicles is expected to take several years.

National Leaders

- Colorado joined 14 other states and the District of Columbia in signing a Memorandum of Understanding (MOU) to advance the market for medium- and heavy-duty electric vehicles. The goal of this MOU is to ensure that 100% of all new medium- and heavy-duty truck and bus sales are zero-emission by 2050, with an interim target of 30% by 2030. The MOU signatories are working together to develop an action plan to accelerate this transition. And in 2021 the Colorado Energy Office completed a Medium- and Heavy-Duty Vehicle Study determining this transition will result in a net societal benefit ranging from $20.2 to $26.6 billion for Colorado.
- The California Air Resources Board is developing a zero-emission fleet regulation with a goal of achieving zero emission fleets by 2045 where feasible, focusing first on drayage applications and last mile delivery.
- California Hybrid and Zero-Emission Truck and Bus Voucher Program (HVIP) vouchers offer point of sale discounts for clean trucks and buses, and connects buyers and sellers through a first-come-first served incentive model. This same model was adopted by New York with the New York Truck Voucher Incentive Program.

Who to Involve in Medium-and Heavy-Duty Vehicle Electrification Planning

- Fleet managers
- Fleet vehicle users
- Fleet mechanics
- Leadership and decision makers
- Facilities managers
- IT personnel

Key Takeaways

- Fleet managers are moving toward electrification as technology becomes available and tested.
- Electrifying medium- and heavy-duty vehicles will offer significant emissions benefits, which will be increasingly important as emissions requirements become more stringent.
- National, state, and regional programs are emerging and evolving to support medium- and heavy-duty fleet electrification; early adopters will benefit from incentives and subsidies.
- Some medium and heavy-duty vehicles have emerged on the market and several more models and technologies are expected to come online in the next five years.
- Cost-effectively electrifying medium- and heavy-duty fleets will require advanced planning and early coordination with Xcel Energy to ensure sufficient electric capacity.

Typical Barriers

- Medium- and heavy-duty assets have a low turnover rate.
- Fleet managers are often risk-averse, preferring to wait for technology to become more established.
- Many medium- and heavy-duty vehicle types are just now becoming available.
- Some vehicle types have achieved or exceed parity in some categories, such as operating costs, environmental impact, and safety; other vehicle types are not expected to reach parity in categories such as initial cost and fueling time for many years.
- Fleet mechanics may require training and/or may lack adequate facility space to perform maintenance in house.
- Facilities may lack adequate space and/or electric capacity to support the charging infrastructure required to charge vehicles.
- Cost-effectively charging medium- and heavy-duty fleets will require careful planning and coordination with Xcel Energy. Fleet managers may even consider "charging as a service."

VEHICLES

Vehicle availability is currently one of the greatest barriers to electrification of medium- and heavy-duty vehicles. Still, even today there are many viable options for fleet managers to consider, with many more expected to come on the market over the next several years. Some of the key players in medium- and heavy-duty vehicle electrification include Daimler, Peterbilt, Tesla, Volvo, BYD, Ford, Rivan, Lion Electric, Chanje, GreenPower Motor Company, Mercedes-Benz, US Hybrid, and Workhorse. The Colorado Energy Office compiled a list of current medium- and heavy-duty models announced to date as an appendix of a 2021 study. Some of these players are manufacturing complete vehicles ready for purchase, while other manufacturers are developing structural components and platforms to support vehicle upfitting.

- Fleet managers are often risk-averse, preferring to wait for technology to become more established.
- Many medium- and heavy-duty vehicle types are just now becoming available.
- Some vehicle types have achieved or exceed parity in some categories, such as operating costs, environmental impact, and safety; other vehicle types are not expected to reach parity in categories such as initial cost and fueling time for many years.
- Fleet mechanics may require training and/or may lack adequate facility space to perform maintenance in house.
- Facilities may lack adequate space and/or electric capacity to support the charging infrastructure required to charge vehicles.
- Cost-effectively charging medium- and heavy-duty fleets will require careful planning and coordination with Xcel Energy. Fleet managers may even consider "charging as a service."

Replacement Rates

While passenger cars are typically replaced every 10 years or every 100,000 miles, truck replacement rates are more variable and, in many cases, the average vehicle's lifespan is more than 30 years. This highlights the importance of strategic electrification in this sector, as each replacement decision can have several decades of impact. Trucks that drive more miles per year are expected to have shorter battery lives, thus necessitating faster turnover rates. However, trucks and other heavy-duty equipment that operates fewer miles per year may have longer turnover rates, so are better candidates for preliminary electrification.

Medium- and Heavy-Duty Vehicle Definitions

Medium- and heavy-duty vehicles are commonly classified by gross vehicle weight rating (GVWR). GVWR combines the weight of a truck plus its payload capacity, weight of the fuel and weight of the driver. The table below summarizes the weight ratings commonly associated with classes 3-8, according to Federal Highway Administration (FHWA) standards. Class 2b, heavy pickup trucks, are included under EPA emissions standards.

Class	GVWR (lbs)	Vehicle Types	Vehicle Examples
2b	10,000	Heavy-duty pickup trucks	Tesla Cybertruck; Rivian Amazon Delivery Van
3	14,000	Small delivery trucks	Mercedes-Benz eSprinter
4	16,000	Box trucks, walk-in trucks, city delivery trucks	Ford E-450 Box Truck
5	19,500	Delivery trucks, bucket trucks, cherry pickers	Chanje v8100
6	26,000	Beverage trucks, rack trucks, school buses	Lion Electric LION6; BYD 6F
7	33,000	Street sweepers, garbage trucks, transit buses, furniture trucks, small semis	Freightliner eM2 Truck
8+	>33,000	Cement trucks, dump trucks, fire trucks, fuel trucks, semi-trucks	Tesla Semi; Daimler e-Cascadia; Peterbilt 520 EV

Key Considerations and Market Trends

The market for electric medium- and heavy-duty trucks is emerging, with several models available across vehicle classes 2b-8 and several more anticipated to come on the market in the next 1-5 years. The table below summarizes the market status for three truck types.

Vehicle Category	Classes	Key Considerations	Market Trends
Heavy-Duty Pickup Trucks	2b	Usually driven for a limited number of miles, which is ideal for electrification. Many of these vehicles are sold as bare chassis and outfitted by a third party to serve as utility vehicles, tow trucks and more. Electrification potential depends on application. This category dominates truck sales volume. On-board energy storage could be used to support auxiliary functions, such as powering tools and lifts, potentially replacing job site generators. Because many Class 2b trucks are owned by individuals or small commercial fleets, electrifying this subsector may require more tailored strategies.	Many electric trucks in this class have been announced and are typically variations of their existing light-duty counterparts
Vocational Vehicles	3-8	Drive cycles with frequent stops are a good opportunity for regenerative braking and to limit pollution from idling, during deliveries, through electrification. Electrifying delivery trucks (Class 3) can improve local air quality and health in more densely populated areas.	Class 3 vehicles are one of the most developed medium- and heavy-duty vehicle markets and are one of the most rapidly growing markets. According to a 2021 Colorado study, Class 3 sales have grown by a factor of 15.6 since 1990 compared to only 2.9 for all medium- and heavy-duty trucks.
Tractors	5-8	Trip length varies widely from less than 100 miles to more than 500 miles. Class 8 dominates energy consumption.	Several models are already available, primarily sold for drayage applications. Trucks capable of traveling 100-500 miles are anticipated to come on the market within the next 1-5 years.

Garbage Trucks

With over 50,000 garbage trucks collecting trash in the United States, these class 7/8 vehicles represent a significant opportunity to electrify our fleets. Garbage trucks travel at low speeds, tend to travel short distances, and stop frequently - making them good candidates for early electrification. It is estimated that diesel garbage trucks require approximately $5,000 in annual maintenance, primarily associated with frequent braking. Regenerative braking available through electric models is good for enhancing vehicle range and reducing brake wear and tear. Lion Electric claims its Lion8 e-truck could reduce maintenance costs for garbage trucks by 80. Lion Electric, Peterbilt, Mack, and BYD all have electric garbage trucks on the market.

CHARGING

While smaller trucks may be able to utilize Level 2 chargers, the large battery sizes and duty cycles of some trucks will necessitate investment in more powerful chargers. Additionally, meeting the charging demand of multiple electric vehicles will likely require installation of multiple chargers, which can result in very high demand. The table below summarizes approximate electricity demand by vehicle class.

Vehicle Class	Charger Type	Charging Demand
2b-3	Level 2 Charger	6 kW
4-5	Level 3 Charger	15-70 kW
6-7	Transit Chargers	60-200 kW
8+	Megachargers (planned)	1,600 kW+

Cost-effectively electrifying medium- and heavy-duty fleet vehicles will require early planning and coordination with Xcel Energy. Fleet managers will need to coordinate with Xcel Energy to understand the capacity of electrical infrastructure at desired charging sites and any potential upgrades necessary to meet charging demand, and explore rate options to keep charging costs low. Utility upgrades can range from $5,000 for secondary distribution upgrades to $9 million for substation upgrades. Fleet managers may also consider leveraging solar options and explore charging services to keep charging costs low.

PHASED STRATEGIES

With the market for vehicles and EV infrastructure evolving so rapidly, taking a phased approach can help fleet managers leverage incentives offered to early adopters, as well as give them time to learn and explore which technologies will be the best long-term fit.

Phase 1: Laying the Groundwork → **Phase 2: Piloting Vehicles** → **Phase 3: Full Fleet Electrification**

Phase 1: Groundwork

Preliminary research and evaluation are important first steps to help guide your community's fleet electrification process. Evaluate your fleet to better understand which vehicles might be eligible for replacement soon, and which vehicles would be good candidates for piloting electrification. Review your procurement process to remove any barriers to fleet electrification and prioritize future EV purchases. Explore options for siting charging stations in coordination with Xcel Energy. Leverage peer learning opportunities and available incentives to support your pilot electrification efforts and accelerate full fleet electrification.

Refresh Procurement Guidelines

Review your procurement guidelines to remove any barriers that may prevent EV purchases (e.g., exclusive bid lists, "like for like" requirements) and consider requiring staff to justify the purchase of a non-EV option. You can also include a requirement that fuel consumption and greenhouse gas (GHG) emissions be considered economic factors when making vehicle purchases, rather than only considering the upfront cost of the vehicle. This will enable procurement processes to capture all benefits of EVs and consider them a part of the decision criteria.

Examples:

- The City of Charlotte adopted a strategy to strongly discourage the purchase of new ICE vehicles, using a multi-tiered procurement approval process that offers the ability to appeal - to move to the next fuel tier with approvals from multiple departments and a special panel. The tiers begin with zero emissions vehicles and descend to alternative fuels, hybrid fuels, gasoline, and finally diesel.
- The City of Seattle's 2019 Green Fleet Action Plan set a target that 100% of all new/replacement vehicles will be chosen from green vehicle standard using the City's GHG+ Total Cost of Ownership (TCO) with cost of carbon calculator to determine best purchase. The plan includes a strategy to begin purchasing EVs for all heavy-duty trucks in 2019.

Define Pilot Vehicle Criteria

Identify a few vehicles you think would be ideal to pilot with an electric vehicle; define how (drive cycle) and how much (duty cycle) the vehicles are used. This information can be collected through telematics or other fleet tracking data and will help you decide which vehicle(s) you can electrify today based on TCO, costs savings, and model availability. This exercise will also help inform where and what type of charging would best serve your pilot vehicle(s).

Identify Potential Pilot Charging Sites

Using the drive and duty cycle data, identify potential locations for EV charging stations. Based on your need, you may select locations that are on-route, at the origin/destination, incorporated into a depot, shared with another entity, or some combination of those options.

You'll also want to consider electrical infrastructure capacity at these sites. Medium- and heavy-duty fleet vehicles may require a larger energy demand compared to light-duty options, so you will need to work closely with Xcel Energy to understand electrical infrastructure requirements and determine if upgrades would be necessary to support charging. With this information, you will be able to narrow down your list to locations that meet the needs of the vehicle and minimize costs from electrical infrastructure upgrades.

Example:

- The Portland, Oregon-based Meals on Wheels People--which provides meals for seniors in the Portland metropolitan area—electrified their transport refrigeration units (TRUs) and installed electrified parking spaces at their loading docks so vehicles can be recharged in the middle of the day when they are being restocked for afternoon deliveries.

Peer Learning

Reach out to peer communities or organizations that have electrified similar fleet vehicles, for information that can help inform decision-making. Be sure to ask about:

- Vehicle performance, especially in local extreme weather conditions
- What type of charging they are using (e.g., on-route, centralized depot)
- Actual fuel and maintenance costs
- Successes and lessons learned from early adopters can help streamline your transition.

Engage Xcel Energy

Be sure to engage Xcel Energy as early as possible to avoid pitfalls like higher-than-expected infrastructure or fuel costs, and to understand available support through Xcel Energy. As soon as you are considering electrifying your medium- and heavy-duty fleet vehicles, set up a preliminary meeting with your Xcel Energy representative to discuss potential scale of cost for infrastructure upgrades to serve the load and available electric rates and programs.

As you go through the planning process, Xcel Energy will be an important partner. Over time it will be important to discuss with them:

- The number of vehicles you anticipate charging and the timeframe for your vehicle purchases
- Amount of power (kWh) vehicles will require for charging
- Time(s) of day vehicles will likely charge
- Site(s) where vehicles will be charged
- Strategies and technology to manage charging to avoid peak demand

Track Available Incentives

Monitor grants, rebates, and other financial incentives for EVs or EV charging infrastructure, to help inform purchasing decisions and reduce financial obstacles. Maintaining an updated list of actively running group-buy and other purchasing programs in areas in or near your community will help you keep up to date on new purchasing programs as they become available and will help fleet operators take advantage of opportunities before they expire. For more information about resources that may be available in your area see the Funding section.

Phase 2: Piloting Electrification

Once you've evaluated the opportunities for electrification in your fleet, policies, and sites, select one or a few vehicles to electrify. This can serve as a pilot project to inform future electrification efforts. Use this phase to research vehicle type(s) and charging infrastructure for your pilot vehicle(s), purchase your equipment, and orient your employees. Pilot vehicles can be "low hanging fruit" - vehicles that are very well suited for electrification and ready for replacement. Pilot vehicles can also be used to demonstrate the value of electrifying ahead of typical replacement schedules, or even to test the electrification of medium- and heavy-duty vehicles as well as vehicles with special uses such as police vehicles.

Purchase Suitable Technology for Pilot

Using the groundwork completed in Phase 1, review available options for the pilot vehicle(s), charging infrastructure, and networking technology. Considerations when choosing pilot technologies include:

- **Vehicle Availability**: Medium- and heavy-duty EV options continue to grow. Explore the U.S. Department of Energy Alternative Fuel and Advanced Vehicle Search to find and compare EV options by vehicle type and other criteria.
- **Upfitting Needs**: You may need to customize your vehicle to your needs (e.g., adding ramps, storage, cab guard, ladder racks, cranes, shelving). When choosing your upfit provider make sure they are comfortable working with an EV; identify any additional costs that may arise.
- **Total Cost of Ownership**: While EVs typically require higher upfront costs, the lower operating and fuel costs and financial incentives can help achieve cost savings over time. Estimate and compare total cost of ownership for pilot EV options, as well as an ICE alternative.
- **Warranties**: Battery warranties are often separate from the vehicle. so be sure to ask what the warranties include and if there is an option to purchase an extended warranty if desired.
- **Maintenance Support**: Ask if the vehicle manufacturer has a dedicated local support team for maintenance, or if they offer training for your maintenance staff.
- **Vehicle Range and Charging Options**: Be sure the EV's battery range is consistent with the trip types required for the vehicle. If the vehicle needs to run all day, consider options for on-route, DC Fast (Level 3) Charging.
- **Networking Compatibility**: The purpose of a pilot project is to inform future decision-making. By setting up networked charging stations, you will be able to better understand the energy use and costs from your pilot and how optimize charging based on time-of-use rates. Make sure your selected charging station equipment and network solutions provider interface well to form a cohesive charging system.

Municipal Refuse Fleet Electrification Pilot

Xcel Energy developed the Municipal Refuse Fleet Electrification Pilot as part of the Transportation Electrification Plan (TEP) in Colorado to provide extended test drive demonstrations at no cost (except for electricity usage).

Example:

- Pacific Gas and Electric Company (PG&E) is piloting the first all-electric utility vehicle to conduct routing on emergency overhead line work. The vehicle was upfitted with an aerial device and other customizations to be able to meet the company's needs.

Install Chargers

Focus on installation of chargers as soon as the vehicles have been ordered. It can take time to procure chargers and make upgrades to facilities to support chargers. Contractors will want to know the specifications of your chargers so they can provide appropriate electrical service to the chargers.

Employee Training

Introduce staff to the vehicle(s) and provide basic EV training that includes:

- **Appropriate Trip Type**: Based on the battery range of the pilot EV, provide guidance on the length of trips that are most appropriate.
- **Charging Instructions**: Provide hands-on training on how to use the charging station and the charging schedule based on rate structure.
- **Basic Vehicle Operation**: Show staff how to use the vehicle, highlighting similarities and differences to ICE model.
- **Benefits**: Share why your organization prioritized this purchase, such as air quality benefits, carbon reduction goals, cost savings, or leading by example. Highlight any expected driving benefits, including reduced engine heat, vibrations, emissions, noise, and braking.

Provide an ongoing channel for staff members to give feedback about their experiences and offer suggestions for other vehicles that might be a good fit for EV conversion.

Example:

- Mack Trucks, an American truck manufacturing company, opened a training facility to provide education and training on the recently released all-electric garbage truck - to Mack employees, owner-operators, fleet customers, technicians, salespeople, and aftermarket personnel.

Evaluate Pilot Results

After six months to a year (this could vary based on how frequently the vehicle is used), gather the findings from your pilot project to inform future purchases. Key takeaways should include:

- **True Operational Costs**: Compare the estimated fuel, maintenance, and networking costs with what you experienced to fine-tune your TOC estimates for future purposes.
- **Charging Optimization Opportunities**: Determine if any adjustments need to be made to where you are charging; work with Xcel Energy to optimize your charging patterns and rates - to minimize costs.
- **Employee Feedback**: Host listening sessions with your drivers and maintenance staff to understand what did and didn't work - to inform future purchases.

Example:

- After the pilot phase of its first all-electric garbage truck in 2020 exceeded expectations, the New York City Department of Sanitation has plans to order an additional seven trucks and is trialing an all-electric street sweeper.

Phase 3: Full Electrification

Use the information you collected in Phase 1 and lessons learned in Phase 2 to plan for electrifying a larger portion of your fleet. Similar to electrifying your light-duty fleet, a full- or partial-electrification plan may include developing a comprehensive vehicle replacement plan and a charging infrastructure plan. Given the potential for extremely high electricity demands if multiple chargers are sited in one location, site planning, design, and construction are paramount for expanding your medium- and heavy-duty electrification efforts.

Develop a Full Vehicle Replacement Plan

Developing a full vehicle replacement plan will require your organization to build on work completed in Phases 1 and 2. Complete a full analysis of drive cycles, duty cycles, and special operational considerations, including typical daily range and dwell time. For larger fleets, telematics for vehicle tracking may be helpful, or even necessary, to adequately analyze your fleet for electrification potential. This analysis can help identify vehicles most suitable for electrification, inform necessary battery sizes and other vehicle features, and preliminarily inform charging siting considerations. Telematics can help identify opportunities to optimize your routes and schedules as well as understand which could be modified to better suit electric options.

Once your analysis is complete, conduct research to identify potential electric alternatives. Consider what qualities need to be on par with traditional vehicles. For instance, many electric vocational vehicles (e.g., delivery vans) have already achieved or exceeded operational cost, safety, and environmental parity, but have not achieved daily range or fueling-time parity. Based on vehicle suitability, replacement cycles, technology availability, and parity, identify vehicles suitable for electrification in the short-, medium-, and long-term. You can use the results of this analysis to set interim and long-term fleet electrification goals.

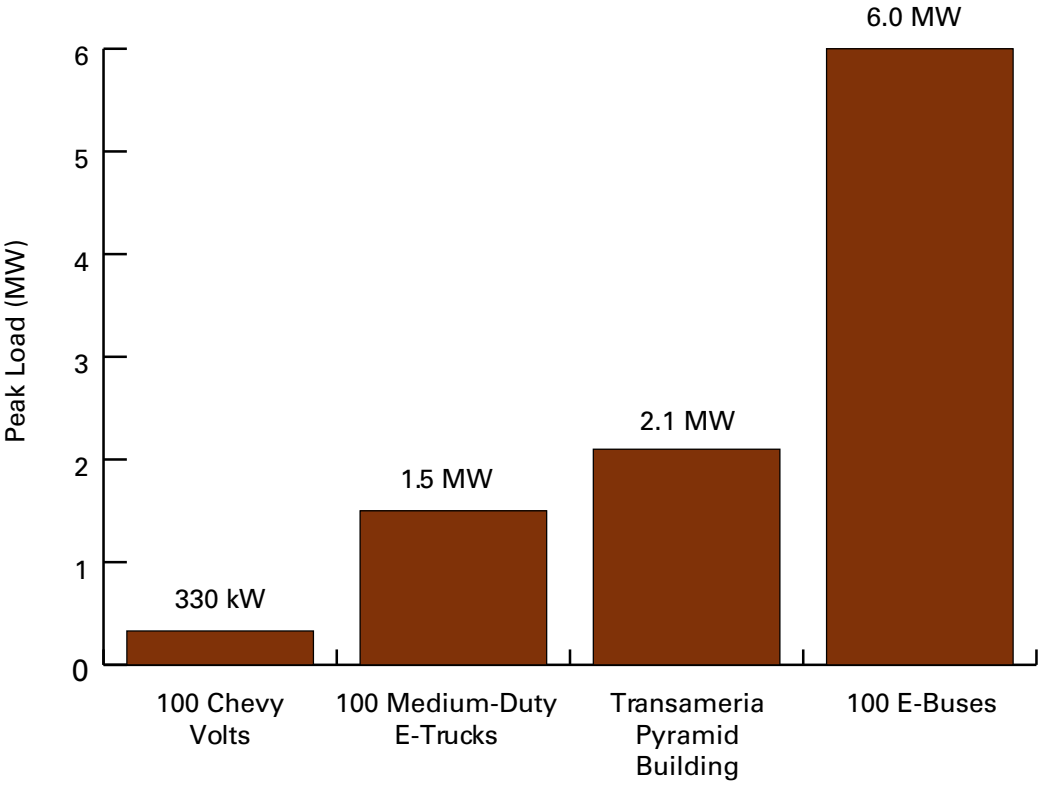
Example:

- The Sacramento Municipal Utility District (SMUD) has established criteria, key performance indicators, and software to evaluate fleet utilization and inform their fleet electrification plan. To address vehicle needs that weren't available from the original equipment manufacturer (OEM) market, SMUD began working with Zeus Electric Chassis which manufactures custom, all-electric Class 4, 5, and 6 work trucks.

Develop a Charging Infrastructure Plan

As you identify vehicles to replace with electric alternatives, use the results of your analysis to develop a charging infrastructure plan. Identify potential locations to site charging infrastructure, either at facilities, on-route, or at an off-site locations. Then, determine what type of charging levels you might need to support drive cycles and duty cycles. For example, you may decide to install DC Fast Charging at the loading facility for delivery vehicles to recharge midday while they are loaded.

Fleet charging loads will depend on vehicle types, duty cycles, vehicle miles traveled (VMT), locations and numbers of vehicles, and other considerations. Coordinate with Xcel Energy early in your planning process to discuss charging considerations, such as whether identified sites have sufficient electric capacity or need upgrades, what charging rate structures are available, and whether there are additional incentives available to bring down upfront costs of infrastructure. You may also consider installing onsite renewable energy to offset some of the new electricity demands. One report stated that a fleet of 56 buses would require approximately 11 MWh/day and a fleet of 542 could require 109 MWh/day (Black and Veatch, 2019). Another source shares sample peak loads for different electrification scenarios, showing that 100 medium-duty e-trucks could yield a peak demand of 1.5 MW.



Peak loads for various EV fleets without mitigating grid impacts, based on 2020 ACEE White Paper by Steven Nadel and Eric Junga

Electricity is more costly to generate and deliver at certain times of day, especially during the hottest and coldest months of the year. Fleet managers can often cut charging costs in half by managing the times their vehicles charge. The general practice of reducing costs by controlling charging is known as "managed charging."

Managed charging can be achieved by staff (who manually connect vehicles to chargers at times when energy is less costly) or by computer-controlled systems. The manual practice becomes labor-intensive and complex as the fleets grow. Manually-managed charging may lead to costly errors (e.g., a single vehicle plugged in 15 minutes earlier than scheduled could add thousands of extra dollars to the month's energy bill). Computer-controlled systems can precisely control the timing of vehicle charging. With these systems, vehicles are plugged in at the end of the day, but the computer system prevents power from flowing to the vehicle until the time when energy costs are the lowest. The computer system can also limit the amount of power being consumed at any one time, reducing the need for costly investments in utility service upgrades. Involve your IT department early in the charging infrastructure planning process to better understand your ability to automate charging equipment. You may also consider exploring "charging as a service" – a service dedicated to ensuring vehicles are charged at the proper locations, as scheduled, to avoid unwanted demand spikes and ensure full batteries when needed.

Finally, your charging plan should include financial considerations – how will your organization pay for the chargers and the additional electricity? Which chargers will be purchased and installed first? See the Funding section to begin identifying funding resources to support your vehicle replacement and charging infrastructure plans. What incentives are available to reduce the cost of charging infrastructure.

Example:

- After determining that Level 2 charging was sufficient for short-haul delivery and distribution, Frito-Lay installed 10 Level 2 charging stations—including load-monitoring equipment and charging monitoring software—at a distribution center in 2010. The project was a success; since then Frito-Lay has invested $6 million in EV infrastructure in more than 25 locations and has plans to continue expansion.

Implement Vehicle Replacement and Charging Infrastructure Plans

Significant lead time is needed for any necessary facility upgrades to support chargers, so you should start planning for site upgrades as soon as you have completed your vehicle replacement and charging infrastructure plans. Site plans can be further refined once you have completed your initial vehicle and charger procurements. An electrical engineer will need to be engaged to draw up plans for charging infrastructure at the site and provide quotes for the work. These plans should be submitted to Xcel Energy or the electric utility serving the site. If the initial conversation with Xcel Energy indicates that significant upgrades will be needed to provide energy to your fleet, Xcel Energy will not be able to design those upgrades until they receive the plans from the engineer. This means a minimum of several months' work must be done before Xcel Energy can begin its work. The Xcel Energy design process can take several months as well. If Xcel Energy initially indicates that only minimal site upgrades will be needed, it is likely that Xcel Energy will only need to review and approve the engineer's drawings. By including Xcel Energy early in you will not only be able to address potential concerns with energizing your charger but you can incorporate any Xcel Energy programs that may be available to support your vehicle purchase and charger installation.

Key decisions will need to be made before plans can be drawn up. Will the EV fleet expand in the future? If so, does it make more sense to oversize the electrical infrastructure now, so it does not need to be upgraded later? Where, exactly, will charging stations be located? Where will conduit run? Where will a new transformer be located? Use your vehicle replacement and charging infrastructure plans and work with an electrical engineering firm to answer these questions.

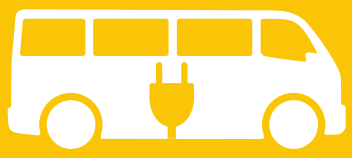
During the charging infrastructure installation process, reach out to vehicle providers to understand the lead time for purchased vehicles - to align with your charging infrastructure plans. This lead time varies widely depending on whether you are purchasing vehicles directly from an OEM or working with a custom-vehicle manufacturer.

Share Your Leadership

Just as you were learning from others in Phase 1, others can learn from your successes and lessons learned. Participate in peer networks and other sharing opportunities - to inspire other fleet managers in the region and continue learning about new innovations that could enhance your fleet electrification efforts.

Example:

- The North American Council for Freight Efficiency (NACFE) and RMI organized the Run on Less-Electric (RoL-E) electric truck technology demonstration event in 2021. The three-week demonstration showcased electric trucks in everyday operation from 13 company fleets across the U.S. and Canada.



TRANSIT AND SCHOOL BUSES

TRANSIT AND SCHOOL BUSES

Transit and school bus electrification is important for communities working to reduce GHG emissions, eliminate harmful air pollutants from diesel fleets, or showcase their commitment to sustainability. Electric buses are a great opportunity for a high-visibility pilot project, with driving routes and distances typically well suited for electrification. And because most school buses have long breaks between morning and afternoon transport, they are good candidates for distributed charging and vehicle-to-grid applications, providing even more cost and sustainability benefits.

Battery electric transit buses (BEBs) and electric school buses (ESBs) are relatively new to the market compared to light-duty electric vehicles (EVs) but were some of the earliest-available technologies in the medium- and heavy-duty categories. Although BEBs and ESBs require a significant capital investment for both the vehicles and charging infrastructure, there are numerous grant and other funding opportunities to support these efforts. Still, a cost-effective transition will require concerted planning, bringing together transit managers, school district fleet managers and other stakeholders to make informed decisions about investing in an electric fleet. This section offers lessons learned and resources from fleets that are already transitioning to BEBs and ESBs, and outlines strategies for a targeted electric bus planning effort.

Electric Bus Leaders

- Montgomery County Public Schools, the largest school district in Maryland, announced it will lease 326 electric school buses over the next four years. This is the largest local government bus purchase in the U.S. to date.
- The Antelope Valley Transit Authority's Board of Directors set a goal to become the first all-electric transit fleet in the U.S. by 2018. They have largely achieved this goal and have provided lessons learned to other transit agencies seeking to electrify.
- The Federal Transit Administration has been funding transit agencies to adopt electric buses through its Low or No Emission Vehicle program since 2016. The FTA's program site includes information on grantees and where projects have been funded throughout the U.S.
- The World Resources Institute has gathered information on where electric school buses are currently being deployed in the US.

Who to Involve in Transit and School Bus Planning?

- Transit agencies
  - Drivers
  - Maintenance staff
  - IT personnel
  - Facilities staff
  - Decision makers (e.g., general managers, transit boards)
- School districts and supervisory unions
  - Drivers
  - Maintenance staff
  - IT personnel
  - Facilities and/or fleet managers
  - Decision makers (e.g., superintendents, school boards)
  - School bus contractors
- Colleges and universities
- Nonprofits and other community organizations operating buses and/or providing community-based transportation services

Key Takeaways

- Battery electric bus and electric school bus models are readily available in the marketplace from multiple manufacturers
- Electric buses offer significant emissions benefits and reduce the impact of harmful air pollutants for passengers and communities served.
- Electric buses are quieter, benefiting passengers and communities served.
- If charging is managed properly, electric buses have increased efficiency and the potential for reduced and more consistent fuel costs than diesel buses.
- Electric buses have the potential to reduce maintenance costs, although evaluation of buses in long-term service is needed to confirm the scale of potential savings.
- Federal and state funding sources are available to help with procurement of vehicles and charging equipment, and installation of chargers.
- While there are questions about performance, including winter operations, recent pilots have shown vehicles can effectively operate in cold weather conditions.

Typical Barriers

- Electric buses are more expensive to purchase than diesel or other alternatively fueled buses.
- Buses have a relatively low turnover rate. The useful life of a full-size transit bus is 10 years; school buses can operate longer.
- Facilities may lack adequate space and/or electric capacity to support the charging infrastructure required to charge buses.
- Staff often need assistance to determine the ideal locations for chargers as well as to select chargers and manage installation.
- Electric buses may not be able to support all routes with only overnight charging. Some operations may require on-route fast charging which requires careful planning and additional expense for chargers.
- Cold weather and heating implications may affect performance.
- Route profile may affect fuel efficiency.
- Cost-effectively charging electric buses requires careful planning and coordination with Xcel Energy. Fleet managers may even consider "charging as a service."
- Transit and school buses are essential services for vulnerable populations, so it is important to develop strategies to provide back-up power to fully electrified bus fleets.

VEHICLES

Electric Transit Buses

All major transit vehicle manufacturers now produce electric transit buses. This includes the primary manufacturers of diesel vehicles: Gillig, New Flyer, Nova Bus, and COBUS Industries; and manufacturers that entered the market specifically to make electric transit buses: Proterra, Build Your Dreams (BYD), and GreenPower Bus. The Colorado Energy Office compiled a list of current electric buses announced, to date, as an appendix of a 2021 study. The electric transit market is relatively mature, with many transit agencies across the country having made small initial purchases of electric buses, and an increasing number of transit agencies making a commitment to switch to an all-electric fleet. Electric bus models are available in a range of sizes, from smaller "cutaways" to the largest articulated buses.

Battery range of buses can be tailored to meet the needs of transit operations. Short-range buses have smaller batteries with ranges of up to 70 miles and can be recharged with fast chargers during daily service operations. Extended-range buses have larger batteries with ranges that can reach up to 350 miles before needing to be recharged (McCutcheon-Schour & Whitaker, 2017). Extended-range buses typically operate on routes during the day and are charged overnight. Typical ranges and charging times for electric bus models are included in the table on the next page.

Transit buses typically drive enough miles over the lifetime of the vehicle that much of the incremental up-front cost of the buses can be recovered in fuel and maintenance savings, particularly when funding programs help lower the initial purchase cost.

Electric School Buses

All major manufacturers of diesel school buses — including Blue Bird, Thomas, IC Bus, Collins, Starcraft and Ford — already produce electric school buses or have announced plans to begin producing them. Other electric-only manufacturers include Lion Bus, Motiv Power Systems, and GreenPower Bus. Trans Tech produces Type A (small) buses exclusively and has an electric model. The Vermont Energy Investment Corporation compiled a list of all-electric school bus models available on the market.

The electric school bus market is growing due to increased interest and awareness sparked by the Volkswagen Settlement Funds available, as well as by an increase in purchases from school districts, particularly in California, where financial incentives are available. The entry of turnkey fleet providers, such as Highland Electric Fleets, into the market is also making it easier for school districts to adopt electric school buses.

School buses are strong candidates for electrification because of their predictable and relatively short routes, significant down time which allows for overnight or midday charging (potentially expensive fast-charging is not typically needed), and the significant health benefits to children who ride the bus and are no longer are exposed to diesel exhaust fumes. This is also an important sector to electrify as school buses outnumber transit buses roughly five to one (Smith, 2019). However, up-front cost of the vehicles is still a significant barrier for cash-strapped school districts. At current price points, the lifetime cost savings offered by electric school buses are not enough to make up for the additional up-front cost, primarily because school buses tend to have low overall mileage.

CHARGING

Two types of charging systems are currently used to support electric transit buses: 1) depot chargers that charge overnight, where vehicles are parked, after regular service operations and 2) on-route fast chargers that may be needed to support transportation operations during the day. ESBs primarily use depot chargers to top off during the day between morning and afternoon runs, and recharge overnight. However, some manufacturers exclusively offer DC fast chargers to power their vehicles.

Cost-effectively electrifying buses will require early planning and coordination. Fleet managers will need to coordinate with Xcel Energy to understand the capacity of electrical infrastructure at desired charging sites and any potential upgrades necessary to meet charging demand and explore rate options to keep charging costs low. Utility upgrades can range from $5,000 for secondary distribution upgrades to $9 million for substation upgrades. Fleet managers may also consider leveraging solar and even explore charging services to keep charging costs low. The table below summarizes typical charging characteristics for various bus types.

Bus Type	Typical Range (miles)	Charger Type	Charger Use	Charging Time from 0%-100%	Charging Demand (kW)
Short Range Transit	250+	Overhead or Wireless	On-Route	6 min. – 1 hr.	175 - 600
Extended Range Transit	100-250	DC Fast Charger	Depot	2 – 13 hrs.	50 - 150
Electric School Bus	100-150	Level 2 DC DC Fast Charger	Depot Depot Depot/On-Route	5 – 9 hrs. 1.5 – 6.5 hrs. 15 min. – 1 hr.	19 25 – 60 175 - 600
* Battery sizes from 2021 Washington State Procurement (Extended Range Transit), 2021 VTrans Cutaway (Short Range Transit), ANR School Bus Procurement (ESB)					

Strategies in this area focus on assisting transit, school bus, and other fleets plan for, purchase, and deploy electric buses as part of their regular transportation services. Other heavy-duty EV options now available include refuse trucks and cargo vehicles, with more options anticipated to enter the market in the next few years.

Charging Options: Electric Transit Bus

In many cases, electric transit buses can be charged overnight at depots with high-powered DC charging systems. This equipment requires access to high voltage three-phase power. Some electric transit bus manufacturers may include the cost of depot equipment in the vehicle's purchase price or will have relationships with preferred charging equipment vendors. Because transit buses often operate all day and for long hours, on-route fast charging may be needed to maintain service operations with BEBs. Two types of on-route chargers are currently available to support BEBs:

1. **Overhead, or pantograph**: These chargers connect to the top of the bus from a pole-mounted system that deploys when the vehicle stops.
2. **Inductive chargers**: These chargers provide power without making a physical connection to the vehicle. Typically, inductive chargers are installed in the pavement, and power is supplied wirelessly to receiving pads on the bus.

On-route fast chargers are expensive systems to purchase and install — in some cases, they can cost as much as half the price of the vehicle itself. Each fast-charging site requires its own custom design process, similar to the process for depot charging. Fast chargers also require additional planning — to understand and mitigate demand charges that may be incurred if buses charge during peak events, or at times of the day when electric demand is high. Therefore, it is important to assess the need for fast chargers and to consider what overall investment commitment the agency is willing to make in electrification.

Charging Options: Electric School Bus

Currently, the majority of electric school buses use standard, Level 2 chargers with a higher amperage (80 amps) than a typical public station (30 amps). With downtime in the middle of the day and at night, school buses are usually good candidates for slower depot charging. DC charging is becoming common as an alternative to AC Level 2 charging and is typically lower powered than DC fast chargers. As school districts adopt more electric school buses or consider full fleet electrification, DC fast chargers may be needed for buses that travel more during the day and exceed the battery charge range.

Managed Charging

Electricity is more costly to generate and deliver at certain times of day, especially during the hottest and coldest months of the year. Transit bus and school bus operators can often cut charging costs in half by managing the times their vehicles charge. The general practice of reducing costs by controlling charging is known as "managed charging."

Managed charging can be achieved by staff (who manually connect vehicles to chargers at times when energy is less costly) or by computer-controlled systems. The manual practice becomes labor-intensive and complex as bus fleets grow. Manually-managed charging may lead to costly errors (e.g., a single vehicle plugged in 15 minutes earlier than scheduled could add thousands of extra dollars to the month's energy bill). Computer-controlled systems can precisely control the timing of vehicle charging. With these systems, vehicles are plugged in at the end of the day, but the computer system prevents power from flowing to the vehicle until the time when energy costs are the lowest. The computer system can also limit the amount of power being consumed at any one time, reducing the need for costly investments in utility service upgrades.

Involve your IT department early in the charging infrastructure planning process to better understand your ability to automate charging equipment. You may also consider exploring "charging as a service" – a service dedicated to ensuring vehicles are charged at the proper locations, as scheduled, to avoid unwanted demand spikes and ensure full batteries when needed.

PHASED STRATEGIES

With a rapidly evolving market for electric buses and EV infrastructure, taking a phased approach can help fleet managers leverage incentives for early adopters while taking the time to learn and explore which technologies will be the best long-term fit to support their transportation services.

Phase 1: Laying the Groundwork → **Phase 2: Piloting Vehicles** → **Phase 3: Full Fleet Electrification**

Phase 1: Groundwork

Preliminary research and evaluation are important first steps to help guide your bus fleet electrification process. This first phase is intended to position you for success by learning from your peers, building support, assessing your infrastructure, and leveraging funding resources.

Peer Learning

Reach out to regional municipalities, transit agencies and school districts that have purchased electric buses - for information that can help inform decision-making. Be sure to ask about:

- Vehicle performance, especially in local extreme weather conditions
- Procurement insights
- Actual fuel and maintenance costs
- Initial deployment experiences

Successes and lessons learned from early adopters can help streamline the transition to battery electric buses.

Build Staff and Community Support for Electric Buses

Buses are publicly funded so it is important to build stakeholder and community buy-in, particularly as a larger upfront investment in the buses in needed for initial purchases. The following activities will help educate and build support for electric bus purchases.

- Host a ride and drive event with electric bus manufacturers that will demonstrate their buses. Make sure mechanics and drivers get a chance to "kick the tires"; invite stakeholders, the public and the press so people can experience the vehicles firsthand.
- Host electric bus workshops in partnership with Clean Cities Coalitions to educate stakeholders such as school districts and transit agencies about battery electric buses. Content could include an introduction to the technology, benefits to the community and the fleets, charging infrastructure and coordination with Xcel Energy, and sources of funding.

Examples:

- Moms Clean Air Force hosted an electric school bus event in Denver in 2021.
- Wisconsin Clean Cities and Xcel Energy hosted an EV educational session and ride-and-drive event in 2019 that focused on light-duty vehicles but could be adapted for buses.
- Charge Up Midwest launched a four-state electric school bus tour in 2017 to raise awareness about electric school buses and the associated benefits related to air pollution.

Select Pilot Routes

Most transit agencies and school districts have routes that can be supported by electric buses. Routes with daily mileage below the range of base model electric buses are ideal for initial pilot deployments because they can be supported by less expensive depot chargers and overnight charging. On the coldest days, assume up to 50% reduction in range. With this in mind, school bus routes with 50 daily miles or less can be supported by base model electric buses. For transit routes, identify routes with 80 daily miles or less.

Example:

- The Vermont Electric School and Transit Bus pilot selected school districts and a transit agency with routes well under the advertised battery range for electric buses. The longest route proposed for the piloted elected school buses was 63 miles and 120 miles for electric transit buses.

Resource:

- Here's What You Should Know about Electric School Bus Range, Thomas Built Buses

Conduct Site Assessment for Charging Infrastructure

Buses are typically parked at depots overnight; this is where they will most likely be charged. Conduct a site assessment to determine if there is sufficient power to charge buses where they are currently parked or whether electric upgrades will be needed. Details such as whether there is room for chargers and whether buses will be connected to chargers at the front or rear will help in decision-making. A facility electrician or a contractor can provide quotes on the costs to install chargers and upgrade facilities.

Engage Xcel Energy

Be sure to engage Xcel Energy as early as possible to avoid pitfalls like higher-than-expected infrastructure or fuel costs, and to understand available support through Xcel Energy. As soon as you are considering electric buses, set up a preliminary meeting with your Xcel Energy representative to discuss potential scale of cost for infrastructure upgrades to serve the load and available electric rates and programs.

As you go through the planning process, Xcel Energy will be an important partner. Over time it will be important to discuss with them:

- The number of vehicles you anticipate charging and the timeframe for your vehicle purchases
- Amount of power (kWh) vehicles will require for charging
- Time(s) of day vehicles will likely charge
- Site(s) where vehicles will be charged
- If on-route charging will be part of the deployment plan. If yes, what sites are under consideration to host chargers.
- Strategies and technology to manage charging to avoid peak demand.

Track Available Incentives and Grants

Monitor grants, rebates, and other financial incentives for electric buses or EV charging infrastructure - to help inform purchasing decisions and reduce financial obstacles. Maintaining an updated list of actively running group-buy and other purchasing programs in areas near your community will help you keep up to date on new purchasing programs as they become available and will help fleet operators take advantage of opportunities before they expire.

Potential funding sources include:

- Federal Transit Administration Low or No Emission Vehicle Program: The Low or No Emission Competitive program provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required support facilities.
- Federal Diesel Emissions Reduction Act Program (DERA): U.S. Environmental Protection Agency administers the DERA program, which includes federal funding opportunities to support the purchase of electric school buses.
- State Diesel Emissions Reduction Act Programs: States are also allocated funds from the DERA program and are responsible for selecting and awarding grants for projects, including repowering or replacement of diesel school buses with electric buses.
- Congestion Mitigation & Air Quality Improvement Program (CMAQ): CMAQ is administered by the Federal Highway Administration (FHA) and allocates $2.3 to $2.5 million annually to states to fund projects that reduce congestion and improve air quality in areas that do not meet federal air quality standards. Bus replacements are eligible for funding under this program.
- State Volkswagen Emissions Settlement Program: The Volkswagen Emissions Settlement Program identifies 10 eligible mitigation actions, which generally focus on reducing NOx emissions through repowering or replacing older heavy-duty diesel vehicles with newer, cleaner vehicles (including EVs). Eligible activities include electric transit and school buses. Transit agencies, school districts, and contractors who provide transportation services for school districts are eligible for up to 100% funding, including the cost of charging infrastructure. While states have the flexibility to fully fund electric buses, it is up to each state to determine how the funds are allocated. States may choose to require cost-sharing to help stretch settlement dollars. Each state administers its own application process used to identify and fund programs.

Electrify Paratransit Mobility Pilot

Xcel Energy developed the Electrify Paratransit Mobility Pilot as part of the Transportation Electrification Plan (TEP) in Colorado to study how best to reduce the upfront and operational costs of electrifying medium-duty shuttle busses serving paratransit operators. The pilot will help cover the upfront costs associated with the vehicles, the charging equipment, and infrastructure necessary to support their operation for a set period.

Phase 2: Piloting Vehicles

Design and implement a pilot electric bus demonstration. Electric bus demonstrations have been implemented to build awareness about the technology; to gather information to validate costs, savings, and benefits of the technology; and to test the technology in a range of operating conditions such as cold weather and hilly terrain. A demonstration includes evaluation activities to collect data for a set period and, ideally, is compared with performance data from diesel vehicles in the fleet. Demonstrations can be a good initial activity to build buy-in and support for larger-scale deployments.

Purchase Suitable Technology for Pilot

Using the groundwork completed in Phase 1, and considering requirements from funders, conduct a procurement for vehicles and charging infrastructure. Generally, an existing specification for a diesel vehicle can be altered to create an electric bus specification. Body, chassis, and on-road performance characteristics generally do not need to be updated. All references to engines, fluids, fuel, starting batteries, cooling systems, transmissions, differentials, brakes, exhaust, etc. should be reviewed and removed or altered as necessary. Add any special considerations that come with electric buses.

Considerations when choosing electric buses include:

- **Battery**: The battery is by far the most expensive component in an EV. Battery warranty terms must be carefully specified in your RFP and then compared between manufacturers to avoid costly replacement of a failed battery. Battery leasing could be a good financial model and is offered by some manufacturers. Additionally, many manufacturers provide an extended battery warranty option that would cover expected vehicle life.
- **Charging Infrastructure**: Some manufacturers require proprietary charging systems, while others use off-the-shelf charging equipment. Some charging systems cost more up front but can scale easily to serve many vehicles at a lower cost per additional vehicle. For manufacturers that require proprietary charging equipment, be sure to request itemized costs of mandatory equipment in proposals. If you expect to receive proposals from manufacturers that use off-the-shelf charging systems, either require that they provide a quote for such a system or separately solicit budgetary estimates from charging system manufacturers before comparing vehicle proposals. Different charging systems come with varying degrees of controllability, and some may even come with advanced control software — whether standard or as an add-on. To accurately compare charging systems, carefully evaluate control options.
- **Other EV-specific Components**: Be sure to request specifications and specific warranty terms for other EV-specific components like electric motors, inverters, heating systems, and AC-DC converters.
- **Training and Support**: If maintenance staff do not have experience with electric buses, provide manufacturer safety and diagnostic training. Dealerships may not have electric bus expertise to assist with repairs locally. Some EV-only manufacturers do not have existing dealer networks. Ask questions about exactly how long it will take each manufacturer to get a qualified service technician to your site.
- **Track Records**: Electric buses are becoming a mature technology, but some manufacturers have only been making them for a few years. Weigh each manufacturer's specific experience with electric bus deployments when you consider expected reliability and performance.

- **Range**: Range is extended by increasing the number of battery packs and comes with an extra cost. The routes selected in Phase 1 should inform your range needs. Range is highly dependent on the type of usage. For transit buses, test data from the Federal Transit Administration's bus testing facility in Altoona, PA, can be used to help estimate range under conditions similar to yours. Nearly every battery technology available suffers from reduced range in cold weather. Electric heating systems can cut range by 50% on the coldest days. If you will operate in cold weather, consider a fossil fuel auxiliary heater.

Examples:

- The Roaring Fork Transportation Authority (RFTA) began its BEB pilot project with a scoping workshop with bus vendors to inform its purchase of eight BEBs and four depot chargers.
- Charlotte North Carolina is piloting 18 BEBs for 12-18 months on the way to its long-term goal of 100% electric buses. Their rollout will prioritize "Corridors of Opportunity" to elevate health equity and to introduce BEBs first in areas with the highest pollution.
- Minnesota's Lakeville Independent School District 194 piloted an ESB in 2017 to gather information and prove it can work in a cold climate.

Resource:

- The U.S. Department of Energy sponsors the Alternative Fuels Data Center, which contains various tools and information on the alternative fuel vehicles on the market.

Install Chargers

Focus on installation of chargers as soon as buses have been ordered. It can take time to procure chargers (if they are not being provided by the vehicle manufacturer) and make facility upgrades to support chargers. Contractors will want to know the specifications of your chargers so they can provide appropriate electrical service to the chargers.

Resource:

- The Vermont Energy Investment Corporation compiled an electric school bus charging equipment installation guide in 2017.

Evaluate Pilot Results

An important element of a pilot is data collection. Identify the key metrics you expect to track and where data will come from to support this analysis. In addition, it is important to determine a baseline for a comparable new or replacement diesel bus to compare performance, emissions, and operating costs. Data can come from various sources include utility meters, chargers, vehicle telematics, and even manual logs maintained by drivers and maintenance staff. Interviews or listening sessions with drivers, maintenance staff, passengers and community members can provide insights into vehicle performance and benefits of electric buses.

Key metrics to track include:

- Vehicle performance, including driver experiences operating the buses
- Operational costs including maintenance, repair, and fuel
- Energy use
- Emissions reductions

Establish a performance period for evaluating electric buses. The performance period should capture a range of seasonal weather. Follow your data collection plan and report results to stakeholders on a regular (monthly or quarterly) basis. Regularly pulling data from the vehicles may also flag performance issues, such as higher than expected fuel costs, that can be addressed during deployment. At the end of the performance period compile data, lessons learned, and recommendations for future electric bus procurements into a report or presentation for stakeholders and the community.

Examples:

- Massachusetts Department of Energy Resources summarized the results of its electric school bus project in this report.
- The Vermont Agency of Natural Resources is funding an Electric School and Transit Bus pilot with Volkswagen (VW) Settlement Funds to test performance of buses and inform future allocation of funding to electric bus technology.

Phase 3: Full Fleet Electrification

Use the information you collected in Phase 1 and lessons learned in Phase 2 to plan for electrifying a larger portion of your bus fleet. A full or partial electrification plan will include developing a comprehensive vehicle replacement plan and a charging infrastructure plan. Given the potential for extremely high electricity demands if multiple chargers are sited in one location, site planning, design, and construction are paramount for expanding your bus electrification efforts.

Develop a Full Vehicle Electrification Plan

Develop a plan for bus electrification that considers replacement schedules and operational needs to serve existing routes. Route lengths and hours of operation are important considerations that will help determine whether existing routes can be served by electric buses on the market, the size of batteries, and whether on-route fast chargers are needed or if buses can be supported with overnight depot charging. Consulting firms are typically engaged to conduct route analyses for transit agencies. Vehicle manufacturers and turnkey fleet electrification companies can also provide some support to transit agencies and school districts considering electric bus purchases.

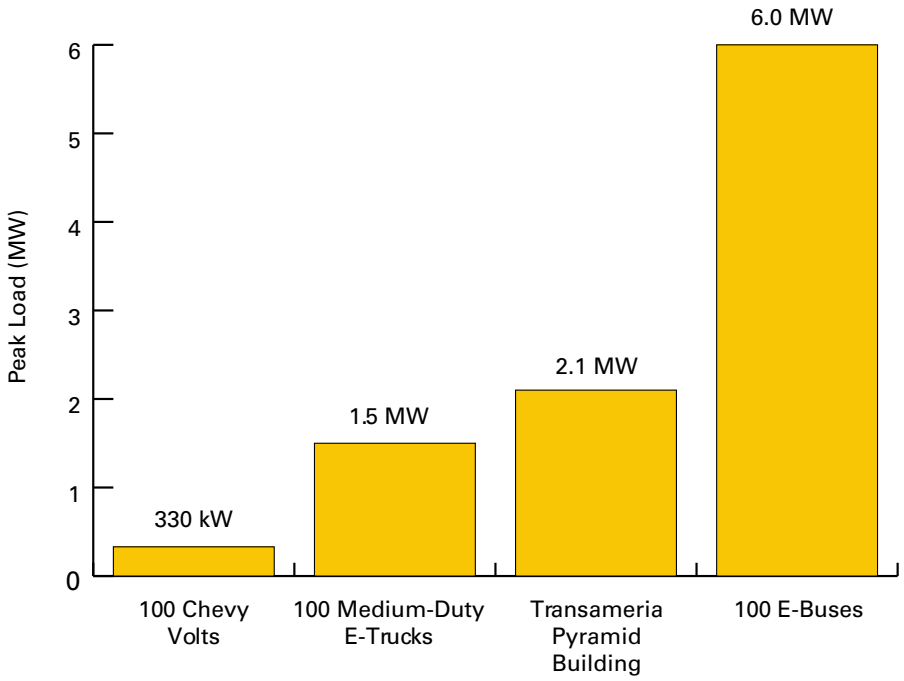
Develop a Charging Infrastructure Plan

As you identify vehicles to replace with electric alternatives, use the results of your analysis to develop a charging infrastructure plan for bus depots (where buses are parked overnight) and if needed, for on-route charging. Then, determine what type of charging levels you will need to support daily operations. In some cases, vehicle manufacturers will offer proprietary charging systems at a certain level. Make sure to consider whether these fit your operational needs, factoring in the cost of the chargers. At the outset, consider how you will stage upgrades to your facilities. Even in the early stages of electric bus adoption, incorporating additional electrical capacity and conduit into the construction of new transportation facilities is significantly less expensive than retrofitting a facility.

Equitable Electric Bus Routes

Because of historical racist housing policies like redlining, low-income neighborhoods and communities of color are often located near highways and arterial roads with high levels of commuter traffic, buses, and heavy-duty vehicles that produce harmful vehicle emissions. As you electrify your bus fleet, prioritize routes in these disproportionately impacted communities.

Multiple chargers at one location can significantly increase electricity demand. Coordinate with Xcel Energy early in your planning process to discuss charging considerations, such as whether identified sites have sufficient electric capacity or need upgrades, what charging rate structures are available, and whether there are additional incentives available to bring down upfront infrastructure costs. One report stated that a fleet of 56 buses would require approximately 11 MWh/day and a fleet of 542 could require 109 MWh/day (Black and Veatch, 2019). Another source shares sample peak loads for different electrification scenarios, showing that 50 ESBs could yield a peak demand of 3 MW (see figure below). You may also consider installing onsite renewable energy to offset new electricity demands.



Peak loads for various EV fleets without mitigating grid impacts, based on 2020 ACEE White Paper by Steven Nadel and Eric Junga

Cost-effective charging will require careful coordination with multiple members of your organization. Involve your IT department early in the charging infrastructure planning process to better understand your ability to automate charging equipment. You may also consider exploring "charging as a service" – a third party service dedicated to ensuring vehicles are charged at the proper locations, as scheduled, to avoid unwanted demand spikes and ensure full batteries when needed. Finally, your charging plan should include financial considerations – how will your organizations pay for the chargers and the additional electricity? Which chargers will be purchased and installed first? See the Funding section to begin identifying funding resources to support your vehicle replacement and charging infrastructure plans. What incentives are available to reduce the cost of charging infrastructure.

Example:

- Miami Dade County, Florida partnered with U.S.-based Proterra to install 75 chargers and 42 new buses in a comprehensive plan to electrify, making this fleet one of the largest e-bus fleets in America.

Implement Vehicle Replacement and Charging Infrastructure Plans

Significant lead time is needed to upgrade facilities to support electric bus chargers, so you should start planning for site upgrades as soon as you have completed your vehicle replacement plan. Site plans can be further refined once you have completed your initial vehicle and charger procurements. An electrical engineer will need to be engaged to draw up plans for charging infrastructure at the site and provide quotes for the work. These plans should be submitted to Xcel Energy or the electric utility serving the site. If the initial conversation with Xcel Energy indicates that significant upgrades will be needed to provide energy to your bus fleet, Xcel Energy will not be able to design those upgrades until they receive the plans from the engineer. This means a minimum of several months' work must be done before Xcel Energy can begin its work. The Xcel Energy design process can take several months as well. If Xcel Energy initially indicates that only minimal site upgrades will be needed, it is likely that Xcel Energy will only need to review and approve the engineer's drawings. By including Xcel Energy early in you will not only be able to address potential concerns with energizing your charger but you can incorporate any Xcel Energy programs that may be available to support your bus purchase and charger installation.

Key decisions will need to be made before plans can be drawn up. Will the EV fleet expand in the future? If so, does it make more sense to oversize the electrical infrastructure now, so it does not need to be upgraded later? Where, exactly, will charging stations be located? Where will conduit run? Where will a new transformer be located? Use your vehicle replacement and charging infrastructure plans and work with an electrical engineering firm to answer these questions.

Example:

- Xcel Energy developed a guidance document on the expected steps and timeline for installing EV charging infrastructure.

Consider Resiliency

School and transit buses provide essential services, transporting vulnerable populations and often serving as community resources in emergencies. Therefore, it is essential that public bus fleets have a strategy to fuel buses in the event of a power outage, as part of a full-fleet electrification plan. There are multiple options: to provide a redundant source of power from diesel-powered generators, to retain some fossil-fuel powered vehicles in the fleet, or to install renewably-powered microgrids.

Example:

- Martha's Vineyard Transit Authority (VTA) is fully electrifying its fleet. Because it is located on an island, having a redundant power source is critical to maintain operations in the event of a power outage. As a result, VTA has developed a renewably-powered solar plus storage microgrid to power its buses, manage peak loads and ensure operations can continue in an emergency.

Share Your Leadership

Just as you were learning from others in Phase 1, others can learn from your successes and lessons learned. Participate in peer networks and other sharing opportunities to inspire other transit and school bus fleet managers in the region; continue learning about new innovations that could enhance your fleet electrification efforts. Venues for sharing information include:

- State public transit associations
- State school bus associations
- American Public Transit Association (APTA) conferences and BEB forums
- National Association for Pupil Transportation (NAPT)
- Clean Cities Coalitions

POLICY

POLICY

Policies can include rules, regulations, guiding principles, and general intentions and, in the context of electric vehicles (EVs), are disseminated from various levels of government to accelerate the integration and acceptance of cleaner transportation. National governments such as China, the United Kingdom, France, the Netherlands, and India are trending toward aggressive vehicle policies that will lead to the eventual phase-out of internal combustion engine (ICE) vehicles (Next 10, 2018). Many U.S. states are adopting zero-emission vehicle regulations, which can be supported by local policies (ICCT, 2019). The level of integration of EVs and charging infrastructure can depend on many local factors. As technology around EVs and charging infrastructure continues to evolve, policies should be revisited and updated accordingly.

This section provides strategies for integrating EVs into existing plans; modifying zoning, codes, and standards to incorporate EVs and charging infrastructure; and updating permitting processes for charging infrastructure both now and in the future. Local policy is most effective when it reflects the needs of the community. A study evaluated the correlation between various EV policies and the relative market share of EVs in the community with the exclusion of California, as its market share of EVs is significantly higher than the rest of the country. This analysis found that EVs are more prevalent in communities with zero-emission vehicle mandates and rebates for vehicles and infrastructure than with policies such as free HOV lane access, decreased licensing fees, and emissions testing exemptions (Cattaneo, 2018).This shows the importance and influence policies have on the EV market.

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

- Local government officials and policy makers
- Local or regional advocacy groups

Key Messaging

- Prepare the community for the future of electric transportation
- Meet the needs of residents
- Improve local air quality
- Reduce greenhouse gas (GHG) emissions

Typical Barriers

- Public support for EV policy
- Pushback from developers, homebuilders, or homeowners associations
- State regulations that may be in conflict with or restrict local control
- Updated cycles of planning efforts that may not coincide with EV planning timelines

What Are the Most Effective Outreach Channels for These Strategies?

- Community activist organizations
- Municipal staff EV and sustainability working groups
- Community planning departments
- Regional partnerships and coalitions

INTEGRATION WITH OTHER PLANS

This topic area shows how EV planning can be incorporated into other community planning efforts for topics like transportation or land use. EV roadmaps may be developed as a stand-alone document or as part of a larger planning effort. In either case, as the number of EVs on the road increases, so does their impact and relevance to other community planning efforts. It is important for community leaders to understand these impacts and plan appropriately.

Basic Information

For many communities, an EV roadmap is just one of many local and regional planning efforts. As with all plans, cities should be aware of the impact that strategies from their EV roadmap will have on other efforts. Some examples of overlap include:

- **Vehicle Energy** Use: Communities that have renewable energy or energy efficiency goals need to determine how the energy use from EVs fits into them. Often, the electricity use of EVs at charging stations is included in the metered electricity use for the building — meaning that it is not easy to distinguish between the two. In some cases, EV chargers can be sub-metered to separate EV use from building use (Fathy & Carmichael, 2019). In other cases, the community can choose to estimate the electricity use from EVs and subtract it from the building energy use. Additionally, the community can plan for the increased electricity use by incorporating it into the goals and forecasts of other plans. If your community has a commercial building benchmarking ordinance, be sure to clearly explain how you would account for energy use from EV charging stations.
- **Parking:** A community should understand how establishing EV-only parking spaces for charging will affect their existing parking regulations, including the number of spots required for new developments as well as public parking regulations and enforcement. For more information, see Parking, Signage, and Enforcement section.
- **Transportation Infrastructure Planning:** While promoting the transition to EVs, communities should keep in mind funding gaps that could occur because EVs do not consume traditional fuel and so do not contribute to transportation revenue through ICE vehicle fuel taxes (Next 10, 2018). Policy solutions such as alternative fuel vehicle taxes or road usage fees can be used to address funding gaps.

First Steps and Quick Wins

As a first step for integrating EVs into local policy, neighboring communities can be a good resource for sharing ideas and establishing best practices, desired goals, and cross-community regulations. Strategies in this section could include starting a conversation with another community or regulatory agency to build partnerships. Through the foundation of good communication, communities can create cohesive policies that benefit residents throughout the area.

Account for EV Energy Use in Benchmarking Ordinances

Communities leverage voluntary or required energy performance benchmarking ordinances to help entities track and compare energy usage over time, usually with the goal of reducing building energy use. Adding EV charging infrastructure to a building could interfere with building owners' ability to show efficiency improvements over time, potentially creating a disincentive to install EV infrastructure. To mitigate this, ensure that energy performance benchmarking ordinances clearly outline how energy use from EV charging stations would be accounted for, so that it does not artificially inflate a building's total energy use and energy use intensity (EUI). A community can choose to allow buildings to subtract EV charging station energy from their overall energy use before reporting. ENERGY STAR® Portfolio Manager allows a building to add a new meter with a negative value to account for EV charging station energy use. This free resource from the U.S. Environmental Protection Agency is used in many communities as a reporting platform for their benchmarking ordinances. If your community is using a different platform, ensure that the guidelines for building owners with EV charging stations are clear.

Coordinate and Advocate Regionally

Learn from and coordinate efforts with neighboring communities and regulatory agencies to provide consistent regulations for customers. When updating plans and codes, look to neighboring communities first to identify best practices, and align with those best practices where feasible. Other regional coordination efforts can include advocating for EV-centric policies at the state or federal level, or conducting joint EV education and outreach campaigns.

Examples of regional partnerships include:

- The Denver Metro Clean Cities Coalition is a group of stakeholders in the Denver metro area who are working together to help residents "make informed decisions about clean transportation and sustainable mobility."
- The Southern Colorado Clean Cities Coalition has a partnership with the American Lung Association in Colorado to promote and encourage the use of clean fuels that result in clean air.
- The Northern Colorado Clean Cities Coalition is a partnership of various northern Colorado municipalities and businesses supporting local and statewide integration of cleaner fuels.
- The Twin Cities Clean Cities Coalition focuses on reducing fuel and vehicle emission impacts on environmental and community health in Minnesota.
- Drive Electric Minnesota brings together all players in the electrical industry to accelerate the adoption of EVs in Minnesota.
- The Wisconsin Clean Cities Coalition is working with municipal and industrial partners to improve the use of alternative fuels and the advancement of vehicle technologies.

Large Efforts and In-Depth Studies

The strategies in this section outline opportunities to integrate EV planning into the community's overall planning process. This step is important in planning to transition EVs to mainstream transportation but generally requires a greater investment of time and financial resources. Communities should be mindful of other community plan update cycles during collaborative EV strategy development.

Local policy is most effective when it reflects the needs of the community and supports regional and state-level initiatives. Both Colorado and Minnesota have state-level EV planning documents to help guide the electrification of the transportation sector over the next 5-10 years. Additionally, local plans might align with Transportation Electrification Plans produced by local utilities. Aligning policies, programs, and planning efforts with these documents is a great way to leverage existing momentum.

Colorado EV Plan 2020: The Colorado EV Plan 2020 is an update to the 2018 plan and sets clear EV goals and actions. The plan establishes a goal of 940,000 light-duty EVs by 2030 and a long-term vision of 100% electric light-duty vehicles and 100% zero emission medium-duty vehicles. One of the main updates to the Colorado EV Plan was the addition of recommendations related to Policy, Planning, and Guidance. The Policy, Planning, and Guidance section highlights the importance of state-level guidance to facilitate alignment of EV standards across multiple jurisdictions.

Accelerating Electric Vehicle Adoption: A Vision for Minnesota: This plan establishes a vision of 20% EVs on Minnesota roads by 2030 and identifies policy as one of the most important actions a city can take to transform into an EV-ready city.

Collaborate through Regional Planning

Establish the desired geography for the planning region, and identify key stakeholders – such as utility representatives, governmental leadership, and policy makers - to convene across that region. Use regional meetings to develop unified EV readiness plans, policies, and regulations and to initiate partnerships through sharing ideas, lessons learned, and best practices. Where feasible, regional agencies can provide support and resources to local governments, such as up-to-date installation checklists, EV projections, and siting analyses. Likewise, coordinate regional training and staff education to allow for consistent information and processes for community staff, residents, businesses, and visitors.

Examples:

- The Georgetown Climate Center is organizing a collaboration among regulatory agencies in the northeast and mid-Atlantic states to develop an EV charging corridor connecting the states.
- The Regional Electric Vehicle Planning for the West is a coalition of regulatory agencies from Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming arranged to create an intermountain EV corridor.
- The Minnesota Pollution Control Agency intends to administer some of the State's Volkswagen settlement funds to bring regional coordination and electric charging connectivity in the state through its proposed charging network.

Integrate into Master Planning

Include EV-readiness goals, policies, and strategies in community master plans. Comprehensive plans, transportation master plans, and transit master plans are all great venues for integrating EV-readiness.

Often, comprehensive plans already have language that supports the concept of EVs such as being a good environmental steward, supporting green technology and sustainability, and promoting multiple modes of transportation that can be adjusted or expanded to be EV specific. Comprehensive plans are often the foundation for codes and standards, highlighting the importance of including EV-ready language to help set the stage for other efforts.

Transportation master plans can also help drive EV-readiness. These plans establish priorities and strategies to meet diverse transportation needs, typically in alignment with higher-level community priorities outlined in comprehensive plans. More and more, transportation master plans are including electrification as part of their transportation solutions. This is especially true for communities seeking to address air quality issues while unable to meet all travel demand through lower-emission options, such as walking, biking, or taking the bus.

Integrating EV-readiness into master plans can take many forms, but might include establishing goals or strategies related to outreach and education, zoning and codes, investment in public infrastructure, equity, fleet electrification, and transit electrification.

In addition to engaging members of the public to better understand community priorities, key stakeholders could consist of utility representatives, business owners, permitting department staff, zoning administrators, parking enforcement staff, downtown development authorities, local community organizations addressing affordable housing, public health, or environmental justice, and, in some instances, staff from universities and large hospitals.

Through stakeholder engagement, the community can determine the appropriate level of planning and zoning language from the following (Clean Energy Coalition et al., 2011):

1. **Accepting**: There is a desire to ensure no barriers exist, but there is no interest in actively promoting the installation of charging stations.
2. **Encouraging**: There is both a desire to ensure no barriers exist and an interest in promoting the installation of charging stations.
3. **Assertive**: There is both a desire to remove barriers that exist and an interest to require the installation of charging stations.

Examples:

- Fort Collins City Plan establishes clear EV-readiness policies and seeks to align with their existing 2018 EV Readiness Roadmap.
- The Clean Energy Coalition in Michigan includes sample master planning and zoning language within each of the tiers from above in Section 6C of their EV roadmap.
- The Raleigh Transportation Electrification Study seeks to align with the City's Strategic Plan, 2030 Comprehensive Plan, and future Community-wide Climate Action Plan.

EV Equity in Master Plans: Since master planning can serve as the foundation for decision making in many communities, the consideration and incorporation of equitable principles is critical in these documents. Equitable EV goals, policies, and strategies can take many forms, and can include investment in EV infrastructure, EV car-share programs, cash vouchers, or even transit electrification in neighborhoods lacking access to EVs. Evaluating which communities have been disproportionately impacted by pollution from ICE vehicles or other harmful policies and projects can also inform which audiences to target with support.

Consider within Climate Action and Sustainability Plans

Incorporate EV goals into climate action plans and sustainability plans. Many communities have established such plans to guide efforts to reduce GHG and carbon emissions. With planning efforts already in place that focus on GHG and carbon emissions from energy use from other sources, transportation will soon emerge as the next big target. In places where alternative modes of transportation such as bicycling, public transit, and ride sharing are not feasible for all residents, EVs are an important emissions reduction strategy. Impacts on climate and sustainability can be measured based on the number of ICE vehicles replaced with EVs, as well as vehicle miles traveled by EVs.

Examples:

- The Mayor of Los Angeles dedicated a chapter in the city's sustainability plan to mobility and public transportation as well as to zero-emission vehicles.
- The City of New York developed climate and sustainability strategies for improving the health of its residents, visitors, and surrounding environment, with mobility and air quality interwoven into each chapter.
- The City of Seattle published a climate action plan that considers general transportation as well as EV ease of use and integration into the community.

Incorporate into 100% Renewable Goals

Evaluate the impact of EV adoption goals on 100% renewable energy commitments. Many communities are setting goals to transition to 100% clean, renewable energy. While communities make this transition and continue to promote EVs, those leading community planning efforts should understand that increased use of EVs will result in higher demands on the electrical grid. As technology continues to evolve, EV batteries may become external storage to help balance energy use and send power back to the grid when needed (Next 10, 2018). Communities should work closely with Xcel Energy to understand the impact of EV goals on the electric grid and on renewable energy sources.

Online calculators are available to help communities estimate how much additional annual electricity will be required by an average EV and necessary charging stations:

- The U.S. Department of Energy developed the Alternative Fuels Data Center, which provides calculators, interactive maps, and data searches to aid in decision-making for community members and regulatory agencies.
- Energy Innovation Policy & Technology LLC created Energy Policy Solutions, which simulates the impacts of various policy changes on reducing GHG emissions.
- The Minnesota Department of Transportation has developed a decarbonizing transportation report that models scenarios for carbon-free transportation by 2050 as well as challenges and opportunities to achieve modeled scenarios.

ZONING, CODES, AND STANDARDS

Developing an EV-friendly community requires adapting local zoning, codes, and standards to make owning and using EVs advantageous to residents, businesses, and visitors. This is often the most effective way to promote EV adoption in your community but can be more difficult to implement than education and outreach efforts.

Basic Information

When a community is choosing to review their zoning, codes, and standards to identify opportunities to promote EVs, three levels of policy language should be considered. Each level requires varying degrees of community support and should be assessed in the context of other local and state policies (Clean Energy Coalition et al., 2011).

1. **Accepting**: At this level, the community's policies do not forbid EV infrastructure. One example is that some community codes classify EV charging station as fueling stations, which may still prohibit their installation in some areas. By reclassifying EV charging stations, the community allows stations to be built while maintaining a laissez-faire approach.
2. **Encouraging**: Zoning, codes, and standards at this level provide additional benefits to community members who choose to install EV infrastructure. Some examples are expedited permitting or allowing exemptions from existing codes (such as a reduced parking requirement).
3. **Assertive**: Under this category, properties are required to install EV infrastructure. One example is building code that mandates all residential homes to be built with a charging infrastructure-ready outlet.

First Steps and Quick Wins

Initial strategies for adjusting zoning, codes, and standards can include parking and street codes. These strategies are a good place to start while a community is building public support for EV policy, as they increase public visibility of EV infrastructure.

Include EVs in Minimum Required Parking Spaces

Allow builders to include EV charging station parking spaces as part of the required off-street parking spaces for new commercial building construction. This allows builders to include EV parking without having to obtain additional areas for parking to meet the minimum requirements. This is a no-cost opportunity for communities to support and encourage builders and building owners to install EV charging stations.

Examples:

- The City of Indianapolis and Marion County updated the municipal codes regarding required off-street parking to incorporate EV charging station installation.
- The State of California legislature adopted a municipal code allowing for EV parking spaces with accessible charging stations to count as one option for the required off-street parking.
- For several other examples see pg.13 of the Great Plains Institute Summary of Best Practices in Electric Vehicle Ordinances.

Amend Street Codes

Amend street codes to allow right-of-way charging locations. By increasing the acceptable locations for EV charging stations, more charging options will become available for drivers who do not have access to reliable charging options at home or at work. Additionally, consistent parking rules and designated EV-only parking signage will make it easier for residents and visitors to use EVs, which will lead to more widespread adoption overall. As EVs become more visible throughout the community, awareness and acceptance of EVs will increase. In communities in Minnesota and Wisconsin, curbside public rights-of-ways are sometimes used for snow storage during the winter, which means additional consideration would be needed regarding plowing operations when siting public charging stations.

Examples:

- The City of Seattle initiated a pilot program that allows public EV charging stations to be installed near the curbside in the public right-of-way.
- The Clean Energy Coalition in Michigan includes sample siting and installation locations for EV chargers in new and existing public right-of-way as well as sample signage and regulations in Section 6D & 6E of their EV roadmap.
- The City of Berkeley in California published a manual for installing EV charging stations near the curbside in the public right-of-way on residential properties.

Designate EV Charging as Permitted Land Use

Work to streamline the EV permitting process by explicitly allowing EV charging stations, where appropriate, within the framework of your City's existing zoning regulations. This may be broken out by the type of EV charging station (level 1,2, or 3), the number of chargers to be installed, or whether the stations will be publicly available. For example, you might amend some or all zoning districts that explicitly permit gas stations to include Level 2 or Level 3 EV infrastructure as permitted uses.

Examples:

- For several examples see pg.6 of the Great Plains Institute Summary of Best Practices in Electric Vehicle Ordinances.

Larger Efforts and In-Depth Studies

In some cases, incorporating EVs into community zoning, codes, and standards will require more planning, budget, approval, and coordination. This could include developing new codes specific to charging stations or updating building codes to require EV-ready infrastructure in new construction. Such strategies should be considered and discussed early during the development stage, as some stakeholders may be resistant to pursuing them.

Develop Charging Codes

Create EV charging codes that can be incorporated into existing zoning, codes, and standards. These codes can help ensure that residents will have a consistent experience with public charging stations owned and operated by the community. Considerations for charging codes include:

- **Types of Charging Stations:** These specifications may include the level of charging station (Level 2 or 3) targeted in specific areas of the community as well as any required capabilities of the station, such as connectivity for tracking and billing purposes.
- **Rates and Billing Responsibility:** In some cases, the community owns and operates the system and can set the billing rates for charging. See the Public Charging Access section for more guidance on setting rates. In other communities, third-party providers maintain ownership and operate the chargers through a contract with the community. In this case, the rates will be set in the contract.
- **Signage and Use Regulations:** This portion of the code specifies the standardized signage for charging stations including regulations and enforcement details. For more information regarding signage, see the Parking, Signage, and Enforcement section.

Examples:

- The City of Fort Collins established public availability of EV charging stations and associated fees for charging in its municipal codes.

Equitable Codes: Technology, payment, and language barriers may limit access to EV charging stations. Most stations do not accept credit cards or cash, but rather require customers to pay via credits they have purchased through their smartphone app. This can be a barrier for those who do not have a smartphone or a data plan. Signage can also be a barrier for those with limited English skills. Both barriers can be addressed by incorporating code language requiring multiple payment types and multilingual signage.

Update Building Codes

Incorporate EV-readiness requirements into building codes for new construction to reduce future installation costs. By requiring EV-ready infrastructure for all new construction, installation costs can be reduced by almost 75% compared to retrofitting, due to the cost of post-construction trenching, demolition, and permitting (Pike, Steuben, & Kamei, 2016). Levels of readiness for a building code include (Frommer, 2018):

- **EV-Capable:** Ensure that the electrical panel has a dedicated circuit branch and continuous raceway conduit from the panel for a future EV charger but does not require the installation of the actual 240-volt outlet.
- **Charging-Infrastructure-Ready Outlet:** Install the electrical panel with a dedicated circuit branch and continuous raceway conduit, from the panel to a junction box or to a 240-volt outlet that a Level 2 charger can connect to.
- **Charging Infrastructure Installed:** Include the electrical requirements above, in addition to a minimum number of Level 2 EV charging stations to be installed for immediate use.

The 2021 International Energy Conservation Code (IECC) will include requirements for EV-Capable or Ready charging stations for residential development. The update may also include EV-Capable or Ready requirements for commercial development. Many communities incorporate parts or all of the IECC into their code ordinances. The 2021 updates could significantly enhance the adoption of EV-Capable or Ready standards across communities.

Examples:

- The City of Boulder requires 1 EV-Ready space per dwelling unit for single family development, 5% EV-Installed, 10% EV-Ready, and 40% EV-Capable (25+ spaces) for multi-family development; and 5% EV-Installed, 10% EV-Ready, and 10% EV-Capable (25+ spaces) for commercial development.
- The City of Fort Collins requires all new buildings with on-site parking to have 5% of spaces EV-ready and all new single-family homes with attached garages or carports to have EV charging infrastructure in place based on the updated building codes.
- The City of Atlanta updated its building code to require all new commercial and multi-family parking structures to have 20% of spaces be EV-ready and all new residential homes to have EV charging infrastructure in place.
- The Bay Area Air and Quality Management District offers suggested methods for local governments to adopt standards and requirements based on state government codes.
- The Southwest Energy Efficiency Project (SWEEP) offers sample code language for EV readiness in residential buildings and multi-family and commercial buildings.
- The City of Bloomington in Minnesota passed an ordinance in 2019 supporting EV-ready infrastructure such as requiring EV chargers on all new multifamily construction.
- For more examples of Cities with EV Ready requirements see pg.7 of the Great Plains Institute Summary of Best Practices in Electric Vehicle Ordinances.

PERMITTING

Municipal permits are important to help communities ensure the safe and consistent installation and maintenance of charging infrastructure. The strategies in this section describe opportunities for improving the permitting process to help remove barriers that may prevent EV integration.

Basic Information

Municipal permits are often required for structural remodels and alterations of a home or building. This can include roof repairs, load-bearing wall demolition, general structural layout alterations, and new electrical wiring or circuiting. Many municipalities are beginning to require EV-ready infrastructure such as electrical conduits in new construction but retrofitting existing developments can be a costly and complicated process. In some instances, residential buildings already have the capability to support a 240-volt outlet for Level 2 chargers and would not need to obtain an electrical permit prior to installing the charging infrastructure. However, if the residential building is not capable of supporting a 240-volt outlet for Level 2 chargers, the owner would need to obtain an appropriate electrical permit and install new wiring and circuit connections.

Similarly, commercial buildings that do not have the necessary infrastructure to support a 240-volt outlet for Level 2 chargers or that want to upgrade their electrical services to support multi-port Level 2 chargers or Level 3 chargers will need to obtain the appropriate electrical permit. By expediating the permitting process and lowering the cost of the permits, a community can facilitate a swifter integration of EVs through private installation of charging stations.

First Steps and Quick Wins

As a first step toward integrating EVs into the community, adjust the permitting process to make it easy for residents and building owners to install charging infrastructure. This section describes foundational actions that can be used to initiate the EV integration process without extraneous effort or resources from the community.

Standardize the Permitting Process

Offer a standardized permitting template with a separate service fee specifically for charging infrastructure to establish a straightforward and consistent method for residents and businesses to become EV ready. A checklist can provide residents and businesses an explicit understanding of what steps need to be taken for the permitting process. This checklist could include required project information needed in the permit submission letter, architectural components needed on the plans and drawings, any associated fees, and resources for customer support throughout the process.

Examples:

- The City of Atlanta provides applicants with an EV plan review checklist to ensure all permit requirements are included prior to submission.
- The City of Berkeley in California offers a code compliance checklist for EV charge station permits.

Expediate the Permitting Process

Use online platforms to streamline the permitting process. Online platforms can be incentivized by offering next-day inspections for residential and commercial installation of charging infrastructure and can be used to easily communicate permitting status updates. Additionally, you can encourage early adoption and installation of charging infrastructure through incentives like offering to waive inspection fees for a set number of permittees on a first-come, first-served basis.

Examples:

- The State of Oregon offers a pre-approval program for licensed contractors on electrical, plumbing, and elevator projects that allow contractors to receive 10 permits at a time, which can be used throughout a year and will be subject to at least one on-site inspection. This allows contractors to move forward on projects quicker, which benefits EV owners by speeding up the charging infrastructure installation process.

Offer Educational Workshops

Host educational workshops to guarantee accurate and up-to-date information for local officials, community inspectors, electrical contractors, and others responsible for aiding in the permitting and installation process. This will ensure community members and local businesses experience a smooth and consistent permitting and installation process. These workshops should include:

- Current policies, standards, and codes regarding charging infrastructure permitting, siting, and installation
- Best practices and troubleshooting for charging infrastructure installation and maintenance
- Inspector guidance and specifications pre- and post-charging infrastructure installation

An existing organization that offers educational workshops about charging infrastructure installations is the National Electrical Contractors Association (NECA), which provides courses and resources for electrical contractors across the country to maintain current industry knowledge as well as to ensure safety and quality. Members of the Clean Cities Coalition Network often host educational workshops and webinars.

Larger Efforts and In-Depth Studies

Significant changes to the permitting process will require additional planning, budget approval, and coordination. However, the strategy in this section could address stakeholder concerns and remove barriers to EV adoption.

Review and Update Taxes and Fees

Review projected EV adoption trends and anticipated transportation revenue required to plan appropriate EV taxes and fees. As the trend of vehicle use shifts from ICE vehicles to EVs, revenues from motor vehicle fuel taxes will decrease. For communities to maintain transportation revenue needed to fund projects for road safety, upkeep, and improvements, other fees such as road usage charges or annual vehicle fees may need to be implemented. It is important that the fees be rightsized — enough to maintain the appropriate infrastructure but not so high as to disincentivize EV adoption.

Examples:

- The City of Raleigh in North Carolina applies thoroughfare facility fees to all vehicle traffic to support street improvement projects.
- The State of Oregon developed the Road Usage Charge Program, which is a pay-by-the-mile tax to ensure funds are collected from EV owners in addition to ICE vehicle owners. Fuel taxes paid at the pump are credited back to ICE vehicle owners.
- The State of Washington piloted the Road Usage Charge Program in 2019 to evaluate other methods of collecting revenue for capital improvement funds without the standard fuel tax. Findings and decisions regarding the program will be released in early 2020.
- The State of Georgia uses annual alternative fuel vehicle fees to gather funds from non-ICE vehicle owners to support capital improvement projects.

Resources

Many organizations have developed toolkits and other guidance documents to help communities find the policies and strategies that are best for them. Examples of these policy toolkits include:

- The Southwest Energy Efficiency Project (SWEEP) in partnership with multiple Colorado agencies developed a local policy toolkit for electric transportation.
- The Clean Energy Coalition in Michigan established an EV-preparedness plan with sample policy and planning methods.
- The Sierra Club and Plug In America created a model of state and local policies for EV adoption.
- The New York State Energy Research and Development Authority published a guide for creating EV-ready towns and cities through planning and policy tools.

APPENDICES

APPENDIX A:
ELECTRIC VEHICLES 101

Light-duty Vehicle Basics

Electric vehicle (EV) is a term for any car that uses an electric engine for locomotion. There are several types of EVs, depending on whether the vehicle has an internal combustion engine (ICE) that supports the electric motor. More details on each type are outlined below

Table 1. Comparison of Types of Electric Vehicles

Electric Vehicle Type	Power Source	Travel Range
Battery Electric Vehicle (BEV)	Electric Motor	80 – 345 miles
Plug-in Hybrid Electric Vehicle (PHEV)	Electric Motor + Gasoline Engine	350 – 600 miles
Hybrid Electric Vehicle (HEV)	Electric Motor + Gasoline Engine	350 – 600 miles

Battery Electric Vehicle (BEV)

A BEV or all-electric vehicle is powered by an all-electric motor and does not require gasoline. Instead, BEVs are fueled by plugging into charging stations where energy is stored in the battery to be used when the car is running. Distances that a BEV can travel on a single charge range from 80 to 345 miles, with longer distances promised in the future through continual advancements in technology. Recharging can take anywhere from 30 minutes to 12 hours depending on the type of charger, size of the battery, and level of depletion in the battery (Drive Change. Drive Electric., 2019).

Plug-In Hybrid Electric Vehicle (PHEV)

A PHEV provides a combination of both an electric motor and a gasoline engine. PHEVs use energy from the electric motor until the battery charge runs out, which can occur between 15 to 50 miles, at which point, the gasoline engine takes over. The distance that a PHEV can travel on a single charge and full tank of gasoline ranges between 350 and 600 miles. The battery is charged similarly to the BEV through a plug, and the fuel tank is filled by traditional gas station (Drive Change. Drive Electric., 2019).

Hybrid Electric Vehicle (HEV)

An HEV has both an electric motor and a gasoline ICE. In these vehicles the ICE is used to power an electric generator, which in turn powers the electric motor. The benefit of this set up is that the ICE can run at a constant speed, greatly increasing the vehicle's fuel efficiency compared to traditional ICE vehicles. However, the battery in these vehicles cannot be charged by an external electricity source, so the vehicle always relies on the ICE.

Resources

- The U.S. Department of Energy's online Find a Car tool allows users to browse available EVs and explore fuel economy, safety ratings, and other specs.
- Xcel Energy's online EV comparison tool allows users to compare EVs by range, price, or a personalized Match Score.
- The International Energy Agency (IEA) Global EV Outlook 2021 online report provides of auto manufacturers' announcements related to electric light-duty vehicles, such as General Motors' plans to offer only electric light-duty vehicles by 2030.

Charging Stations

EV charging stations are broken out into three categories to indicate the speed at which the vehicle is charged: Level 1, 2, and 3. Level 3 chargers are also known as DC fast chargers. The sections below detail the appropriate application for each charger type. Keep in mind that faster charging is nearly always associated with higher infrastructure and fuel costs.

Residential Charging Stations

There are two types of chargers that residents can install in their homes (shown in Table 2). A brief explanation is outlined, along with the pros and cons of each type. All currently available electric vehicles can use either charger type.

Table 2. Residential Electric Vehicle Charging Types

	LEVEL 1	LEVEL 2
Electric Current (AC)	120 volts; 20 amps	208/240 volt; up to 80 amps
Charging Rate (mile range per hour of charging)	4 to 6	25 to 40
Benefits	• Uses standard residential wall outlet • Little to no investment in infrastructure required	• Quicker charging • Some models have available Wi-Fi controls to allow residents to take advantage of time-of-day electric rates • In the case of multifamily housing, controls could be managed by a property manager.
Drawbacks	• Slower charging rate, but usually sufficient for residents who charge overnight	• Requires 240 Volt outlet or hardwired charger • Electrician likely required to install • Higher infrastructure cost investment
Estimated Costs (does not include any necessary electrical upgrades)	Low to no cost	$500 to $2,500

Resources

- Xcel Energy's Home Charging Advisor online tool estimates costs to install and power a Level 2 home EV charging station.

Commercial Charging Stations

Level 2 and Level 3 chargers are most appropriate for commercial applications since vehicles are generally parked for shorter periods of time than in residential applications. Many commercial chargers also come equipped with software that allows the user to control when vehicles are charging and may facilitate payment in public applications. Table 3 shows the advantages and disadvantages of Level 2 and Level 3 chargers.

Table 3. Level 2 and 3 Charging Infrastructure

	LEVEL 2	LEVEL 3/DC Fast Charger
Electric Current	208/240 volt; 30 amps (AC)	480 volts DC
Charging Rate (mile range per hour of charging)	25 to 40	Up to 240
Benefits	• More economical than Level 3 • Safe for long term use	• Fastest charging option available
Drawbacks	• Slower charging	• Very expensive to purchase and install • Can cause degradation to EV batteries with prolonged use
Estimated Costs (does not include any necessary electrical upgrades)	$2,500 to $5,000 (US DOE, 2019)	$50,00 to over $150,000

Resources

- Xcel Energy's step-by-step guide for property owners interested in providing charging in commercial or multifamily properties.
- The U.S. Department of Energy maintains webpages for workplace charging, public charging, and multifamily charging, with information on planning, signage, operations and maintenance of charging stations.

Benefits of EVs

The popularity of electric vehicles is continuously rising, and many communities are looking to find ways to promote electric vehicle adoption. Some of the benefits of conversion to electric vehicles are described below.

Reduce GHG Emissions

Electric vehicles can significantly decrease the GHG emissions associated with on-road transportation, which overtook electricity generation as the largest source of GHG emissions in the US in 2017 (Environmental Protection Agency, 2019). The amount of savings depends on the electricity generation mix of your local electricity grid. According to one report, in 2025 a BEV charging station in the Denver Metro Area could reduce NOx emissions by 84 percent, VOC emissions by 99 percent, and greenhouse gas emissions by 49 percent compared to a new gasoline vehicle (Denver Environmental Health, 2020). Regardless of Xcel Energy's existing generation profile, national trends suggest that electric utilities are improving emissions from electricity generation at a faster rate than fuel economy is improving in ICE vehicles. Electric vehicle charging can be paired with residential roof-top solar, commercial solar parking structures, or community solar to further reduce associated GHG emissions.

Resources

- The U.S. Department of Energy publishes vehicle emission estimates, by state, through the Alternative Fuels Data Center.

Energy Independence

Over 65% of the petroleum imported by the US in 2018 was used for transportation fuel. Transitioning to electric vehicles shifts the fuel source to fuels that are more likely to be domestic (e.g., coal, nuclear, natural gas, and renewable energy). Transitioning to electric vehicles is an important strategy for reducing dependence on fuel imports and isolating transportation costs from the volatile petroleum market. (Office of Energy Efficiency and Renewable Energy, 2018).

Air Quality

Use of traditional ICE vehicles contribute to Ozone and fine particulate (PM2.5) creation, especially along heavily traveled routes. These pollutants have been linked to respiratory problems such as asthma and premature death for people with chronic exposure. These pollutants are significantly reduced in the case of HEVs and PHEVs and are eliminated in BEVs. One study of the Houston area found that moderate to complete vehicle electrification would reduce ozone by 1-4 ppb and PM2.5 by 0.5-2 µgm-3. This change is estimated to prevent 114-246 premature deaths annually, as well as to significantly reduce asthma exacerbation by 7,500 cases and reduce school loss days by 5,500 (Pan, et al., 2019).

Resources

- Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) online tool compares air pollutants from new alternative fuel vehicles and gasoline (light-duty) and diesel (heavy-duty) vehicles.
- The U.S. Environmental Protection Agency (EPA) AirCompare maps provide information on air pollutants by county and how those pollutants impact people with asthma, older adults, young children, and other population groups.

Lower Fuel and Maintenance Costs

While cost savings vary based on vehicle type, driving patterns, and geographic region, the average driver spends about half as much money in fuel and maintenance costs when they drive an EV (compared to a traditional ICE). This can be a significant savings, as about 20% of US household income is spent on transportation costs. One study concluded that Xcel Energy customers who are EV owners will see additional annual savings between $260-$276 (MJB & A, 2019). To maximize fuel cost savings, be sure you understand Xcel Energy's electricity rates and adjust your charging patterns accordingly (Office of Energy Efficiency and Renewable Energy, 2019)

What Affects My Cost of Electricity?

There are two charges that may be applicable to your electricity use.

1. **Total Use Charge (kWh):** This is a measurement of the total amount of electricity used in the month (measured in kilowatt-hours).
    a. **Time-of-Day Rates:** Some utilities vary the cost per kWh by the time of day - with lower rates overnight when the electrical demand of the community is less. This provides an excellent opportunity for additional cost savings for EV owners who can charge at home overnight. Some charging stations and most vehicles allow the owner to program charging times, to automatically take advantage of these rates.
2. **Peak Demand Charge (kW):** This charge is based on the maximum amount of power that is used at any one time during the month. These charges are generally only seen in larger commercial rates. A facility should be cognizant, when installing charging stations, of the impact on their peak demand charges - as it can significantly increase the cost of charging if it impacts the facility's peak demand charge. A business can consider metering their electric vehicle charging separately or scheduling fleet charging overnight to help manage cost.

Resources

- The U.S. Department of Energy's (DOE) Vehicle Cost Calculator uses basic information about your driving habits to calculate total cost of ownership.
- For residential customers, Xcel Energy's Home Charging Advisor online tool estimates costs to charge an EV at home.
- For commercial customers, your Xcel Energy representative can help you understand your local rates and offer ways to minimize electricity charges related to charging your electric vehicle(s).

Real and Perceived Barriers to EV Adoption

1. **Vehicle Type:** Currently most plug-in electric vehicle (PEVs) are small sedans, but small sedans are declining in popularity. In 2017, 42% of people stated that their next vehicle would be a sedan - down from 45% in 2016. (National Renewable Energy Laboratory, 2017)
2. **Vehicle replacement cycles:** New vehicle technology is slow to be incorporated into a community's vehicle fleet since many people don't replace their vehicles frequently. A survey found that 46% of people plan to replace a vehicle over the next 3 years. Of these vehicle purchases, about 40% of people responded that they probably or definitely would purchase a new vehicle, which will also delay uptake of electric vehicles since the supply of used PEVs is limited. (National Renewable Energy Laboratory, 2017).
3. **Awareness:** In the 2017 study, over 50% of people were not able to name a specific make and model of a PEV.
4. **Exposure:** Often first-hand exposure to a new technology is a precursor to the purchase of that technology. As of 2017, 40% of people had owned, driven, or sat in a PEV.
5. **Public Opinion:** The number of people who believe that EVs are not as good as traditional gasoline vehicles has been declining, with the number down to 35% in 2017; but about 20% were unsure. Still, over half of the people surveyed stated they would not purchase or lease an EV.

6. **Range:** The median range that consumers said would be required, in order for them to purchase an EV, was 300 miles (while the current average range of most vehicles is around 200 miles).

7. **Charging availability:** Only 8% of surveyed people said they could charge their vehicle at work, and 16% said they could charge their vehicle at other locations they frequent. 54% said they could plug in their vehicle at home most days.

8. **Purchase Price:** Initial vehicle price is the largest deterrent for most people. Most people (66%) stated that they expect to spend $30,000 or less on their next vehicle. Both the Chevy Volt and Chevy Bolt are within this range after the federal tax credit is applied. (National Renewable Energy Laboratory, 2017). Battery prices, the main factor driving EV price, has been steadily decreasing which has been driving down the incremental cost of EVs. The price of EVs is expected to be similar to internal combustion engine vehicles by the mid-2020s. (BloombergNEF, 2019)

Reasons to Purchase/Lease an EV	Percentage of respondents (trend from 2016)
Better for the environment	84% (down from 87%)
Save money on fuel costs	83% (up from 79%)
Better for national security	63% (up from 62%)
Better performance	34% (up from 29%)
Cutting edge technology	60% (same)

Reasons NOT to Purchase/Lease an EV	Percentage of respondents (trend from 2016)
Technology is not dependable	28% (down from 35%)
Not available in vehicle segment	24% (down from 32%)
Too expensive	51% (down from 55%)
Poor performance	24% (down from 26%)
Unable to charge at home	30% (no data in 2016)
Unable to charge away from home	48% (no data in 2016)

EV FAQS

1. Are EVs affordable?

a. Today, most electric vehicles cost a little more to purchase than their traditional counterparts, but typically cost about half as much to operate and maintain. EVs require little to no maintenance, and electricity is cheaper and cleaner than gasoline or diesel fuel. Plus, there are many incentives to purchase an EV, such as federal tax incentives. Look for additional discounts through special promotions, such as "group-buys" where dealers offer electric vehicles at a lower price to incentivize a large volume of sales.

2. How far can an EV travel on one charge?

a. Typical battery range is between 80-350 miles. Visit the U.S. Department of Energy's Find a Car online tool to find an EV that would best suit your needs.

3. Are electric trucks and SUVs available?

a. There are already more than 50 electric SUV models available, and several auto manufacturers including Ford, GMC, and Tesla are in the process of releasing electric trucks. Without the burden of a traditional motor, electric vehicles can offer lots of torque, so you can expect electric trucks to provide all the power you need.

4. How do winter conditions affect EVs?

a. Extreme cold can impact the range in EVs by 25-30%. The additional heating needed for passenger comfort during extreme cold requires more energy than more moderate temperatures and cold batteries do not hold their charge as well. However, temperature-control technology is improving to compensate for some of these issues. Several models are now available with battery heaters or other technology to improve efficiency in cold climates.

5. Where can I charge my EV?

a. The easiest way to find charging stations is to use websites like the U.S. Department of Energy Alternative Fueling Station Locator, or apps like PlugShare and OpenCharge that let you filter by charger type, price, and other features.

6. How long will it take to charge my EV?

a. Charging can take anywhere from 20 minutes to 12 hours depending on the type of battery, how empty the battery is, and the type of charger. Level 2 chargers, the most common type at public charging stations, typically provides 25-40 miles of range per hour of charge.

7. Are EVs better for the environment?

a. *Tailpipe emissions (local air pollution)*: When internal combustion engine (ICE) vehicles turn gasoline into power, they produce harmful byproducts (e.g., nitrogen oxide, carbon monoxide, particulate matter) that are released from the vehicle's tailpipe. Tailpipe emissions from traditional vehicles produce greenhouse gas emissions and can lead to local air pollution by contributing to smog and haze. In turn, this air pollution can cause or worsen health problems, such as asthma and chronic bronchitis. Unlike ICE vehicles, EVs do not produce any tailpipe emissions and therefore can benefit local air quality and public health.

b. *Fuel production emissions (global pollution)*: When taking a more holistic look, both EVs and ICE vehicles produce emissions related to the production of fuel (gasoline or diesel for ICE vehicles and electricity for EVs). In the case of gasoline and diesel fuel production, emissions are produced through the extraction, refining, and transportation of fuel to pumping stations. When it comes to EVs, there are emissions associated with the generation of electricity used to charge cars. The difference in emissions associated with fuel production varies greatly depending on the source of electricity generation. Still, research suggests that EVs have lower greenhouse gas emissions than ICE vehicles, even based on current electricity generation. This is largely because much of the electricity produced in the US comes from cleaner sources like natural gas, wind, and solar. As the cost of renewable electricity generation continues to plummet, and both utilities and states commit to increasing the percentage of renewables in their supply, the greenhouse gas emissions associated with charging EVs will decline over time. See the Department of Energy (DOE) Alternative Fuels Database for more information on comparing greenhouse gas emissions associated with EVs and ICE vehicles.

c. *Manufacturing and end-of-life emissions and other environmental impacts*: Environmental impacts and greenhouse gas emissions are associated with the manufacture and disposal of any vehicle. However, the lithium-ion batteries in current EVs pose specific social, economic, and environmental challenges related to the materials used to produce them. Battery materials sourcing and recycling are the top supply chain impacts to be addressed. There is significant ongoing research and commercial development aimed at both reducing the amount of cobalt and other materials used in EV batteries, while also improving options for battery reuse (building and grid storage) and recycling (for example the DOE ReCell Advanced Battery Recycling Project).

8. How clean is the electricity I am using to charge my EV?

a. The sustainability of EVs largely depends on the source of the electricity generated and used to charge the vehicle. Currently, EVs charged in Xcel Energy territory use electricity from an energy mix that ranges from 37 to 62% carbon free and are expected to be 100% carbon-free electricity by 2050. Communities outside Xcel Energy territory can find out how their electricity source affects EV emissions by visiting the U.S. DOE's electric emissions tool.

9. How sustainable are EV batteries?

a. *Battery production emissions*: Differences in battery materials and production techniques, including the location and the energy mix for production, affect the overall sustainability of EV batteries. A battery produced using coal-fired electricity, for example, will have significantly higher emissions than one produced using cleaner power. In total, analyses of battery production (including the extraction of component minerals) suggest that emissions from manufacturing an EV battery are roughly equivalent to the emissions from manufacturing the rest of the vehicle. Some experts suggest that these emissions represent approximately 5-15% of the total life-cycle emissions of an EV in many locales, although these estimates can vary widely. The good news is that new production technologies are developing, and the overall electrical grid is becoming less carbon intensive. Some experts anticipate a 50% reduction in an EV's life-cycle emissions by 2030, and by one estimate of a fully renewable future grid EVs could eventually produce at least 90% fewer life-cycle emissions than do ICE vehicles.

b. *Battery production social impacts*: Certain challenges are particularly connected with mining for minerals, such as cobalt, used in EV batteries. Unregulated cobalt mining in

the Democratic Republic of Congo (DRC), which produces more than half of all mined cobalt, is linked to regular risk of injury and death due to mine collapse, lung disease from particle inhalation, and child labor concerns (with weak enforcement of health and safety standards or child labor rules). It is important to note that fossil fuel exploration and extraction has also been associated with similar human rights abuse, conflict, and corruption. The average scores on the Resource Governance Index for oil-producing countries (47 out of 100) and mineral-producing countries (48 out of 100) are virtually identical, signaling that misgovernance, specifically related to child labor, remains a challenge in both sectors.

c. *Battery lifespan*: Electric vehicle (EV) batteries are designed for extended life; but, as with any other rechargeable battery, they will degrade over time. Federal regulations require that every battery in an EV sold in the U.S. come with a warranty providing coverage for a minimum of eight years or 100,000 miles. However, current estimates predict that an EV battery will last 10–20 years before it needs to be replaced. EV drivers can maximize battery life by avoiding high temperatures, overcharging, completely draining the battery, and aggressive driving patterns. After the battery's first life is over, it can be reused for energy storage, telecommunications backup services, and other applications before it needs to be recycled.

10. When should I consider replacing my existing gas-powered vehicle with an EV?

a. From a cost perspective: Total cost of ownership for a vehicle includes purchase or lease price, fuel/electricity, maintenance, and insurance. Due to low fuel/electricity and maintenance costs, owning an EV is often less expensive (over several years) than owning an ICE vehicle. Visit the U.S. DOE online Find a Car tool to explore potential savings for various EV models. As the EV market grows, so will used EV options, further improving cost-benefit analysis.

b. From an environmental perspective: Normally, it is best not to replace products unnecessarily. This is because the greenhouse gas emissions related to most things we purchase (e.g., clothing, furniture) come from the energy used to manufacture and ship the items. However, products that consume fossil fuels for power (e.g., vehicles, furnaces, and lawn mowers) produce emissions every time they are turned on. An ICE vehicle will produce 8 to 10 times more emissions from driving than from its manufacture. Therefore, replacing ICE vehicles sooner, with EVs, can significantly improve overall emissions and air quality.

APPENDIX B: GLOSSARY

Term	Definition
Alternating current (AC)	The most common form of electricity used in homes and businesses uses alternating current where the current periodically changes direction. Batteries require DC electricity to charge, so EV chargers must convert the supplied AC electricity to DC power.
Amps	The measurement of amount of electrical energy "flowing" through a charger. This is determined by the electrical load required by the equipment and can vary over time.
Battery Electric Vehicle (BEV)	An all-electric vehicle fueled by plugging in to an external charger and has no tailpipe emissions. Requires low maintenance costs.
Direct current (DC)	The form of electricity where the current only flows in one direction. This is the type of electricity that batteries supply and require to charge. EV chargers must convert the supplied AC electricity to DC power.
Electricity consumption	Measured in kilowatt-hours (kWh) and represents the amount of electricity that has been consumed over a certain time period.
Electric demand	Measured in kilowatts (kW) and represents the rate at which electricity is consumed. Most commercial energy rates incorporate a charge for electric demand as well as electric consumption.
Electric vehicle (EV)	A vehicle that uses an electric engine for all or part of its propulsion.
Electric vehicle supply equipment (EVSE)	Infrastructure required to support EVs such as chargers, electrical supplies, etc.
Heavy-duty vehicles	Commercial vehicles over a minimum Gross Vehicle Weight Rating (GVRW) of 8,500 lbs.
Hybrid Electric Vehicle (HEV)	Contains both an electric motor and a gasoline engine. The gasoline engine powers a generator that charges the electric motor. No external battery charger is used. Runs at a constant speed, which increases fuel efficiency.
Internal combustion engine (ICE)	Traditional vehicle engine that uses the direct combustion of gasoline, diesel, or other fuels.
Kilowatt-hour (kWh)	The amount of electricity being sent to the EV battery from the charger in one hour. This is calculated by volts times amps divided 1,000.
Level 1 charging station	Uses a standard 120-volt AC outlet and can take 8 to 12 hours to fully charge a depleted battery; intended for residential use only.
Level 2 charging station	Uses a 220-volt or 240-volt AC outlet and can fully charge a depleted battery in 4 to 6 hours; can be used in both residential and commercial settings.
Level 3/DC Fast charging station	Uses an industrial 480-volt DC outlet and can charge a battery to 80% in 20 to 30 minutes; used in commercial settings where the anticipated charge time is limited such as supermarket, gas station, etc.; will be used on the Alternative Fuel Corridors – a national network of major thoroughfares supporting EVs and other alternative fuels.
Light-duty vehicles	Passenger cars with a maximum Gross Vehicle Weight Rating (GVRW) of 8,500 lbs.
Plug-in Hybrid Electric Vehicle (PHEV)	Contains both an electric motor and a gasoline engine. An external plug is used to fuel the electric motor. The electric motor is used until the battery is depleted; at which point, the gasoline engine takes over. Lower tailpipe emissions than traditional ICE and longer ranges than most BEVs.
Range Anxiety	Fear of running out of power in an EV before reaching a charging station or desired destination.
Range per hour (RPH)	A measurement of the miles an EV can travel on one hour of charge. This is generally applied to EV charging stations and expressed in terms of typical EV efficiency.
Vehicle miles traveled (VMT)	A way of measuring integration of EVs and associated reduction in GHG emissions by considering electric miles replacing traditional vehicle miles.
Volts	A measurement of the force pushing the flow of energy through charger. This measurement is determined by electricity supply. Standard household outlets provide 120 volts, outlets for dryers or other high-powered household equipment supply 240 volts.

APPENDIX C:
PLANNING PROCESS RESOURCES

SAMPLE KICK-OFF MEETING AGENDA

[Community, State]
EV Roadmap Kick-off Meeting Agenda

[Date]

Discussion Topics

1) **Welcome & Introductions:** Introduce the project management team, including each person's role and background.

2) **Roles & Responsibilities:** Define the project teams and the tasks each will be responsible for. As an example:

   a. Project Management Team - A small team of municipal staff responsible for project coordination and deliverables.

   b. Stakeholder Team – The larger planning team that provides input during planning workshops. A preliminary list of community stakeholders should be identified at the kick-off meeting.

3) **Schedule/Approach:** Review the planning process schedule including preliminary timing of planning workshops and roadmap approval.

   a. Schedule workshops and PM team meetings

   b. Sample 4-month timeline

   - Month 1: Data Collection & Analysis, stakeholder recruitment
   - Month 2: Workshop #1
   - Month 3: Workshop #2
   - Month 4: Finalize and adopt/approve roadmap

4) **First Workshop Logistics:** For planning processes with a fast timeline, it can be useful to schedule the first workshop during the kick-off meeting.

   a. Date/Time

   b. Location

   c. Refreshments

5) **Community Background and Data:** Determine the data to be gathered to inform the community baseline and decide who will be responsible for requesting and processing data. See step 2 for more details.

6) **Additional topics/questions**

EXAMPLE STAKEHOLDER RECRUITMENT LETTER

[Publish Date]

Dear [Stakeholder Name],

[Community Name] is working to develop an Electric Vehicle (EV) Roadmap to help the [community name] meet its EV goals. The roadmap will help the [community name]:

- Understand the current state of EVs in our community and across the country
- Develop a vision of what the future of EVs looks like in [community name]
- Set goal(s) for EV adoption, to support the identified vision
- Determine the areas of EV adoption that are of highest importance to the community
- Identify and prioritize strategies to promote EV adoption

You have been identified as a member of the community who may have an interest in and/or expertise to offer this process. As such, we would like to extend to you an invitation to participate on an advisory committee to help develop our plan. This will entail attendance at 2 facilitated workshops over a 4-month period to help us develop goals, strategies, and a plan of action.

If you have questions about the program or would like to discuss your involvement on the planning committee, please contact me at the email address below.

Thank you for your time. Please share your availability so we can schedule our first workshop to launch this exciting opportunity for [community name].

Sincerely,

[SIGNATURE]

[COMMUNITY LEAD NAME]

SAMPLE WORKSHOP 1 AGENDA

[Community, State]
EV Roadmap Workshop 1 Agenda

[Date]

Discussion Topics

1. Welcome, Introductions, & Project Grounding (30 minutes)
2. Baseline Data Summary (15 minutes)
3. Vision Exercise (45 minutes)
4. Preliminary Goal Review (30 minutes)
5. Break (15 minutes)
6. Focus Area Framework (15 minutes)
7. Strategy Brainstorming (45 minutes)
8. Wrap-Up & Next Steps (5minutes)

SAMPLE WORKSHOP 2 AGENDA

[Community, State]
EV Roadmap Workshop 2 Agenda

[Date]

Discussion Topics

1. Welcome (10 minutes)
2. Vision Statement (10 minutes)
3. Focus Areas (15 minutes)
4. Strategy Prioritization (10 minutes)
5. Break (10 minutes)
6. Finalize Strategies (30 minutes)
7. Work Plan Activity (30 minutes)
8. Break (10 minutes)
9. Goal Review (10 minutes)
10. Target Setting (35 minutes)
11. Wrap-up and next steps (10 minutes)

SAMPLE PLAN OUTLINE

[Community, State]

EV Roadmap Plan Outline

1. Executive Summary – Summarizes the plan and outlines the vision, goals, and strategies.

2. Acknowledgements – Lists stakeholders and all other significant contributors to the plan.

3. Introduction

   a. Electric Vehicles 101 – Provides general information about EVs from types of vehicles, types of chargers, and necessary infrastructure.

   b. Why an EV Roadmap? – Supports the development of the plan in the larger context of the nation, state, and community.

   c. The Planning Process – Details the collaborative process between the stakeholders and planning team in the development of the plan.

   d. Vision and Goals – Presents the vision and goals guiding the plan.

4. Baseline – Establishing the starting point for the community to use for benchmarking in terms of characteristics, vehicle data, and greenhouse gas emissions data.

5. Focus Areas and Strategies – Describes the focus areas and strategies the community will use to achieve the desired goals as well as a workplan to guide for implementation.

6. Work Citied – Compiles all sources cited in the plan.

7. Appendix A – Contains all supporting data and information

ELECTRIC VEHICLE BASELINE SURVEY

Adapted from the Plug-In Electric Vehicle Community Readiness Scorecard, developed by the National Renewable Energy Laboratory (Rubin, 2013).

Education and Outreach

1) Does your area host a website for the general public that provides local information about electric vehicles (EVs) and charging infrastructure?

   a) Yes

   b) No

Comments:

2) Do your outreach efforts make use of available educational resources for EVs, such as the Alternative Fuels Data Center website, FuelEconomy.gov, or local coalition websites?

   a) Yes

   b) No

Comments:

3) Is your area connected with a national outreach program to encourage the use of EVs (such as Clean Cities or National League of Cities)?

   a) Yes

   b) No

Comments:

4) Are educational efforts in your area coordinated at the regional or state level?

   a) Yes

   b) No

Comments:

5) Is there electric vehicle supply equipment (EVSE) installer training or certification programs available for electricians in your area?

   a) Yes

   b) No

Comments:

6) Has there been a Ride and Drive Event hosted in your area?

a) Yes, we have them regularly.
b) Yes, we have done at least one.
c) No, but we have plans to do one in the future.
d) No, we have not and do not have current plans to do one.

Comments:

7) Are you conducting targeted EV outreach campaigns? Select all that apply.

a) No
b) Yes - Multifamily developments
c) Yes - Employers
d) Yes - Low-income residents
e) Yes - Other

Comments:

8) Does your area offer a tax incentive, grant, or rebate to purchase highway certified, EVs? If yes, indicate the maximum amount allowable per vehicle.

a) No
b) Less than $1000
c) $1001 to $2000
d) $2001 to $3000
e) More than $3000

Comments:

9) Does your area have a tax incentive, grant or rebate for residential of public charging equipment? If yes, indicate the maximum allowable per installation.

a) No
b) Less than $250
c) $251 to $500
d) $501 to $750
e) More than $750

Comments:

10) Does your area have any attractive financing or special purchase options for EVs or EVSE?

a) Yes

b) No

Comments:

Public Access

11) What low-cost or nonmonetary incentives for EVs does your area offer? Select all that apply.

a) Free parking

b) EV-specific parking

c) Exemption from vehicle testing (e.g., emissions)

d) HOV lane access or bypassing taxi queues

e) Free charging

f) Reduced licensing or registration fees

Comments:

12) Has a charging demand analysis study been conducted in your area?

a) Yes.

b) No, but we have one planned.

c) No.

Comments:

13) Does an EV-specific car share or ride hailing program exist in your area?

a) Yes.

b) No.

Comments:

14) Are local establishments offered incentives to allow public charging outside their properties?

a) Yes.

b) No.

Comments:

15) Is public equity considered when developing public infrastructure (such as proximity to residents with low availability for at-home charging?

a) Yes

b) No, but we are planning to include it in future plans.

c) No

Comments:

16) How is public EV infrastructure promoted and enforced? Select all that apply.

a) EV-only parking

b) Standardized signage and regulations

c) Locations listed on websites and apps

d) Others?

Comments:

Light and Heavy-Duty Fleet

17) Does your area have a municipal electrification plan (considering vehicle replacement, infrastructure, etc.)?

a) Yes, for both light and heavy-duty fleets.

b) Yes, for light-duty fleet only,

c) Yes, for heavy-duty fleet only.

d) No.

Comments:

18) Has an EV feasibility inventory been conducted in your area?

a) Yes, for both light and heavy-duty fleets.

b) Yes, for light-duty fleet only,

c) Yes, for heavy-duty fleet only.

d) No.

Comments:

19) Have sites for charging been identified (either criteria for the sites or actual locations)?

a) Yes, for both light and heavy-duty fleets.

b) Yes, for light-duty fleet only,

c) Yes, for heavy-duty fleet only.

d) No.

Comments:

20) Are any of the following employee engagement opportunities offered in your area? Select all that apply

a) Vehicle type training

b) Charging station training

c) Involvement in planning process

d) Employee incentive program

e) Others?

Comments:

21) Are there any procurement standards in place? Select all that apply.

a) Vehicle types

b) Charging station types

c) Group buy offerings

d) Others?

Comments:

Utility Coordination

22) Do utilities in your area have a program in place to address grid infrastructure requirements and operational impacts of charging for EVs?

a) Yes

b) No

Comments:

23) Do utilities in your area offer a separate rate for EVs?

a) Yes

b) No

Comments:

24) Do utilities in your area offer any tools to help the consumer understand the costs and benefits of EVs under different rate structures?

a) Yes

b) No

Comments:

25) How engaged are the utilities in local efforts to deploy EVs and charging infrastructure (for example, participation in planning efforts, working with local jurisdictions to understand building permitting and codes or working with public utility commissions on how to help with EV rollouts)?

a) Not engaged

b) Somewhat engaged

c) Moderately engaged

d) Highly engaged

Comments:

26) Have the utilities in your area analyzed the impacts of EVs on the local grid or forecasted the location of potential EV concentrations?

a) Yes

b) No

Comments:

Policy

27) In your area, what is the average time it takes for an EVSE owner or site manager to complete the permitting, installation, and, if applicable, inspection process?

a) Less than 1 day

b) 1 week

c) 1 to 2 days

d) 2 days to 1 week

Comments:

28) What are the options for submitting an EVSE permitting application? Select all that apply.

a) Online

b) Snail mail

c) In person

d) By telephone

Comments:

29) Indicate all the types of EVSE installation permit applications you have that are separate from general electrical work permit applications.

a) Residential
b) Commercial/workplace
c) Public
d) Fast charger
e) None

Comments:

30) How is information describing the permitting process made available? Select all that apply.

a) Online Training sessions
b) Telephone hotline
c) Other/not available
d) Print publications

Comments:

31) Is there an accessible, designated point of contact for questions about the EVSE permitting process?

a) Yes
b) No

Comments:

32) What is the average fee for a residential EVSE permit and inspection in your area? If your area charges a separate fee for these two services, add the two together.

a) $0-50
b) $51-100
c) $101-300
d) $301-500
e) More than $500

Comments:

33) What is the average fee for a commercial EVSE permit and inspection in your area? If your area charges a separate fee for these two services, add the two together.

a) $0-50

b) $51-100

c) $101-300

d) $301-500

e) More than $500

Comments:

34) Have permitting inspectors in your area been trained on the specifics of EVSE installations?

a) Yes

b) No

Comments:

35) Does your area have any existing policies that benefit EVs and infrastructure use (for example, local fleet mandates to use EVs, low carbon fuel standards, greenhouse gas emission regulations, planning/zoning requirements for new construction to include EVSE provisions, etc.)?

a) Yes

b) No

c) No, we have laws that restrict EVs

Comments:

36) Are there any future laws, policies, or incentives pending or planned that would affect the deployment of EVs?

a) Yes, there are laws or incentives that encourage EVs.

b) No.

c) No, there are proposed policies that restrict EVs.

Comments:

37) Have EV considerations been incorporated into local/regional planning efforts?

a) Yes, we have coordinated with surrounding entities to align on EV laws and policies.

b) We are in the process of coordinating efforts.

c) No.

Comments:

38) Are there local codes that accommodate EV (such as charging codes, street codes, building codes, parking codes)?

a) Yes, we have EVs integrated into all municipal codes.

b) Yes, we have EVs integrated into some municipal codes.

c) No, but we plan to integrate EVs into the codes in the future.

d) No, we have codes that restrict EVs.

Comments:

39) Are there policies that regarding the placement of public charging stations?

a) Yes

b) No

Comments:

APPENDIX D:
FUNDING RESOURCES

AVAILABLE LOCAL AND NATIONAL INCENTIVES AND POLICIES

To accelerate the shift towards EVs and cleaner transportation, local and national governments, non-profits, and other organizations are offering incentives, rebates, and policies changes for purchasing EVs and installing EVSE. The U.S. Department of Energy hosts a list of EV tax credits and other incentives across the country that include federal programs, state laws and regulations, and utility/private incentives.

National

- Qualified Plug-In Electric Vehicle (PEV) Tax Credit from the IRS.
- Xcel Energy periodically partners with car manufacturers to offer customers vehicle-specific rebates. Nissan USA is currently offering rebates until January 2, 2020 on the 2019 Nissan Leaf to Xcel Energy customers. Some restrictions apply.
- EV charger manufacturers such as ChargePoint.
- Insurance company may offer discounts for EV owners.
- Clean Cities Coalition – a national organization with nearly 100 local coalitions – is geared toward advancing vehicle electrification by connecting stakeholders with resources and information.
- The Climate Mayors Electric Vehicle Purchasing Collaborative lowers the cost of EVs and charging infrastructure for public fleets by leveraging the buying power of member communities. The Collaborative also hosts information and shares resources in support of EV transitions for public fleets.

Colorado

- Colorado Energy Office (CEO) and Regional Air Quality Council (RAQC) are funding the Charge Ahead Colorado program that supports installing Level 2 and Level 3 public chargers based on various criteria and the ALT Fuels Colorado that improves air quality by incentivizing fleet vehicle upgrades.
- Gunnison County Electric Association offers customers rebates on Level 2 home chargers with the requirement of signing up for time-of-use rates.
- Poudre Valley REA provides customers rebates on Level 2 home or public chargers and Level 3 chargers on a case by case basis.

- Holy Cross Energy residential customers can receive up to two free ChargePoint Home Level 2 chargers with the homeowner responsible for paying the installation costs.
- The State of Colorado is using its Volkswagen Emissions Settlement Program funds for initiatives that replace high emission vehicles such as diesel transit buses with alternative fuel sources, and the installation of public charging infrastructure both in communities and along major corridors. Various applications are available through existing programs.

Minnesota

- Xcel Energy uses two rate options to incentivize residential customers to charge EVs at home.
- Xcel Energy is offering an EV service pilot to 100 residential customers to simplify the path to add Level 2 charging to their homes.
- The Center for Energy and Environment (CEE) businesses in Minnesota an energy efficiency loan, which can include EV charging stations and PV solar infrastructure and installations. This can also be paired with the Property Assessed Clean Energy (PACE) financing solutions.
- Dakota Electric has rebates for installing residential EV chargers with a multi-step process.
- Connexus Energy offers residential customers rebates on Level 2 chargers with the requirement of signing up for time-of-use rates.
- Lake Region Electric Cooperative (LREC) is providing members reduced time-of-use rates for off-peak EV charging and rebates on Level 2 home chargers.
- Otter Tail Power Company is offering rebates for Level 2 home chargers and supplies customers with information regarding off-peak hour rates.
- The State of Minnesota is breaking its Volkswagen Emissions Settlement Program funds into three phases. The first phase is in effect until the end of 2019 and is currently accepting applications for projects that include replacing school buses and other heavy-duty fleet vehicles with EVs and installing public EV charging stations. The other two phases are still in the planning stages and the state is seeking public input.

Wisconsin

- The Wisconsin State Legislature provides a tax exemption for alternative fuel vehicles.
- Madison Gas and Electric is piloting a program to provide Level 2 home chargers from ChargePoint to electric customers in Wisconsin.
- Alliant Energy Corp. has rebates on Level 2 home and workplace chargers and on new or used EV purchases.
- The State of Wisconsin is focusing its initial use of the Volkswagen Emissions Settlement Program funds for public transit buses. The Transit Capital Assistance Grand Program application process was closed as of September 27, 2019 for cities to receive funding to upgrade public transit vehicles -focused on communities or routes deemed "critical for connecting employees with employers".

APPENDIX E:

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