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Metropolitan Council Electric Vehicles Planning Study: Electric Vehicle Landscape Summary

PRODUCED FOR THE METROPOLITAN COUNCIL
BY THE GREAT PLAINS INSTITUTE

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ABOUT THE GREAT PLAINS INSTITUTE

A nonpartisan, nonprofit organization, the Great Plains Institute works across the US to transform the energy system to benefit the economy and environment. Learn more at www.betterenergy.org.

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Executive Summary

The Metropolitan Council hired the Great Plains Institute and Bellwether Consulting in January 2021 to conduct an Electric Vehicles (EV) Planning Study with the following goals in mind:

- Summarize the current landscape related to EVs
- Evaluate and prioritize strategies for the Metropolitan Council to undertake that can accelerate the adoption of EVs as a means toward reducing greenhouse gas emissions
- Engage and inform staff and policy makers at the Metropolitan Council and partner agencies

The Metropolitan Council generally serves the seven-county region of the Twin Cities. As the federally designated Metropolitan Planning Organization for the region, it also serves the contiguous urban parts of Wright and Sherburne counties. This *Electric Vehicle Landscape Summary* addresses the first goal of the Electric Vehicles Planning Study, setting the stage for a subsequent report that evaluates and prioritizes strategies.

ROLE OF ELECTRIC VEHICLES IN ADDRESSING CLIMATE CHANGE

The Metropolitan Council's long-range plan for the Twin Cities region, *Thrive MSP 2040,* established sustainability as one of five desired outcomes to help guide future policy. According to the plan, working toward this outcome includes "providing leadership, information, and technical assistance to support local governments' consideration of climate change mitigation, adaptation, and resilience."[1]

As the Metropolitan Council works to mitigate climate change and meet other goals in *Thrive MSP 2040*, electrifying transportation is one piece of the puzzle. According to the US Environmental Protection Agency, the transportation sector emits the largest share of greenhouse gas emissions in the United States at 28.7 percent.[2] The same is true in Minnesota, where transportation emissions represent one-fourth of all greenhouse gas emissions.[3] More than 70 percent of the emissions produced by the transportation sector in Minnesota come from light-, medium-, and heavy-duty cars and trucks.[4]

Additionally, electrifying transportation can help reduce pollution for vulnerable populations, including children, seniors, people with preexisting health conditions, and people who are pregnant. Furthermore, it can reduce pollution for Black, Indigenous, people of color, and low-income communities facing greater pollution impacts from living close to high-traffic corridors.

STATE OF THE ELECTRIC VEHICLE MARKET

Light-Duty Electric Vehicles

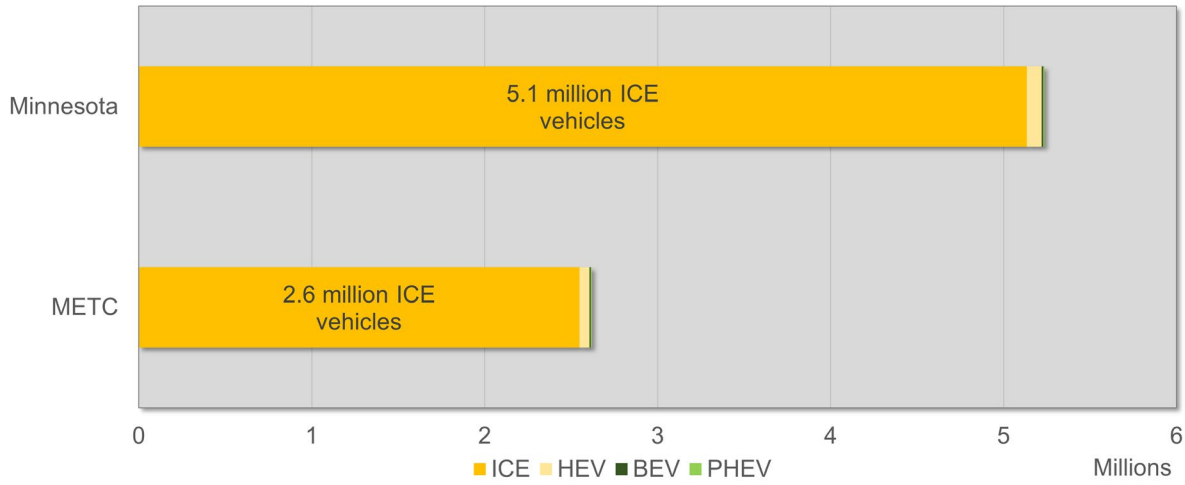
Light-duty vehicles include vehicles like compact cars, SUVs, and pickup trucks. When electrified, they can either be plug-in hybrid (using electricity and gasoline) or battery electric (solely using electricity). EVs usually save consumers money in reduced fuel and maintenance costs over the vehicle's lifetime, even though they tend to cost more upfront than conventional vehicles.

In the United States, there are 49 EV models available for purchase. Of the available EVs, 18 are battery EVs.[5] Compared to the rest of the US, the availability of EVs in the Midwest region is significantly more limited. In the Midwest, there are 39 EV models available, of which 15 are battery EVs.[6]

Based on Shift2Electric data, ranges for battery EVs on the US market can vary anywhere from 114 miles for the Mini Cooper SE to 405 miles for the Tesla Model S.[7] According to the US Office of Energy Efficiency and Renewable Energy, the median driving range for battery EVs was greater than 250 miles in 2020.[8] Over the next several years, the light-duty EV market is expected to grow and will introduce more vehicles that have an average range of 300 miles.

As of April 2021, only 0.37 percent of light-duty vehicles registered in Minnesota were EVs. Over 80 percent of the registered EVs in the state were located within the seven-county metropolitan area, as shown in figure 1 and table 1.

Figure ES-1. Vehicle registrations in the seven-county metropolitan region



Note: ICE means internal combustion engine, HEV means hybrid EV, BEV means battery EV, and PHEV means plug-in hybrid EV.

Sources: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Eidbo, April 2021); "Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

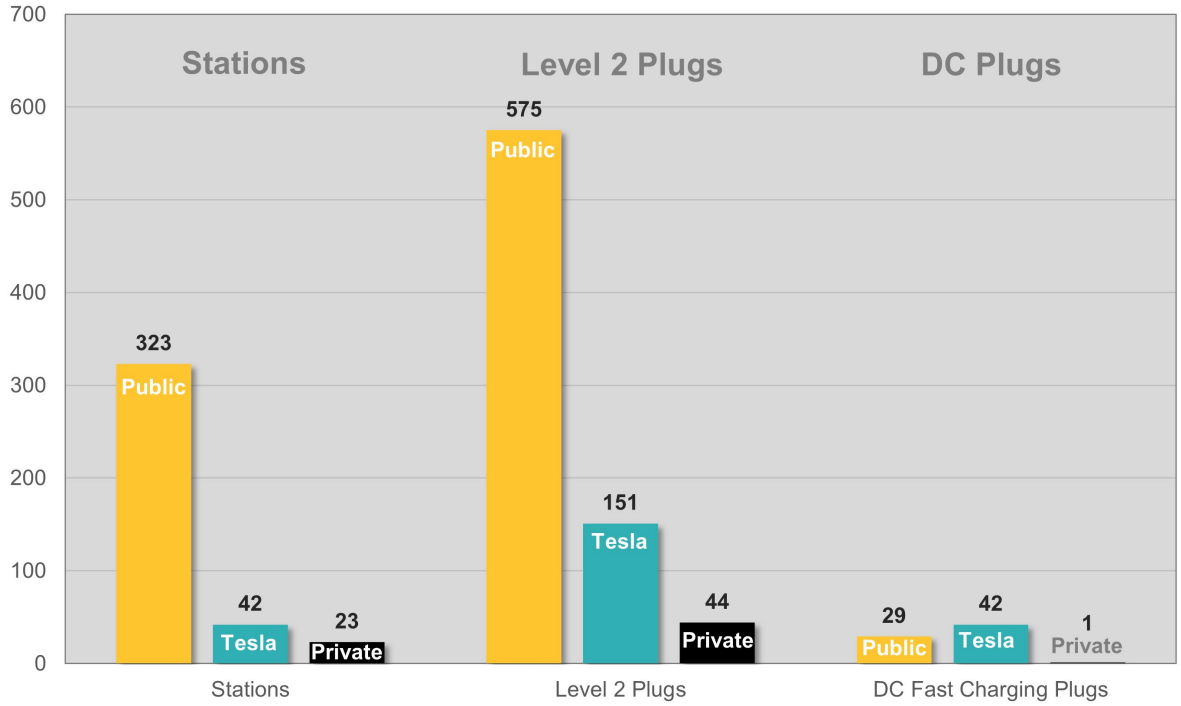
Table ES-1. Vehicle registrations in the seven-county metropolitan region

	BEV	PHEV	Hybrid	ICE	Total
Metro	8,453 (85% of state)	4,765 (77%)	59,932 (67%)	2,548,488 (50%)	2,618,638 (50%)
Minnesota	9,941	6,163	85,125	5,134,276	5,235,505

Source: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Eidbo, April 2021); "Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

Light-duty EVs can be charged on Level 1, Level 2, or direct current (DC) fast chargers. Across the metropolitan region, there are 388 charging stations with 770 Level 2 plugs and 72 DC fast charging plugs available. Figure 2 shows the breakdown between public, Tesla, and private stations.

Figure ES-2. Charging stations in the Twin Cities metropolitan region



Note: One station can have multiple charging plugs.

Source: "Electric Vehicle Charging Station Locations," US Department of Energy, Alternative Fuels Data Center, accessed November 10, 2021, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

Most of the metropolitan region's charging stations are concentrated close to the center of the Twin Cities region, with very few stations located in communities toward the region's outer edges. Communities toward the region's edges have fewer stations with multiple plugs available. Limited plugs mean longer waiting times if multiple drivers need to charge at a single station and even fewer options if a plug breaks down.

Several organizations across the state are working to increase the number of available charging stations, including the Minnesota Pollution Control Agency through the Volkswagen settlement funds, the Minnesota Department of Transportation through the Clean Transportation Pilot Program, the Clean Energy Resource Teams through seed grants, electric utilities, and others.

Medium- and Heavy-Duty Electric Vehicles

Medium- and heavy-duty vehicles include minibuses, step vans, bucket trucks, school buses, transit buses, long-haul tractor trailers, and others. Most medium- and heavy-duty EVs can travel over 100 miles on a single charge, with some vehicles traveling as far as 500 miles. Like light-duty EVs, medium- and heavy-duty EVs cost more upfront than conventional vehicles. According to the Pacific Gas & Electric Company, the purchase price for medium- and heavy-duty EVs can be twice that of comparable diesel vehicles. However, the company pointed out that medium- and heavy-duty EVs typically require less maintenance and repair and cost less to fuel, saving money for the fleet operator over time. The company also noted that incentive programs that reduce the upfront purchase price and charging costs can make these EVs very attractive to operate compared to conventional vehicles.[9]

Today, the most common electrified medium- and heavy-duty vehicles are step vans, school buses, and transit buses. Heavier vehicles like long-haul tractor trailers and garbage trucks are in varying stages of development but are not yet widely used.

As of April 2021, medium-duty vehicles represented 2.7 percent and heavy-duty vehicles represented 2.5 percent of all vehicle registrations in Minnesota. Only one heavy-duty vehicle registered in Minnesota was electric (no medium-duty vehicles were electric). However, the data only includes registered vehicles, excluding fleet vehicles that are not registered, including a significant share of Metro Transit vehicles.

Medium- and heavy-duty EVs use the same charging plugs as light-duty EVs except for Level 1 outlets. Yet, they often cannot use public charging stations designed for smaller light-duty EVs due to their larger size. They also have larger batteries, requiring longer charging times than most light-duty EVs. Heavy-duty EVs can take advantage of conductive automated connection devices, which automatically connect to the vehicle and can be used for on-route and overnight depot charging

ELECTRICITY PLANNING

As EV adoption increases, they will draw more electricity from the electric grid. System operators and electric utilities are planning for increased load and grid impacts associated with EVs. This includes the Midcontinent Independent System Operator that facilitates wholesale electricity markets in Minnesota.

Utility Electric Vehicle Programs

Electric utilities have designed time-varying rates, rebates, charging programs, and EV education campaigns to encourage increased transportation electrification, take advantage of increased electricity sales, and manage impacts on the electric grid from increased electricity load. In Minnesota, programs vary between investor-owned, cooperative, and municipal utilities. So far, investor-owned utilities and cooperative utilities have implemented more EV programs than municipal utilities in the Metropolitan Council's region.

BEST PRACTICES TO ACCELERATE ELECTRIC VEHICLE ADOPTION

EVs offer numerous benefits for individuals and society. They save consumers money through lower maintenance and operating costs, provide cleaner air by emitting zero tailpipe emissions and less particulate matter, reduce reliance on foreign oil, and more. As a result, countless entities throughout Minnesota are working to increase EV adoption.

Increasing Vehicle Availability and Access

While the number of EV models available to consumers and fleets has vastly improved since the introduction of EVs, vehicle availability still pales in comparison to conventional vehicles. Efforts to increase EV availability and access in Minnesota include the following:

- **Clean Cars Minnesota.** Clean Cars Minnesota requires all vehicle manufacturers to provide the Minnesota market with vehicles that produce reduced greenhouse gas and other air pollutant emissions compared to federal standards. Clean Cars Minnesota was adopted in July 2021 and is overseen by the Minnesota Pollution Control Agency.
- **Electric school bus pilot project.** As part of its plan to use the Volkswagen settlement funds, the Minnesota Pollution Control Agency awarded over $2.1 million in 2020 to purchase eight electric school buses for various school districts and one charging station for each bus.[10]
- **EV Spot Network.** Developed by the City of Saint Paul, City of Minneapolis, HOURCAR, and Xcel Energy, the network will also host publicly available EVs as part of a car sharing program called Evie. Users can return the vehicles to a charging hub or anywhere inside the service area.
- **Future Fuels Act.** Introduced through a bipartisan and bicameral process in 2021, this clean fuels standard could provide significant funding for EVs.
- **Gold Status Dealerships.** Xcel Energy offers a voluntary dealer partnership program with training, customer information, charging displays, and marketing to participating dealers. As a benefit of participating in the program, Gold Status Dealerships receive a kit that includes brochures, desktop signage, window clings, and an interactive educational charging pillar.
- **Metro Transit.** After deploying eight 60-foot fully electric buses on its METRO C Line, Metro Transit is now developing a Zero-Emission Bus Transition Plan to provide further guidance as it works to add more electric buses to its fleet, beginning with eight 40-foot electric buses that will be used on local routes in 2023. The plan is expected to be

completed by the end of February 2022. Metro Transit also plans to purchase up to 70 electric buses for use on routes in 2025.[11]

- **Purchase price incentives.** Drive Electric Minnesota and its partners have been working diligently to pass purchase price incentives through the Minnesota legislature to help lower the upfront cost of EVs.

Building Out Charging Infrastructure

Lack of charging infrastructure is often cited as a top barrier to increasing EV adoption. In addition to having the ability to charge at home, it is important for EV owners to have access to on-the-go charging at workplaces and other destinations. A robust charging network enables confidence among current and prospective EV owners as well as fleet drivers.[12] Several initiatives in Minnesota are working to build a robust charging network throughout the state:

- **Charging at multi-unit dwellings.** Recognizing the climate benefits EVs bring in addition to a desire to provide more amenities for residents, Green Rock Apartments owner Dale Howey installed charging stations at several of their multi-unit dwellings in Minneapolis in 2019. The shared chargers are available to tenants at no additional cost and are also used to charge Green Rock's fleet vehicles used for property maintenance.[13]
- **City leadership.** In September 2021, the city of Plymouth's city council approved a proposal from Carbon Solution Group to deploy 115 EV charging stalls throughout the city, including locations at Plymouth City Hall, Plymouth Ice Center, Plymouth Community Center, Station 73 Park and Ride, and several park locations.[14]
- **Electric Vehicle-Ready Certification Pilot Program.** The Great Plains Institute is developing an Electric Vehicle-Ready Certification Pilot Program with an aim to support cities and tribal nations in completing actions that encourage and facilitate EV adoption, including adopting policies that increase EV charger deployment.
- **EV Spot Network.** The network will provide EVs through a car sharing program, and create numerous EV charging hubs around the Twin Cities that anyone can use.
- **Future Fuels Act.** The proposed policy could provide significant funding for EVs and EV charging stations.
- **Volkswagen settlement.** The Minnesota Pollution Control Agency is using 15 percent of the Volkswagen settlement funds to expand EV charging infrastructure in Minnesota. The expansion includes a focus on DC fast chargers along highways in Greater Minnesota.
- **Zoning ordinances.** Local governments in the Twin Cities metropolitan region are encouraging charging station development through their zoning ordinances. For example, the City of St. Louis Park requires charging infrastructure to be installed in all new or reconstructed parking structures with varying requirements for multi-unit dwellings and non-residential buildings.

Beyond Minnesota, efforts led by other organizations to deploy charging infrastructure can serve as an example for the state. For example, North Florida Transportation Planning Organization used its power as a municipal planning organization to secure funding from the Congestion

Mitigation and Air Quality Improvement Program to invest in a regional EV charging network, partnering with JEA, a Florida utility. The organization used $300,000 in funding to install 25 charging stations and committed to investing another $450,000 to expand the network.[15]

Education, Outreach, and Marketing

Studies have shown that consumers who experience EVs firsthand are statistically more likely to consider purchasing one.[16] Numerous groups around Minnesota are working to increase EV education:

- **Cities Charging Ahead.** Cities Charging Ahead, facilitated by the Great Plains Institute and Clean Energy Resource Teams, was a peer learning cohort of 28 cities and tribal nations working to become EV ready. Numerous actions resulted from the first cohort, including a dozen cities purchasing, leasing, or planning to purchase EVs; 11 cities installing or planning to install charging stations; and 13 cities establishing or working to implement guidance on EV-ready development in the private sector.[17]
- **Drive Electric Minnesota.** Drive Electric Minnesota, facilitated by the Great Plains Institute, partners with city governments, state agencies, electric utilities, charging providers, and dealerships to further EV adoption throughout Minnesota. In 2021, the coalition launched the state's first Electric Vehicle Resource Database of educational resources from numerous organizations to broaden education efforts across the state.[18]
- **Local governments.** Local governments play a large role in transforming the EV market, and many cities and tribal nations have been taking action. For example, the City of Fridley, Minnesota, hosted a ride and drive event to encourage local EV adoption. The City of Fridley also incorporated EV awareness efforts into other city events like parades and environmental fun fairs.[19]
- **Minnesota Electric Vehicle Owners.** Minnesota Electric Vehicle Owners, a chapter of the National Electric Auto Association, provides a forum where EV owners can connect and continuously learn about new vehicles and technologies on the market. They also serve as a resource for prospective EV buyers.
- **Utilities.** Many electric utilities in Minnesota are educating their customers about EVs by hosting ride and drives, including information on their websites, and more.

There are several organizations actively working to increase EV education across the US, including Plug In America, EVNoire, Forth Mobility, and others. More information about regional and national education efforts can be found in the *2021 Minnesota Electric Vehicle Assessment: Increasing Demand for Electric Vehicles* on the Minnesota Department of Transportation's website.

Electric Vehicle Supply Chain Innovation

Similar to other consumer products like cell phones, EVs rely on batteries for power. Current battery composition requires materials that are mined, including lithium, cobalt, and nickel.[20] Of these materials, cobalt has been linked to unethical mining practices.[21]

As EV adoption increases, innovation will be critical to ensure a sustainable and ethical supply chain. National and global efforts to develop a more sustainable and ethical supply chain

include the Initiative for Responsible Mining Assurance, Drive Sustainability, lithium-ion recycling, and the Global Battery Alliance. Additionally, the Biden Administration has developed policy recommendations to improve America's supply chain that supports EV batteries. Local efforts in Minnesota include the following:

- **Exsolve Recycling Technologies.** The start-up company aims to extract key minerals used in EV batteries (cobalt, nickel, and copper) from industrial waste and harness them for new products like EVs.[22]
- **Rechargeable battery and products law.** In 1994, Minnesota passed a rechargeable battery and products law, overseen by the Minnesota Pollution Control Agency, that prohibits rechargeable batteries, including EV batteries, from being disposed of with mixed municipal waste.[23]

LOOKING AHEAD

This *Electric Vehicle Landscape Summary* addresses the first goal of the Metropolitan Council's Electric Vehicles Planning Study in summarizing the current landscape related to EVs. While several initiatives have increased EV adoption in Minnesota, it is still relatively low compared to conventional vehicles. To meet climate goals, EV adoption will need to increase significantly.

The subsequent report in this study will evaluate and prioritize strategies the Metropolitan Council can use to increase EV adoption.

Introduction

The Metropolitan Council hired the Great Plains Institute and Bellwether Consulting in January 2021 to conduct an Electric Vehicles Planning Study with the following goals in mind:

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Mitigating Climate Change

CLIMATE CHANGE GOALS

The Metropolitan Council's long-range plan for the Twin Cities region, *Thrive MSP 2040,* established sustainability as one of five desired outcomes to help guide future policy. According to the plan, working toward this outcome includes "providing leadership, information, and technical assistance to support local governments' consideration of climate change mitigation, adaptation, and resilience."[24]

In the Metropolitan Council's region, many local governments have outlined climate goals and taken action to mitigate climate change:

- **Comprehensive plans.** All cities located in the Metropolitan Council footprint are required to adopt a comprehensive plan. Typically, these plans provide regulation in areas like land use, housing, economic development, and transportation. The Metropolitan Council has included resilience as an optional component. The council found that cities within its boundaries have increasingly incorporated some aspects of climate and energy into their plans. According to an analysis by the Great Plains Institute, 24 percent of Metropolitan Council communities mentioned EVs or charging equipment within their plans.[25]
- **Hennepin County Climate Action Plan.** In 2021, Hennepin County adopted a climate action plan that set a goal to reduce greenhouse gas emissions by 40 percent by 2030 compared to 2010 levels. Additionally, the plan set a target for the county to have net-zero emissions by 2050.[26]
- **Minneapolis Climate Action Plan.** Among other goals laid out in their climate action plan, the City of Minneapolis aims to reduce greenhouse gas emissions by 30 percent by 2025. The city also aims to produce 10 percent of its electricity from local and renewable sources.[27]
- **Minneapolis Green Zones.** In 2017, the City of Minneapolis designated two Green Zones: the Southside Green Zone and the Northside Green Zone. Green Zones are defined as a "place-based policy initiative aimed at improving health and supporting economic development using environmentally conscious efforts in communities that face the cumulative effects of environmental pollution, as well as social, political and economic vulnerability."[28] In 2018, the Southside Green Zone received $75,000, and the Northside Green Zone received $40,000 in addition to the normally allocated program funds to assist in implementing their plans of action.[29]
- **St. Louis Park Climate Action Plan.** Adopted in 2018, the City of St. Louis Park set an ambitious goal in its climate action plan to have a net-zero carbon footprint by 2040. To help the plan succeed, it included a goal to reduce vehicle emissions by 25 percent, install EV chargers in public parking lots, increase EV adoption, and more.[30]

- **St. Paul Climate Action & Resilience Plan.** In 2019, the City of Saint Paul adopted a Climate Action & Resilience Plan with a goal of achieving carbon neutrality citywide by 2050. The plan outlines several high-impact strategies to reduce greenhouse gas emissions across four categories: residential (under five units), commercial and industrial, transportation, and waste and water.[31]
- **Zero-Emission Bus Transition Plan.** Metro Transit purchased eight 60-foot electric buses that it piloted on the METRO C Line and plans to buy eight 40-foot electric buses for use on other local routes in 2023. It is also developing a Zero-Emission Bus Transition Plan, with an expected completion date in February 2022. Metro Transit also plans to purchase up to 70 electric buses for use on routes in 2025.[32]

Beyond the Metropolitan Council's region, the threat from climate change is evident in international, national, and regional goals, benchmarks, and laws:

- **International.** The most notable international actions that have occurred include the Sustainable Development Goal 13 and the Paris Agreement. All United Nations' Member states, including the United States, adopted the Sustainable Development Goals in 2015. Goal 13 specifically calls for urgent action to combat climate change and contains five targets for countries to meet this goal successfully.[33] The United Nations also spearheaded and adopted the Paris Agreement in 2015, an international treaty aiming to limit the rise of the global temperatures compared to pre-industrial levels by no more than 2 degrees Celsius, but ideally 1.5 degrees Celsius. The Paris Agreement operates in 5-year cycles—with each cycle, the economic and social transformation goals become continuously more ambitious.[34] The United States officially re-joined this initiative in January 2021.
- **National.** In April 2021, the Biden Administration announced that the United States will aim to reduce emissions by 50-52 percent compared to 2005 levels by 2030. Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, made further commitments to climate change initiatives, focusing on
    - mobilizing financing,
    - transforming energy systems and the transportation sector,
    - creating a workforce that benefits from the clean energy economy,
    - scaling clean technologies through innovation,
    - providing support and building the resilience of vulnerable nations affected by climate change, and
    - promoting and implementing nature-based solutions.[35]

  Additionally, the bipartisan Energy Act of 2020 that passed in late 2020 authorized over $35 billion in funding for technologies that will meet energy and climate goals.[36]

- **Regional.** State governments across the United States have taken additional actions to address climate change. Twenty-four states, including Minnesota, and

Washington D.C., adopted targets to reduce greenhouse gas emissions, demonstrating broad support for climate action. Additionally, 32 states have either released a climate action plan or are developing one.[37]

In Minnesota, mitigating climate change continues to be a top priority, which is evident by the numerous goals and plans adopted over the years:

- **Next Generation Act (2007).** Minnesota adopted the Next Generation Act in 2007, which set targets to reduce greenhouse gas emission levels 15 percent by 2015, 30 percent by 2025, and 80 percent by 2050 compared to 2005 levels.[38] Minnesota did not meet its 2015 target and is not on track to meet its 2025 or 2050 targets without further intervention.[39]
- **Statewide Multimodal Transportation Plan (2012).** Developed by the Minnesota Department of Transportation, the Statewide Multimodal Transportation Plan is a 20-year policy plan for the state's transportation sector. One of its strategies is to "minimize and reduce total greenhouse gas emissions."[40]
- **Climate Solutions and Economic Opportunities (2014).** This report, led by the Minnesota Environmental Quality Board, identifies actions through 2030 that can reduce greenhouse gas emissions, reach climate goals, and recognize opportunities for cross-sector partnerships.[41]
- **Statewide Multimodal Transportation Plan (2017).** In January 2017, the Minnesota Department of Transportation updated its 2012 plan to "establish a greenhouse gas emissions reduction goal for the transportation sector that aligns with the Next Generation Energy Act."[42]
- **Executive Order 19-27 (2019).** Minnesota Governor Tim Walz signed Executive Order 19-27, which develops sustainability goals, creates a sustainability enterprise governance system, and denotes cabinet agency responsibilities. Goals related to sustainability aim to conserve energy and water and reduce fossil fuel consumption, greenhouse gas emissions, and solid waste production.[43]
- **Pathways to Decarbonizing Transportation in Minnesota (2019).** A collaboration between many state agencies, *Pathways to Decarbonizing Transportation in Minnesota* examines ways to reduce greenhouse gas emissions caused by light-, medium-, and heavy-duty vehicles. Recommendations and next steps are highlighted in the report.[44]
- **Clean Energy Plan Proposal (2021).** In January 2021, Governor Walz revealed policy proposals known as the 100 percent Clean Energy Plan. The four-part plan uses the Next Generation Energy Act as a foundation and would do the following:
    - Require all electric utilities to use carbon-free energy by 2040
    - Require the prioritization of energy efficiency and clean energy when proposing replacing or building new power generation
    - Make energy optimization a priority and focus on energy-saving assistance for low-income households

    - Set a target of reducing greenhouse gas emissions from existing buildings by half by 2035.[45]
- **Minnesota Electric Vehicle Assessment (2021).** Building on the 2019 report *Accelerating Electric Vehicle Adoption: A Vision for Minnesota,* this assessment "provides updated data on EV market trends, highlights proven strategies to increase EV adoption, and recommends actions the state can take to meet EV adoption and carbon pollution reduction goals with a focus on equity."[46]

ROLE OF ELECTRIC VEHICLES IN ADDRESSING CLIMATE CHANGE

As the Metropolitan Council works to mitigate climate change and meet other goals in *Thrive MSP 2040*, electrifying transportation is one piece of the puzzle. According to the US Environmental Protection Agency, the transportation sector emits the largest share of greenhouse gas emissions in the United States at 28.7 percent.[47] The same is true in Minnesota where transportation emissions represent a quarter of all greenhouse gas emissions.[48] More than 70 percent of the emissions produced by the transportation sector in Minnesota come from light-, medium-, and heavy-duty cars and trucks.[49]

Vulnerable groups, including children, seniors, people who are pregnant, and people with preexisting health conditions like asthma, all experience greater impacts from transportation pollution. These impacts include asthma attacks, lung cancer, shortness of breath, increased susceptibility to infections, and more.[50] Black, Indigenous, people of color, and low-income communities also experience greater impacts from transportation pollution due to living closer to high-traffic corridors. Electrifying transportation can help reduce pollution for these vulnerable populations and meet climate goals by reducing greenhouse gas emissions.

However, electrifying transportation alone is not enough to fully reduce transportation emissions, as demonstrated by E3's modeling in *Pathways to Decarbonizing Transportation in Minnesota*. Other strategies that make up a comprehensive transportation strategy include improving vehicle efficiency, using more low-carbon fuels, reducing electric sector emissions, providing alternatives to traveling alone in a vehicle, and others.[51]

State of the Electric Vehicle Market

The three types of vehicle weight classes covered in this summary include light-duty, medium-duty, and heavy-duty, as shown in table 1.

Table 1. Vehicles by weight class according to Federal Highway Administration

Class	Weight (lbs.)	Vehicles Included	Classification
1 & 2	< 10,000	• Sedans • SUVs • Pickup trucks	Light-duty
3,4,5, & 6	10,001 - 26,000	• Shuttles • Vans • Delivery trucks • School buses	Medium-duty
7 & 8	> 26,001	• Transit buses • Refuse trucks • Semi-trucks	Heavy-duty

Source: "Vehicle Weight Classes & Categories," Alternative Fuels Data Center (website), accessed September 27, 2021, https://afdc.energy.gov/data/10380.

LIGHT-DUTY ELECTRIC VEHICLES

Types of Electric Vehicles

Plug-in EVs consist of battery EVs and plug-in hybrid EVs. Battery EVs are fully electric, while plug-in electric hybrids rely on both electricity and gasoline for fuel.[52]

RANGE

EV ranges, or how far a vehicle can travel on a single charge, have vastly increased since their introduction. Based on data compiled by Shift2Electric, current ranges for battery EVs on the market in the United States can vary anywhere from 114 miles for the Mini Cooper SE to 405 miles for the Tesla Model S.[53] According to the Office of Energy Efficiency and Renewable Energy, the median driving range for battery EVs was greater than 250 miles in 2020.[54]

EV ranges can vary from day to day based on a variety of factors such as temperature extremes, driving habits, and driving conditions. On cold days, drivers may use more energy to heat the car's interior and defog the windows. On hot days, they may use more energy to cool the vehicle's interior.[55] According to a report by AAA, EV range decreased 41 percent when temperatures dropped to 20 degrees Fahrenheit while using the heating system. Without using the heating system, the range was only reduced by 12 percent.[56]

EV drivers can maximize their range by avoiding hard breaking, pre-heating or cooling the cabin while plugged in, following the speed limit, using the economy mode feature, and removing excess weight.[57]

Over time, an EV's range will reduce slightly due to battery degradation, which reduces the capacity of the battery to store energy. High temperature, time, high electric current, operating

at extreme states of charge, and the number of energy cycles impact an EV's battery health. However, according to a study by Geotab, battery degradation minimally impacts EV range over its lifetime. On average, a battery will lose 2.3 percent capacity every year, but only 1.6 percent in ideal driving conditions. After five years of using an EV with 150 miles of range, the average user will experience a loss of 17 miles of range. Manufacturers have built-in safeguards to reduce impacts from battery degradation. These include preventing batteries from completely charging or completely depleting and having thermal management systems to prevent batteries from overheating.[58]

COST

EV costs consist of the upfront cost and total ownership costs. EVs tend to have higher upfront costs but lower total ownership costs compared to conventional vehicles. A study by *Consumer Reports* suggests that owning an EV could save an average person anywhere from $6,000-$10,000 over the course of a vehicle's life from lower maintenance and fueling costs.[59]

According to the International Council on Clean Transportation, upfront EV costs are likely to decrease because of improved battery technology, scale improvements, and lower costs incurred by the automaker for research and development. As a result, battery EVs with a range of 150 miles could achieve cost parity with conventional vehicles in 2024. Battery EVs with ranges above 200 miles are not expected to reach price parity until 2026 and beyond. Meanwhile, plug-in hybrid EVs with a range of 50 miles may never reach cost parity with traditional cars due to their dual-fuel systems.[60]

AVAILABILITY

In the United States, there are a total of 49 EVs models available for purchase. Of the EVs available, 18 are battery EVs.[61] Compared to the rest of the United States, the availability of EVs in the Midwest region is significantly more limited. In the Midwest, there are 39 EVs models available, and 15 are battery EVs.[62] According to Jukka Kukkonen, founder of Shift2Electric, greater availability of EV models can increase EV sales. In 2020, the United States saw just a handful of new EV models introduced to the market, compared to dozens of new EV models introduced to the European market. As a result, sales in Europe surpassed one million EVs sold, tripling their sales.[63] BloombergNEF arrived at a similar conclusion in its *Zero-Emission Vehicles Factbook,* citing that "a lack of EV models to choose from, combined with weak fuel economy standards, are among the reasons for the U.S. lagging China and Europe in ZEV [zero emission vehicle] deployment."[64]

OUTLOOK

The light-duty EV market is expected to grow over the next several years. By the end of 2024, *Consumer Reports* suggests there will be nearly 100 new battery EV models on the market, including compact cars, sedans, SUVs, coupes, pickup trucks, and crossovers.[65] Table 2 lists several EVs that will be introduced to the US market in the future.

Table 2. New electric vehicle models and date available in the US

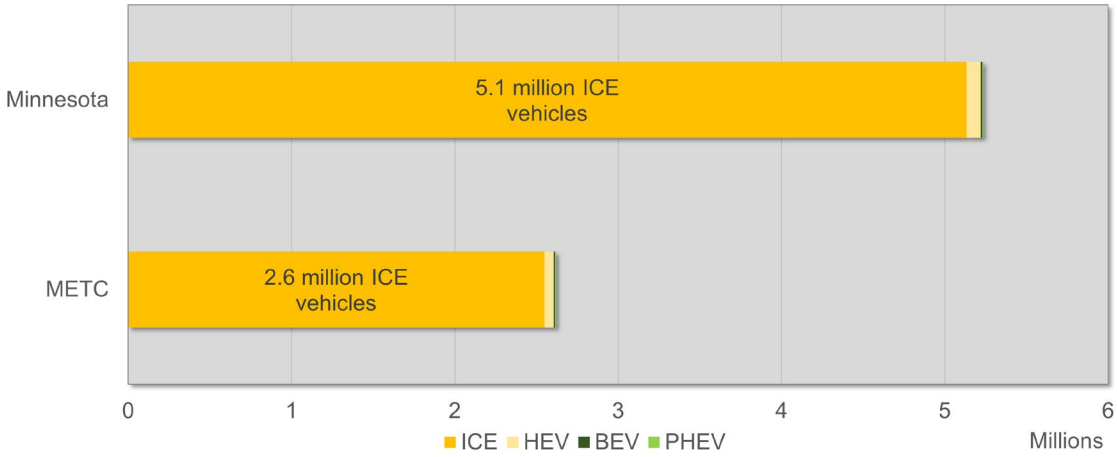
Make	Model	Projected Range	Expected Availability
Audi	Q4 e-tron	250 miles	2021
Kia	EV6	300 miles	Late 2021
BMW	i4	300 miles	Late 2021
GMC	Hummer EV SUV Edition 1	300 miles	Early 2022
Bollinger	B1	200 miles	2022
Mercedes-Benz	EQB	200-250 miles	2022
Tesla	Cybertruck	250 miles	2022
Ford	F-150 Lightning	230 miles	Spring 2022
Mazda	MX-30	124 miles	2022-2023
Cadillac	Lyriq	300 miles	Early 2023
Chevrolet	Silverado Electric	Up to 400 miles	2024

Sources: "Every Electric Vehicle That's Expected in the Next Five Years," *Car and Driver*, April 26, 2021, https://www.caranddriver.com/news/g29994375/future-electric-cars-trucks; "Hot New Electric Cars That Are Coming Soon," *Consumer Reports*, June 4, 2021, https://www.consumerreports.org/hybrids-evs/hot-new-electric-cars-are-coming-soon/; "The Truck of the Future is Here: All-Electric Ford F-150 Lightning," Ford Motor Company, May 19, 2021, https://media.ford.com/content/fordmedia/fna/us/en/news/2021/05/19/all-electric-ford-f-150-lightning.html.

Electric Vehicle Adoption Today

The *2021 Minnesota Electric Vehicle Assessment* published by the Minnesota Department of Transportation reported Minnesota EV adoption trends from 2018 to 2021, showing that only 0.37 percent of light-duty vehicles registered were EVs as of April 2021.[66] Over 80 percent of the registered EVs in the state were located within the seven-county metropolitan area, as shown in figure 1 and table 3.

Figure 1. Vehicle registrations in the seven-county metropolitan region



Sources: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Eidbo, April 2021); "Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

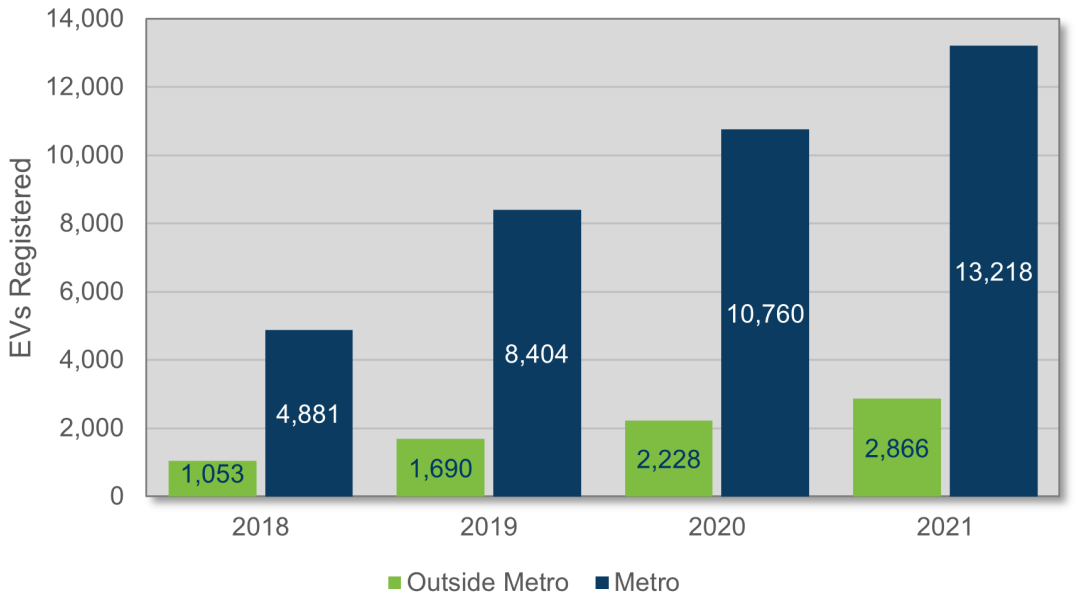
Table 3. Vehicle registrations in the seven-county metropolitan region

	BEV	PHEV	Hybrid (HEV)	ICE	Total
Metro	8,453 (85% of state)	4,765 (77%)	59,932 (67%)	2,548,488 (50%)	2,618,638 (50%)
Minnesota	9,941	6,163	85,125	5,134,276	5,235,505

Sources: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Wyatt, April 2021); "Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

While the share of EVs on the road today in Minnesota and the Twin Cities area is still relatively small compared to the total number of vehicles on the road, it has grown considerably since 2018, as shown in figure 2. The subsequent report to this *Electric Vehicle Landscape Summary* will explore EV growth scenarios for the metropolitan area as well as strategies to increase EV adoption and meet climate goals.

Figure 2. Electric vehicle adoption growth in Minnesota (2018-2021)

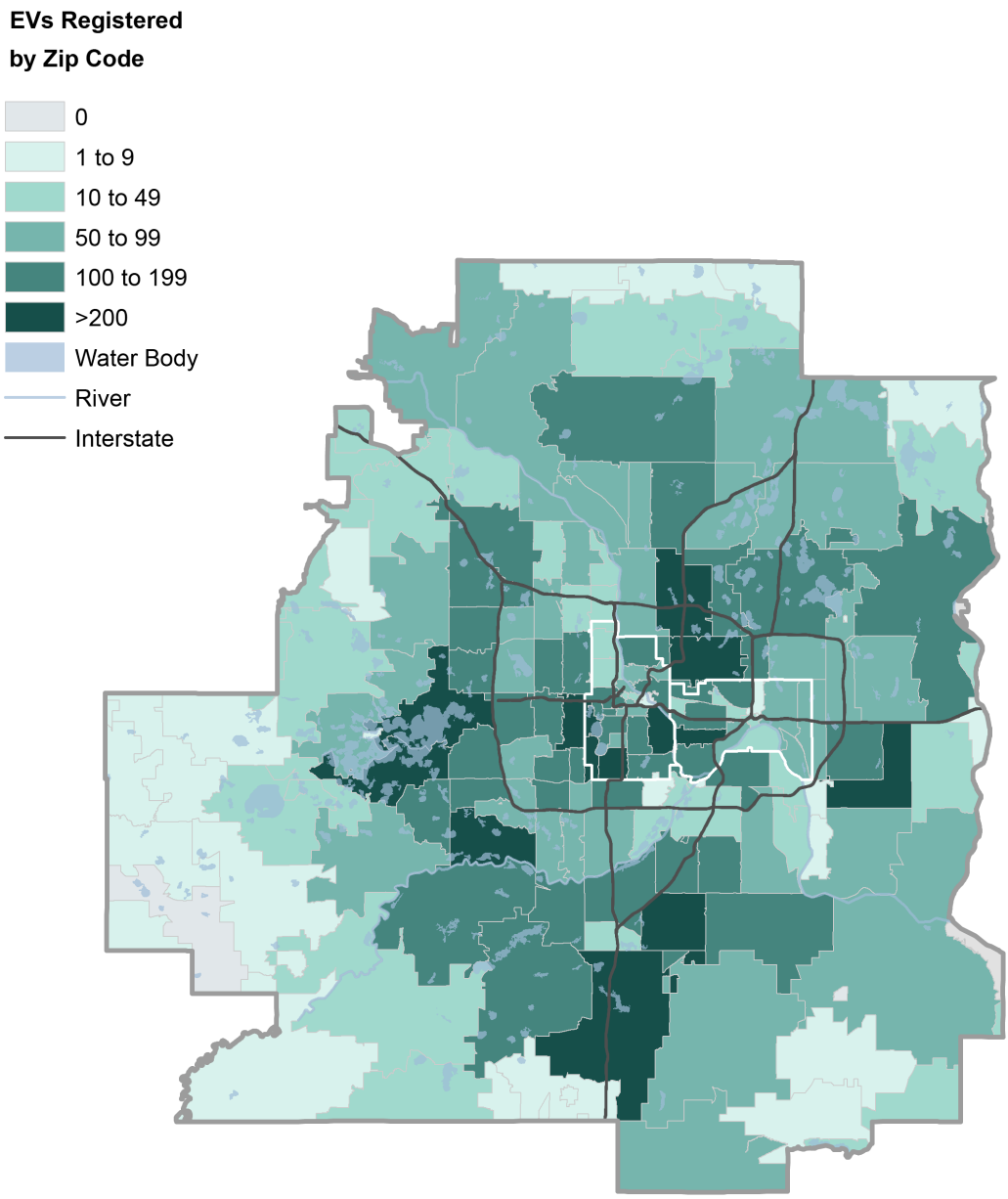


Note: Includes battery EVs and plug-in hybrid EVs. The chart does not reflect EVs registered to out of state or invalid zip codes.

Source: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Eidbo, April 2021); "Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

Mapping EV registrations by zip code shows that there is a greater concentration in various pockets of the metropolitan area with less concentration visible further away from the center of the Twin Cities region, as shown in figure 3.

Figure 3. Electric vehicle registrations mapped by zip code in the metropolitan region



Sources: Minnesota Department of Public Safety and Minnesota Pollution Control Agency (unpublished statewide vehicle registration data shared via secure email communication to Jessi Eidbo, April 2021); Minnesota EV dashboard," Minnesota Pollution Control Agency (website), updated June 12, 2021, https://www.pca.state.mn.us/air/minnesota-ev-dashboard.

Charging Light-Duty Electric Vehicles

All EVs need to refuel by plugging into a wall outlet or charging station. Table 4 below describes the various methods used to charge light-duty EVs.

Table 4. Charging standards used in Minnesota

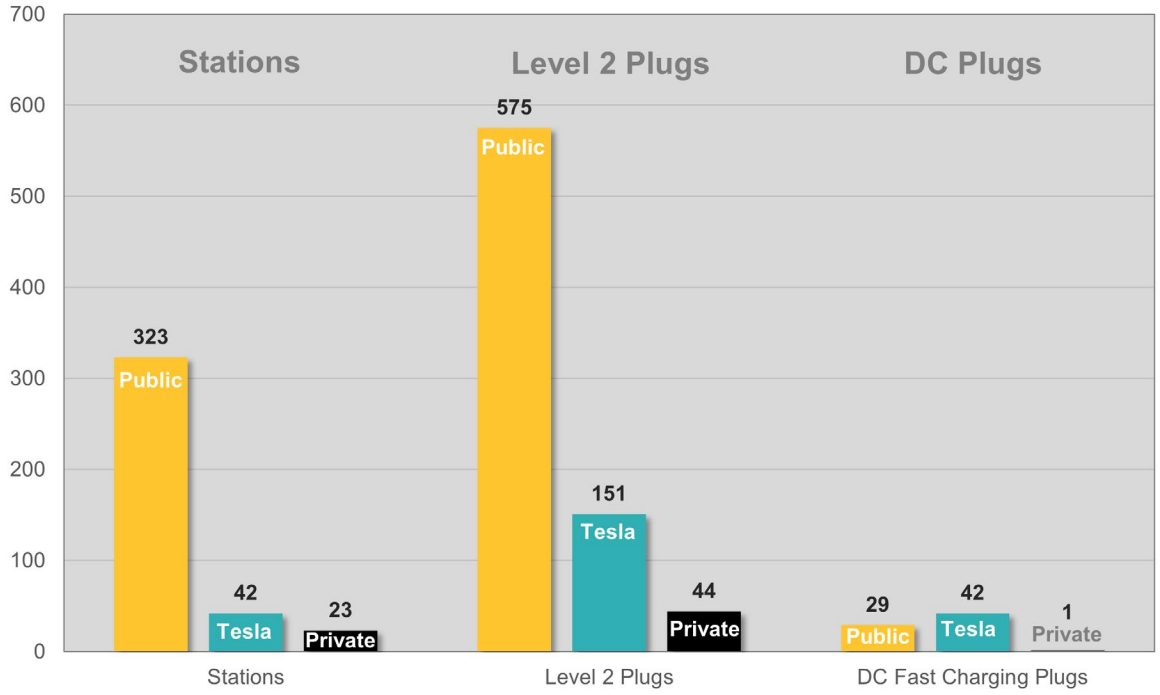
	Level of Charging	Plug Standard	Voltage	Charging Time	Vehicles
	Level 1	-	120 volts	2-5 miles of range per hour connected	All
	Level 2	J1772	240 volts	10-20 miles of range per hour connected	All
	DC Fast Charging	CCS-1	25kW-350kW	80-90 miles of range in 30 minutes with 50kW station	Chevy Bolt, BMW i3, Kia e-Niro, Jaguar I-Pace, Nissan Ariya, and others
	DC Fast Charging	CHAdeMO	25kW-150kW	80-90 miles of range in 30 minutes with 50kW station	Nissan Leaf, Mitsubishi Outlander, and Tesla vehicles (with adaptor)
	DC Fast Charging	Tesla Supercharger	up to 250kw	100 percent in less than 25 minutes	Tesla vehicles only

Source: Adapted with permission from “Charging Electric Vehicles 101,” Drive Electric Minnesota (website), https://www.driveelectricmn.org/charging/.

AVAILABILITY

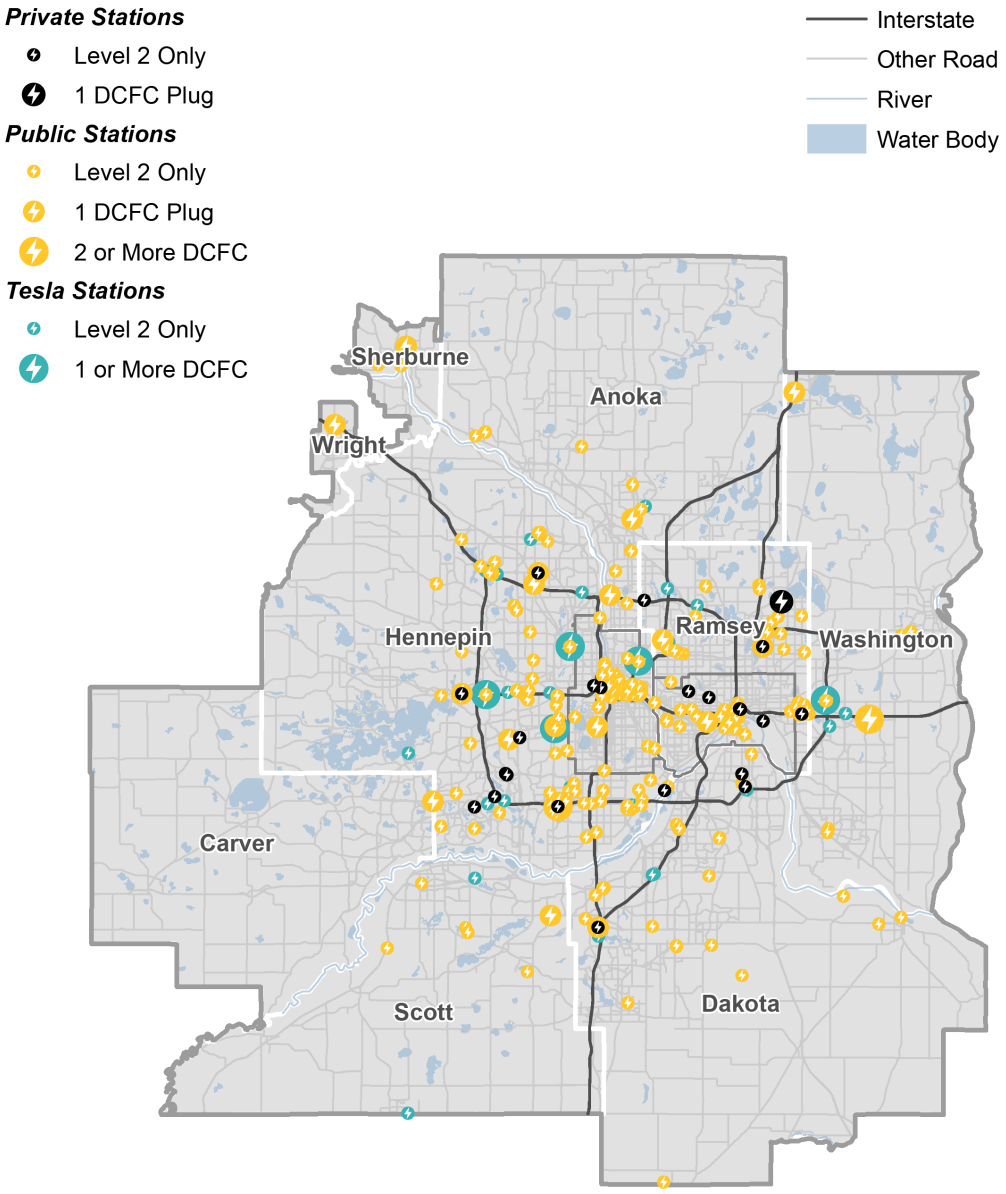
Across the metropolitan region, there are a total of 388 charging stations with 770 Level 2 plugs and 72 DC fast charging plugs available. Figure 4 shows the breakdown between public, Tesla, and private stations, and figure 5 shows the geographic spread across the region.

Figure 4. Existing charging stations in the Twin Cities metropolitan region



Source: "Electric Vehicle Charging Station Locations," US Department of Energy, Alternative Fuels Data Center, accessed November 10, 2021, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

Figure 5. Existing charging stations by access type and number of DC fast charger plugs



Source: "Electric Vehicle Charging Station Locations," US Department of Energy, Alternative Fuels Data Center, accessed May 25, 2021, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

As shown in figure 5, most of the metropolitan region's charging stations are concentrated close to the center of the Twin Cities region, with very few stations located in communities toward the region's outer edges. Additionally, communities toward the region's edges have fewer stations with multiple plugs available, meaning longer waiting times if there are multiple drivers needing to charge at a single station and fewer options if a plug breaks down. Several organizations across the state are working to increase the number of available charging stations, including the Minnesota Pollution Control Agency through the Volkswagen settlement funds, the Minnesota

Department of Transportation through the Clean Transportation Pilot Program, electric utilities, Clean Energy Resource Teams through seed grants, and others.

The subsequent report to this *Electric Vehicles Landscape Summary* will explore priority locations for additional charging stations in the metropolitan area to best support increased EV adoption.

COST OF INSTALLATION

Installation costs for charging stations can vary greatly based on the type of charger, features of the charger, location, and how much work is needed to connect the station to the power source.

Level 1 charging typically does not require any installation since many garages come equipped with a basic wall outlet. However, prospective drivers without electricity in their garages will face higher costs associated with running electricity to the garage and installing one or multiple wall outlets.

Installing a Level 2 charging station can cost anywhere between $500 and $15,000. Residential Level 2 charging stations typically cost less ($500-$2,000) than commercial charging stations ($5,000-$15,000). The charging unit itself can cost anywhere from $400 to several thousand dollars depending on if it is non-networked (less expensive) or networked (more expensive).[67]

DC fast charging stations are significantly more expensive to install compared to Level 2 stations and vary depending on the voltage of the unit. Purchasing a 50kW charging unit can run from $25,000 to $40,000, and higher voltage charging units will cost more. DC fast chargers with a 150kW voltage, for example, typically cost more than $75,000. Installation for DC fast chargers can range from $60,000 to $100,000.[68]

Operation and Maintenance

In addition to unit costs and installation costs, the operation and maintenance costs for the charger's lifespan should be considered, especially for networked Level 2 chargers and DC fast chargers.[69] Recommended maintenance includes things like cable management, checking parts for any needed repairs, and cleaning the equipment. According to the Alternative Fuels Data Center, maintenance could cost $400 per charger annually, though it will differ based on manufacturer and type of charger.[70] Generally, the more bells and whistles a charger has, the more maintenance it requires. For example, a Level 2 networked charging station with a credit card swipe and touchscreen will likely require more repairs over time than a Level 2 non-networked charging station without those features. Depending on which element has broken down, either an electrician or network provider should be able to handle the repairs.[71]

Many network and third-party providers now offer operating and maintenance packages to site hosts to alleviate the burden of providing regular maintenance. For example, EV Connect offers EV Connect Shield that includes support for both hardware and software. The company promises to dispatch a team within 72 hours if it cannot troubleshoot the issue remotely.[72] ChargePoint offers a similar package through its ChargePoint Assure program.[73]

Demand Charges

In commercial settings, more energy is needed to power the lights and run heavy industrial equipment. Due to this increased need for energy, the utility must install a system that can handle the high-power capacity. Utilities often pass on this extra expense to install and run these systems to commercial users via demand charges. Because DC fast chargers must deliver a high energy output in a short period of time, utilities may assess demand charges to their site owners. Demand charges can be very costly for the operator, especially if the station is not used enough to recoup costs.[74]

A study led by the Great Plains Institute and other stakeholders showed that managed charging and pairing EV charging with solar energy can mitigate demand charges for the operator. Managed charging can regulate the rate at which charging occurs to meet a management goal, allowing the operator to minimize demand charges. Aligning managed EV charging and solar energy production through an on-site solar array can further reduce demand charges.[75]

COST OF CHARGING

Charging costs for EV drivers vary based on where the charger is located (e.g., home or public). If charging at home, costs are limited to the driver's electricity rates set by their electric utility. If charging in public, charging could be free or cost a nominal fee, which is determined by the charging network or the property owner. Operators may decide to collect user fees to generate revenue.[76] However, the monthly fees required to process user payments (e.g., credit card transactions) often cost more than the revenue received, particularly when station use is low. For this reason, site hosts may decide to offer the charging for free until EV adoption reaches a point where revenue is greater than monthly transaction fees. On the other hand, operators may choose to provide charging for free as a public amenity to encourage EV adoption and may determine that they can easily absorb the electricity costs generated by charging stations.

Charging at DC fast chargers generally costs more than charging at a Level 2 due to the higher electricity output. According to Drive Electric Minnesota, "some stations assess a per kilowatt-hour fee (e.g., $0.30/kWh or more), others assess a per hour fee (e.g., $12/hour), and still others assess a connection fee in addition to a per kilowatt-hour or by minute or hourly fee (e.g., $2.50 to connect and $0.35/kWh)."[77]

REGULATION

In Minnesota, statutes define requirements for charging stations installed in the state. Minnesota Statutes 325F.185 and 326B.35 require EV charging stations to accommodate any EV model, adhere to state safety standards, and facilitate bi-directional charging when cost-effective for electrical utilities.[78] Additionally, Minnesota Statute 216B.02 states that EV charging operators are not defined as a public utility, meaning the Minnesota Public Utilities Commission does not regulate them.[79]

ROLES

Action from both the private sector and public sector is needed to build out a successful and reliable charging network. Until EV adoption increases to a point where charging stations are profitable for the private market, incentives provided by governments can help kick-start the

market.[80] Additionally, actions by local and state governments can provide much-needed guidance for private investment. For example, state governments can adopt regulations that encourage interoperability within the private market. Without interoperability, customers have a steep learning curve when navigating which DC fast charging plugs can fuel their EV. They may find themselves stranded at a charger that is unable to fuel their vehicle. A lack of interoperability among charging network providers also forces customers to maintain accounts for all network providers they wish to use (e.g., EVgo, ChargePoint, Greenlots, etc.).[81] At the same time, action taken by local governments to adopt zoning ordinances and building codes encouraging EV development by the private market can speed up market penetration.

MEDIUM- AND HEAVY-DUTY ELECTRIC VEHICLES

Medium- and heavy-duty vehicles come in various shapes and sizes to fit application needs, including minibuses (Class 3), step vans (Class 4), bucket trucks (Class 5), school buses (Class 6), transit buses (Class 7), long-haul tractor trailers (Class 8), and others.

Range

Ranges of medium- and heavy-duty EVs vary based on the use case, manufacturer, and vehicle model. Most medium- and heavy-duty EVs can travel beyond 100 miles on a single charge, but there are some vehicles that can travel much further, as shown in table 5. As battery costs come down and vehicles become more efficient, medium- and heavy-duty EVs will likely see increased ranges.

Table 5. Sampling of estimated ranges of available and upcoming medium- and heavy-duty electric vehicles in the US

Use Case	Manufacturer	Vehicle Model	Estimated Range
Transit Bus	Proterra	ZX5	120 mi
School Bus	Blue Bird	All-American RE Electric	120 mi
School Bus	Lion	LionA	150 mi
Medium-duty Step Van	Workhorse	E-100	150 mi
Cargo Van	Chanje	V8100	150 mi
Transit Bus	BYD	K11M	220 mi
Heavy-duty Truck	Tesla	Semi	500 mi

Source: CALSTART, “Zero-Emission Technology Inventory Tool Version 5.9,” Global Commercial Vehicle Drive to Zero (website), accessed September 30, 2021, https://globaldrivetozero.org/tools/zero-emission-technology-inventory/.

Cost

Like light-duty EVs, medium- and heavy-duty EVs cost more upfront than conventional vehicles. According to the Pacific Gas & Electric Company, the purchase price for medium- and heavy-duty EVs can be twice that of comparable diesel vehicles. However, the company pointed out that medium- and heavy-duty EVs typically require less maintenance and repair and cost less to fuel, saving money for the fleet operator over time. It also noted that incentive programs that reduce the upfront purchase price and charging costs could make them attractive to operate compared to conventional vehicles.[82]

Availability

Today, the most common electrified versions are step vans, school buses, and transit buses. Heavier vehicles like long-haul tractor trailers and garbage trucks are in varying stages of development but are not yet widely used. According to CALSTART's Zero-Emission Technology Inventory tool, 38 vehicle models are available today in the United States and Canada, with an additional 107 models arriving through 2023, ranging from yard tractors to long-range semis.[83]

Adoption Today

According to data from the Minnesota Department of Public Safety, over five million total vehicles were registered in Minnesota as of spring 2021, with medium-duty vehicles representing 2.7 percent and heavy-duty vehicles representing 2.5 percent of all registrations. Only one heavy-duty vehicle registered in Minnesota was electric (no medium-duty vehicles were electric). However, the data only includes registered vehicles. The data does not include fleet vehicles that are not registered, including a significant share of Metro Transit vehicles. Additionally, vehicle registration data does not capture medium- and heavy-duty vehicles registered in other states that operate on Minnesota roads. While the Minnesota EV share of medium- and heavy-duty vehicles is likely small, it can be assumed that it is greater than the amount reported through vehicle registrations.

Charging

Medium- and heavy-duty EVs use the same charging plugs as light-duty EVs except for Level 1 outlets. Yet, due to their larger size, medium- and heavy-duty EVs often cannot use public charging stations designed for smaller light-duty EVs. They also have larger batteries, requiring longer charging times than most light-duty EVs. For example, a Freightliner eCascadia with a battery size of 550 kilowatt-hours and range of 250 miles could take up to 26 hours on a Level 2 station and up to six hours on a 120-kilowatt DC fast charger, according to a report from the North American Council for Freight Efficiency.[84] Advances in charging technologies will reduce the amount of time it takes to charge these vehicles.

A variety of connectors and plugs can charge medium- and heavy-duty EVs:

- **Automated wireless chargers** transfer power wirelessly to vehicles, making them a convenient and fast way of transferring power to batteries. It is a fully automated system

that requires almost no human input or training. However, these chargers are expensive to set up and have a slightly lower power range (typically 50-250 kW).[85]

- **Conductive automated connection devices** are the next generation of electric chargers that are rapidly gaining popularity. These chargers automatically connect to the vehicle to carry out charging and can be used for on-route and overnight depot charging. The SAE J3105 is a recommended standard for electric buses and heavy-duty EVs.
    - **Enclosed pin and socket connection.** A charging pin is horizontally inserted into the EV to commence charging.
    - **Infrastructure-mounted cross rail connection.** To start charging, a curbside charging station lowers contacts from an overhead charger onto the EV's overhead pantograph (machinery mounted on the vehicle's roof to collect power through contact with an overhead line). Electric transit buses use this when they need to charge along their routes.
    - **Vehicle-mounted pantograph connection.** This type of charging station is also overhead, but the charger remains stationary. The EV extends its pantograph up from its roof to connect with the charger.
- **Plug-in connectors** are the most well-known and used EV charging stations in the industry because of the lower installation costs, simpler design, and ability to support higher power transfer. These connectors are popular for fleets charging vehicles overnight at their depot.

Planning for Increased Electricity Load

As EV adoption increases, they will draw more electricity from the electric grid. The Midcontinent Independent System Operator (MISO) is planning for the potential growth from EVs through its Transmission Expansion Planning process. MISO facilitates wholesale electricity markets and coordinates transmission line construction and use to carry electricity over large distances in the Midcontinent region (which includes Minnesota).

The most recent planning process incorporated four EV growth scenarios modeled by the Lawrence Berkeley National Laboratory from low to very high. MISO merged these scenarios into its three modeled Futures, resulting in the EV growth projections shown in table 6.

Table 6. MISO Transportation Expansion Planning electric vehicle growth projections

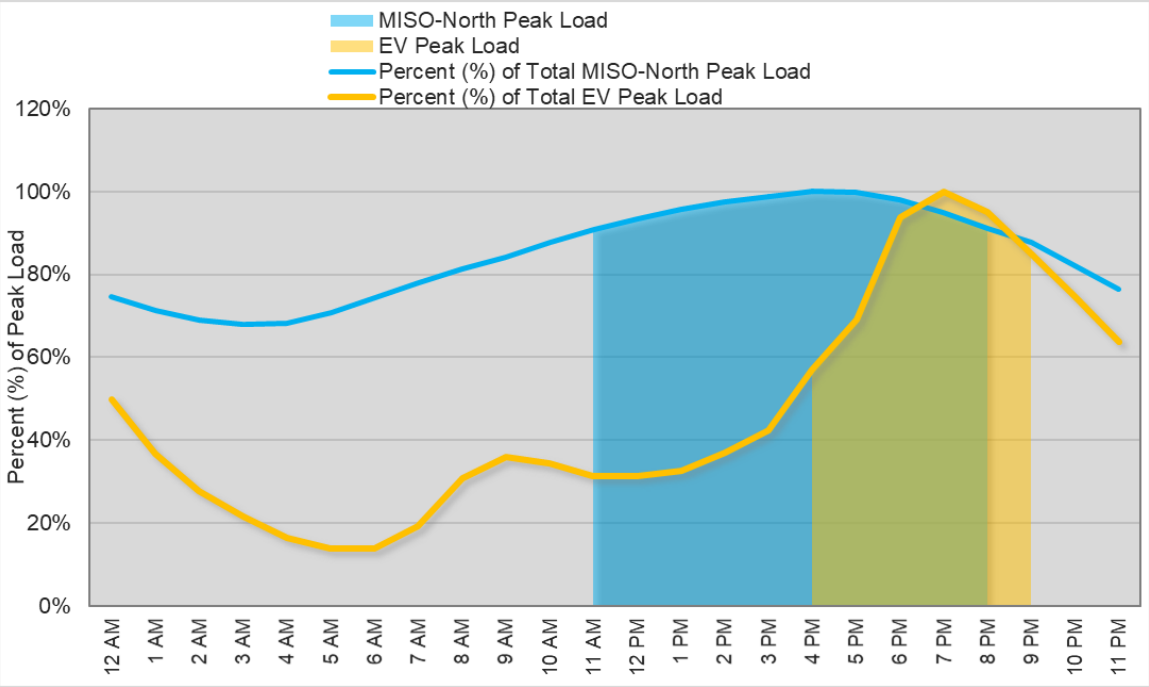
	2020	2030	2039
Future 1 (uncontrolled charging)	0.135 million EVs	1.33 million EVs	4.19 million EVs
Future 2 (vehicle-to-grid charging after 2035)	0.26 million EVs	3.47 million EVs	12.49 million EVs
Future 3 (vehicle-to-grid charging after 2030)	0.416 million EVs	7.598 million EVs	32.686 million EVs

Source: MISO, *MISO Futures Report* (April 2021), 37, https://cdn.misoenergy.org/MISO%20Futures%20Report538224.pdf.

MISO will use results from the Transmission Expansion Planning process to guide future planning efforts and ensure that it can continue operating the system reliably and efficiently.[86]

Existing data can help demonstrate the overlap between overall peak load and peak load from EVs, as shown in figure 6. Examining demand across MISO-North—a footprint spanning North Dakota and South Dakota to Wisconsin and from northern Minnesota to southern Iowa—shows that peak load occurs around 4:00 p.m. to 5:00 p.m. Meanwhile, peak load from EVs occurs between 7:00 p.m. and 8:00 p.m.[87] Both load profiles overlap daily between 4:30 p.m. and 8:00 p.m., which may create opportunities to support the grid as technology for vehicle-to-grid support improves.

Figure 6. Electric grid load and EV charging load patterns: Peak load in MISO-North compared to electric vehicles



Note: The figure shows a percentage of overall peak loads for MISO-North and EVs on the system. It does not demonstrate the total electric demand of which EVs comprise a small fraction of the MISO-North systemwide capacity.

Sources: US Department of Energy, "Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite."; MISO, "Historical Daily Forecast and Actual Load by Local Resource Zone."

OVERVIEW OF UTILITY ELECTRIC VEHICLE PROGRAMS

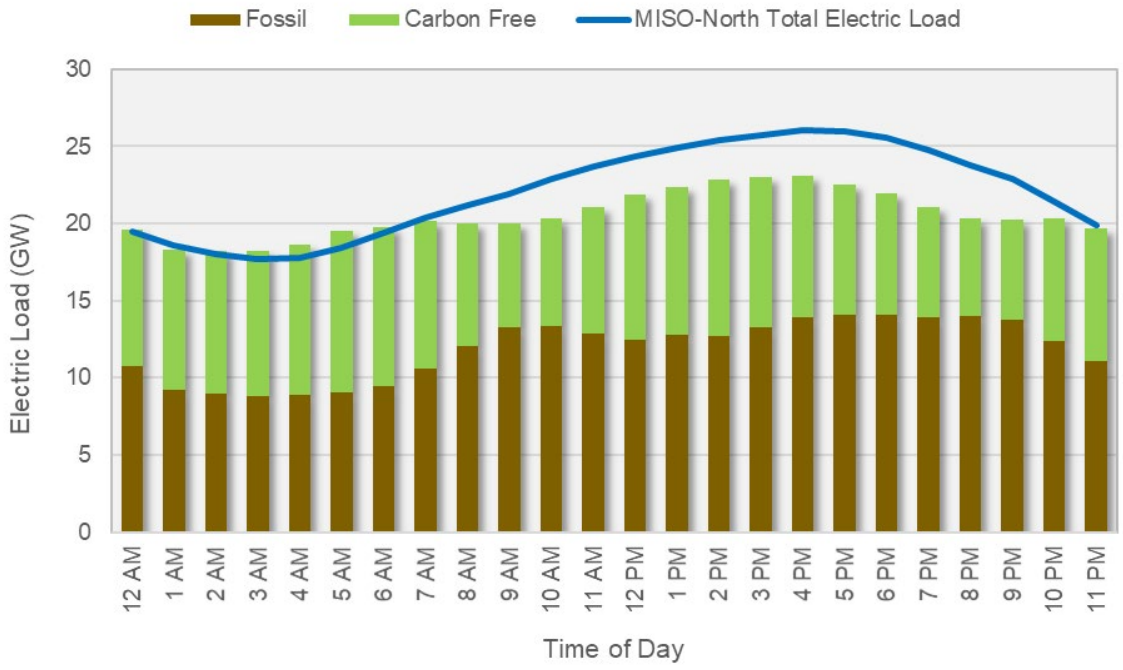
Electric Grid 101

The electricity that powers EVs is generated at a power plant and then moved through the electric grid to wherever it is needed. To ensure reliability and stability, grids at the local level are interconnected to much larger networks that span whole regions of the United States.[88] When a consumer purchases electricity from their utility, the source of the electricity varies. The electricity may come directly from the utility, or it could be purchased from a different utility, power marketers, independent power producers, or from a wholesale market.[89] Additionally, power generation varies throughout the day, as shown in figure 7 using historical data from MISO.[90]

The source of electricity generation has tremendous implications for the total greenhouse gas emissions associated with vehicle charging, providing opportunities to

time vehicle charging when there is a greater proportion of carbon-free sources available.

Figure 7. Electric grid generation sources throughout the day in MISO-North, August 2021



Note: The total electric load (or demand) for MISO-North varies throughout the day. Figure 7 shows the total electric load profile for MISO-North in gigawatts with the corresponding mix of fossil versus carbon-free electricity generation sources on an hourly basis. Carbon-free electricity generation sources are most readily available as a percentage of the total electric mix in the early morning hours, which is largely due to the increased volume of wind generation capacity within the MISO-North footprint at night. Conversely, the greatest reliance on fossil electricity generation sources occurs during the afternoon and early evening (approximately 3:00 p.m. to 8:00 p.m.).

Source: MISO, “Generation Fuel Mix.”

Common Utility Electric Vehicle Program Elements

There are many common elements found in utility EV programs, including time-varying rates, rebates, charging programs, and EV education.

TIME-VARYING RATES

Time-varying rates (e.g., off-peak or time of use) can encourage EV owners to charge their vehicles when energy demand is low and when renewable energy production is high (e.g., overnight for wind and midday for solar), reducing strain on the electric grid. These rates can also support low-income customers by reflecting the true cost of providing energy based on the time of day that customers use it. According to the Illinois

Citizens Utility Board, the most equitable time-of-use plans include a marked difference in charging price by time, do not require a separate meter for home chargers, do not include extra fees beyond the cost of service, and list EV electricity usage separately on electric bills.[91]

REBATES

Electric utilities can help reduce the initial investment for EVs and charging stations by offering rebates on charging stations or EVs. Often, utilities will offer consumers rebates on charging stations if they subscribe to a time-varying rate program. Utilities can provide greater support for low-income households to adopt EVs by offering them higher rebates in addition to offering rebates for used EVs.

PUBLIC CHARGING

Utilities install chargers in their territories to create a robust charging network and reduce range anxiety for drivers. Utilities can help provide greater support for disadvantaged communities by placing chargers in those communities. While that alone is unlikely to increase EV adoption, it may encourage current EV owners to spend dollars or benefit EV car sharing programs in those communities.

RESIDENTIAL CHARGING

More than 80 percent of EV charging takes place at EV drivers' homes.[92] And while electric utilities provide the electricity to make home charging possible, there are some challenges utilities can help alleviate through program design:

- Some time-varying rate programs require the installation of a second meter, which can be cost-prohibitive for the EV owner. Designing rate programs that encourage overnight charging through lower rates but do not require a second meter can reduce this barrier.
- Homeowners with a detached garage that want to install a smart Level 2 charger may experience increased barriers. Since a Level 2 charger requires a minimum 240-volt service, additional conduit may need to be run from the house or a nearby utility pole. Either scenario may require the installation of a second meter, which can be cost-prohibitive for the EV owner. Utilities could design programs with this barrier in mind, which may encourage more homeowners with detached garages to adopt EVs.
- Residents living in multi-unit dwellings often do not have access to an outlet or a designated parking space, preventing them from charging an EV at their residence. While providing access also requires action from the property manager, utilities can design programs specific to multi-unit dwellings to help alleviate some of the barriers for residents.

ELECTRIC VEHICLE EDUCATION

Utilities can play an influential role in providing customers with EV education, including the benefits they can gain by purchasing or leasing an EV. To support equitable access to EV education, utilities can produce educational resources in multiple languages and ensure that resources are accessible across physical ability statuses.

ELECTRIC UTILITY PLANNING

Like MISO, electric utilities in Minnesota are planning for the increased load from EVs. Utility planning efforts vary based on utility type (i.e., investor-owned, cooperative, or municipal). Investor-owned utilities are regulated by the Minnesota Public Utilities Commission, cooperative utilities report to boards, and municipal utilities are often guided by their power suppliers.

Investor-Owned Utilities

Minnesota's investor-owned electric utilities (Xcel Energy, Minnesota Power, and Otter Tail Power Company) are regulated by the Minnesota Public Utilities Commission (PUC). They are required to submit annual transportation electrification plans for their service territories. Appendix A provides a list of EV program dockets that the utilities operating in the Metropolitan Council's region have submitted to the PUC for approval.

Xcel Energy is the only electric investor-owned utility within the Metropolitan Council region. It has several existing EV programs in place:

- For residential charging, Xcel Energy offers a variety of EV charging programs, including time-of-day rates on a separate meter, time-of-day rates for the whole home, charging with renewable energy, and a flat rate subscription.[93]
- For commercial charging, Xcel Energy offers a Public Charging EV Service Pilot, a Fleet Electrification Advisory Program, a Fleet Service Pilot, and multifamily charging solutions.[94]
- Occasionally, Xcel Energy will partner with area automobile dealers to offer purchase and lease incentives on EVs for their customers. All incentives available to their customers are clearly displayed on their website.[95]

Cooperative Utilities

Electric cooperatives have also created EV programs to increase EV adoption in their territories. Several cooperatives in the Metropolitan Council region, including Great River Energy and its member cooperatives, have made strides in offering EV programs to their customers.

- **Connexus Energy**. Connexus Energy, a member cooperative of Great River Energy, offers several EV programs to residents and commercial customers, including a time-of-day rate, $500 Level 2 charger rebate for subscribing to the

time-of-day rate program, an $800 Level 2 charger rebate for the first 200 customers to purchase an EV charger from the utility, and Level 2 charger rebates for commercial customers. Additionally, customers are automatically enrolled in Great River Energy's Revolt program (detailed in the Great River Energy description below).[96]

- **Dakota Electric Association**. Dakota Electric Association is a member-owned, not-for-profit electric distribution cooperative. It is the only cooperative utility in Minnesota that is regulated by the Minnesota PUC. Dakota Electric provides its customers with two EV charging programs: an off-peak storage rate and a time-of-use rate. The off-peak storage rate charges only 4.87 cents per kilowatt-hour but requires all charging to be completed during off-peak hours. The time-of-use rate charges a flat rate of 7.55 cents per kilowatt-hour on weekends and holidays. During weekdays, depending on the hour of the day, the time-of-use rate ranges from 7.55 to 44.2 cents per kilowatt-hour.[97] The cooperative also offers a $500 rebate for installing an EV charger if the customer enrolls in the off-peak rate.[98] Great River Energy's Revolt program is also available to members of Dakota Electric.
- **Great River Energy**. Great River Energy is a generation and transmission cooperative utility that has encouraged EV adoption and action for its 28 member cooperatives and the members' customers. Great River Energy participates in Drive Electric Minnesota, a coalition working to develop EV infrastructure and increase the number of EVs driven in the state. In collaboration with their member cooperatives, Great River Energy has hosted numerous ride and drive events to provide their members' customers with a hands-on experience with EVs. Under its PlugIntoMN initiative, Great River Energy assisted in creating the first EV charging corridor in Minnesota along Interstate 35. Furthermore, Great River Energy developed a program with Dakota Electric Association called Revolt. At no extra cost, Revolt provides current EV owners with the opportunity to power their EV with 100 percent wind-generated electricity. Additionally, Great River Energy manages the website Energy Wise MN that helps educate customers about EVs. It includes sections about EV facts, a savings calculator, a carbon dioxide reduction calculator, EV model information, and more.[99]
- **Wright-Hennepin Cooperative Electric Association**. Wright-Hennepin offers residential customers two charging programs. Customers can participate in the ZEFNET charging program and receive a rebate of up to $1,000. Participation in the program requires charging between 11 pm and 7 am, but residents receive a lower rate of $.06434 per kilowatt-hour. Alternatively, customers can purchase a charging station and receive a rebate of up to $500 if they participate in the EV storage charging program or EV time-of-use program. The EV storage charging program offers a lower charging rate and limits charging to 11 pm to 7 am. The EV time-of-use program allows charging all day but varies charging rates based on the equipment's location and when the charging occurs. Both the EV storage charging program and EV time-of-use program require a separate meter.[100]

Municipal Utilities

Compared to Xcel Energy and electric cooperatives, municipal utilities in the Metropolitan Council region have been slower to adopt EV programs. However, there are a couple of programs worth noting:

- **City of Chaska Electric Department.** The City of Chaska Electric Department offers a $500 rebate for commercial customers and a $250 rebate for residential customers that purchase a Level 2 charger.[101]
- **New Prague Utilities.** New Prague Utilities has a time-of-use program its EV customers can subscribe to with nighttime off-peak rates at $0.069 per kilowatt-hour. Customers that take advantage of the lower rate are required to install a second electric meter.[102]

Best Practices to Accelerate Electric Vehicle Adoption

EVs offer numerous benefits for individuals and society. They save consumers money through lower maintenance and operating costs, provide cleaner air by emitting zero tailpipe emissions and less particulate matter, reduce reliance on foreign oil, and more. As a result, countless entities throughout Minnesota are working to increase EV adoption. The previous section focused on efforts utilities are doing in their service areas—this section looks beyond utilities.

INCREASING VEHICLE AVAILABILITY AND ACCESS

While the number of available EV models available to consumers and fleets has vastly improved since the introduction of EVs, vehicle availability still pales in comparison to conventional vehicles. Fortunately, recent efforts in Minnesota should improve vehicle availability, including providing access to zero-emission transit and EV car sharing:

- **Clean Cars Minnesota**. The State of Minnesota officially adopted the Clean Cars Minnesota rule in July 2021, following an approval from an administrative law judge.[103] Overseen by the Minnesota Pollution Control Agency, Clean Cars Minnesota requires that vehicle manufacturers provide the Minnesota market with vehicles that produce reduced greenhouse gas and other air pollutant emissions compared to federal standards. Starting in 2025, dealerships will be required to have more EVs available for purchase on their lots. With this rule, Minnesota joins 14 other states and the District of Columbia in the implementation of zero and low emission standards.[104]
- **Electric school bus pilot project.** Through the national Volkswagen settlement, Minnesota is receiving $47 million over 10 years, which began in 2018.[105] As part of its plan to use the funds, the Minnesota Pollution Control Agency awarded over $2.1 million in 2020 to purchase eight electric school buses for various school districts and one charging station for each bus.[106]
- **EV Spot Network**. Developed by the City of Saint Paul, City of Minneapolis, HOURCAR, and Xcel Energy, the network will also host publicly available EVs as part of a car sharing program called Evie. Operated by HOURCAR, the program will enable anyone to reserve a vehicle for one-way trips. Users can return the vehicles to a charging hub or anywhere inside the service area. The program will complement other sustainable modes of transportation, including public transit, biking, and walking, providing users with the means of enjoying all the benefits of EVs without having to own or lease one.[107]
- **Future Fuels Act**. Recommended by the Governor's Council on Biofuels[108] and the Sustainable Transportation Advisory Council,[109] this legislation would reduce

greenhouse gas emissions by increasing the use of low-carbon fuels. It received a bipartisan, bicameral introduction during the 2021 legislative session. Modeling conducted by the Great Plains Institute indicates that the passage of the Future Fuels Act could result in significant funding for EVs.[110]

- **Gold Status Dealerships**. Xcel Energy offers a voluntary dealer partnership program with training, customer information, charging displays, and marketing to participating dealers. Gold Status Dealerships have increased knowledge about EVs and helped make the consumer's transition to EVs smooth and easy.[111] As a benefit of participating in this program, dealerships receive a kit that includes brochures, desktop signage, window clings, and an interactive educational charging pillar.
- **Metro Transit.** In 2019, Metro Transit purchased eight 60-foot fully electric transit buses and deployed them on its METRO C Line. After doing so, it experienced several performance and reliability issues related to the charging infrastructure but is working through those issues with the manufacturer. Still committed to reducing transportation emissions, the service is now developing a Zero-Emission Bus Transition Plan to provide further guidance as it works to add more electric buses to its fleet, starting with eight 40-foot electric buses deploying on local routes in 2023. Metro Transit expects to complete its plan in February 2022. The service also plans to purchase up to 70 electric buses for use on routes in 2025.[112]
- **Purchase price incentives.** Drive Electric Minnesota and its partners have been working diligently to pass purchase price incentives to help lower the upfront cost of EVs. Its policy committee has worked with House Democrats to introduce legislation but has not been successful in passing anything. Passing a rebate program and other financial incentives continues to be a priority of the coalition.[113]

BUILDING OUT CHARGING INFRASTRUCTURE

Lack of charging infrastructure is often cited as a top barrier to increasing EV adoption. In addition to charging at home, EV owners need access to on-the-go charging at workplaces and other destinations.[114] A robust charging network provides confidence to current and prospective EV owners as well as fleet drivers.[115] Efforts underway in Minnesota, described below, can contribute to building a robust network throughout the state:

- **Charging at multi-unit dwellings**. Access to charging stations at multi-unit dwellings provides tenants with the ability to adopt EVs. As an example, Green Rock Apartments owner Dale Howey installed charging stations at several of its multi-unit dwellings in Minneapolis in 2019. Howey installed the stations recognizing the climate benefits of EVs and out of a desire to provide more amenities for residents. The shared chargers are available to tenants at no

additional cost. They are also used to charge Green Rock's fleet vehicles used for property maintenance.[116]

- **City leadership.** City governments can show leadership by installing chargers at government buildings or partnering with third parties to install chargers throughout their city. In September 2021, the Plymouth City Council approved a proposal from Carbon Solution Group to deploy 115 EV charging stalls throughout the city. Carbon Solution Group will cover the capital and operating costs and plans to recover the costs through station user fees.[117]
- **Electric Vehicle-Ready Certification Pilot Program.** The Great Plains Institute is developing an Electric Vehicle-Ready Certification Pilot Program. The program will support cities and tribal nations in EV adoption, including policies that increase EV charger deployment. The program places a greater emphasis on equitable policy-based actions.
- **EV Spot Network**. The network will provide EVs through a car sharing program and create numerous EV charging hubs around the Twin Cities that can be used by anyone.[118]
- **Future Fuels Act**. The proposed policy could provide significant funding for EVs and charging stations, according to modeling conducted by the Great Plains Institute.[119]
- **Volkswagen settlement.** The Minnesota Pollution Control Agency dedicated 15 percent of the Volkswagen settlement funds to expanding EV charging infrastructure in Minnesota.[120] The majority of the funding will go toward installing DC fast chargers along highways in Greater Minnesota, a region lacking EV charging infrastructure.[121]
- **Zoning ordinances.** Local governments in the Twin Cities metro are encouraging charging station development through their zoning ordinances. For example, the City of St. Louis Park requires charging infrastructure to be installed in all new or reconstructed parking structures with varying requirements for multi-unit dwellings and non-residential buildings. In multi-unit dwellings that have 15 to 49 parking stalls, 5 percent of the required parking must have access to Level 1 charging. For 50 or more parking stalls, 10 percent of the required parking must be served by Level 1 charging and one Level 2 station. Each of the scenarios must have at least one handicapped accessible parking stall with charging access. In non-residential cases, parking lots that are publicly available that have 15 to 49 parking stalls should have one Level 2 station that serves a minimum of two spaces. One of the stalls adjacent to the Level 2 station should be an accessible spot. Additionally, in both multi-unit dwellings and non-residential buildings, 10 percent of the required parking should be EV ready for Level 2 charging or DC fast charger stations.[122]

Beyond Minnesota, efforts led by other organizations to deploy charging infrastructure can serve as an example for the state. For example, North Florida Transportation

Planning Organization used its power as a municipal planning organization to secure funding from the Congestion Mitigation and Air Quality Improvement Program to invest in a regional EV charging network, partnering with JEA, a Florida utility. The organization used $300,000 in funding to install 25 charging stations and committed to investing another $450,000 to expand the network.[123]

EDUCATION, OUTREACH, AND MARKETING

For market transformation to occur, consumers need to feel confident, comfortable, and knowledgeable about the product they are buying.[124] Studies have shown that consumers who experience EVs firsthand are statistically more likely to consider purchasing an EV.[125] Numerous groups around Minnesota are working to increase EV education:

- **Cities Charging Ahead.** Cities Charging Ahead, facilitated by the Great Plains Institute and the Clean Energy Resource Teams, was a peer learning cohort of 28 cities and tribal nations working to become EV ready. Numerous actions resulted from the first peer learning cohort, including 12 cities purchasing, leasing, or planning to purchase EVs; 11 cities installing or planning to install charging stations; and 13 cities accomplishing or working to implement guidance on EV-ready development in the private sector.[126] A second cohort held during 2020 resulted in additional actions and commitments from cities and tribal nations.
- **Drive Electric Minnesota**. Drive Electric Minnesota, facilitated by the Great Plains Institute, is a "partnership of Minnesota's electric vehicle (EV) champions, dedicated to encouraging the deployment of EVs and the establishment of EV charging infrastructure through public-private partnerships, financial incentives, education, technical support and public policy."[127] It partners with city governments, state agencies, electric utilities, charging providers, and dealerships to further EV adoption throughout Minnesota. In 2021, the coalition launched the state's first Electric Vehicle Resource Database, categorizing educational resources from numerous organizations to broaden education efforts.[128]
- **Local governments**. Local governments play a large role in transforming the EV market, and many cities and tribal nations have been taking action. For example, the City of Fridley, Minnesota, hosted a ride and drive event to encourage local EV adoption. It also incorporated EV awareness efforts into other city events like parades and environmental fun fairs.[129]
- **Minnesota Electric Vehicle Owners**. The Minnesota Electric Vehicle Owners, a chapter of the National Electric Auto Association, is a group of passionate EV owners who meet every other month around Minnesota. The group provides a forum where EV owners can connect and continuously learn about new vehicles and technologies on the market. It also serves as a resource for prospective EV

buyers.[130] The private Minnesota EV Owners Facebook group currently hosts over 2,300 members.[131]

- **Utilities.** As previously discussed, many electric utilities in Minnesota are educating their customers about EVs by hosting ride and drives, including information on their websites, and more.

Beyond Minnesota, there are several organizations actively working to increase EV education across the US, including Plug In America, EVNoire, Forth Mobility, and others. More information about regional and national education efforts can be found in the *2021 Minnesota Electric Vehicle Assessment: Increasing Demand for Electric Vehicles* on the Minnesota Department of Transportation's website.

ELECTRIC VEHICLE SUPPLY CHAIN INNOVATION

Similar to other consumer products like cell phones, EVs rely on batteries for power. Current battery composition requires materials that are mined, including lithium, cobalt, and nickel.[132] Of these materials, cobalt has been linked to unethical mining practices.[133] As EV adoption increases, innovation will be critical to assure a sustainable and ethical supply chain. Several efforts are already underway throughout the world:

- **Drive Sustainability**. Launched in 2011, 11 automakers—including BMW Group, Daimler AG, Ford, Volkswagen Group, and Volvo Group—are partnering to make the automotive supply chain more sustainable. According to its website, the partners feel strongly about making sure that "the people making vehicles, components, or providing services are afforded decent working conditions and are treated with dignity and respect, while minimizing the environmental impact of their industry and promoting business integrity."[134]
- **Executive Order 14017**. On February 24, 2021, President Biden signed an executive order directing several federal agencies to review various supply chains in America, identify risks, and propose policy recommendations to address risks. Specifically, the order directed the secretary of energy to "submit a report identifying risks in the supply chain for high-capacity batteries, including electric-vehicle batteries, and policy recommendations to address these risks."[135] The subsequent report highlighted several opportunities to strengthen the United States' supply chains that support EV batteries, including "(1) reducing or eliminating critical or scarce materials needed for EV or stationary storage, including cobalt and nickel; (2) accelerating battery technology advances including next generation lithium ion and lithium metal batteries and solid state design, and (3) developing innovative methods and processes to profitably recover 'spent' lithium batteries, reclaim key materials, and re-introduce those materials to the battery supply chain."[136]
- **Global Battery Alliance**. Founded in 2017, the Global Battery Alliance involves international organizations, NGOs, academics, and governments working to create a sustainable battery value chain by 2030. The alliance's main goals are

to “establish a circular battery value chain as a major driver to achieve the Paris Agreement; establish a low carbon economy in the value chain, create new jobs and additional economic value; and safeguard human rights and economic development consistent with the UN Sustainable Development Goals.”[137]

- **Initiative for Responsible Mining Assurance**. Founded in 2006 by a coalition of NGOs, businesses, affected communities, mining companies, and labor unions,[138] the initiative works “to protect people and the environment directly affected by mining.”[139] Its members include the BMW Group, Daimler AG, and the Ford Motor Company—three prominent EV manufacturers.[140] Companies that join the initiative demonstrate their commitment to sourcing minerals in a sustainable way.
- **Li-Cycle**. Li-Cycle, a lithium-ion recycling company, quickly escalated from a mini-pilot in 2017 recycling 50 tons of lithium-ion annually to two fully commercialized operations in 2020 with the combined capacity to recycle 10,000 tons of lithium-ion per year. The company is working to launch its third commercial facility with a capacity to recycle 10,000 tons of lithium-ion annually.[141] Designed as a closed-loop facility, Li-Cycle can recover over 95 percent of materials in lithium-ion batteries and package them into new products for the economy, reducing the demand for raw materials.[142]

Efforts in Minnesota are small in comparison to efforts taking place throughout the world and nationally. However, there are two worth noting:

- **Exsolve Recycling Technologies**. Co-founded by Rob Bergmann, Dr. Bill Fisher, and Brian Lentz, CPG (two of whom are based in Minneapolis), the start-up company aims to extract cobalt, nickel, and copper from industrial waste and harness the materials for new products like EVs.[143]
- **Rechargeable battery and products law**. In 1994, Minnesota passed a rechargeable battery and products law prohibiting rechargeable batteries, including EV batteries, from being disposed of with mixed municipal waste. The law also requires companies selling rechargeable batteries in the state to have a state-approved collection program. Companies that are not able to comply with the law are prohibited from selling rechargeable batteries and products in Minnesota. The Minnesota Pollution Control Agency oversees compliance with the law.[144]

Conclusion

This *Electric Vehicle Landscape Summary* addressed the first goal of the Metropolitan Council's Electric Vehicles Planning Study in summarizing the current landscape related to EVs. It highlighted several initiatives, including utility EV programs, EV car sharing programs, increased charging infrastructure, and marketing campaigns that have helped to increase EV adoption in Minnesota. However, it also stressed that the use of EVs in the state is still relatively low compared to conventional vehicles. To meet climate goals, EV adoption will need to increase significantly.

The subsequent report in this study will evaluate and prioritize strategies the Metropolitan Council can use to increase EV adoption.

Appendices

APPENDIX A. METROPOLITAN INVESTOR-OWNED UTILITY ELECTRIC VEHICLE PROGRAMS SUBMITTED TO THE MINNESOTA PUBLIC UTILITIES COMMISSION

Docket Number	Description	Utility	Status
12-874	Residential Electric Vehicle Service • Time-of-use and off-peak charging options	Dakota Electric Association	Approved
15-111	Residential Electric Vehicle Charging Tariff • Time-of-day charging option in compliance with Minn. Stat. 216B.1614	Xcel Energy	Approved
17-817	Residential EV Service Pilot • Time-of-day charging rate using embedded Level 2 charger submetering technology	Xcel Energy	Approved
17-879	Inquiry into Electric Vehicle Charging and Infrastructure • Also includes transportation electrification plans	All investor-owned utilities	Ongoing
18-643	EV Infrastructure Pilots • Make-ready infrastructure investments for fleet and public charging	Xcel Energy	Approved
19-186	Residential EV Subscription Pilot • Flat monthly rate for off-peak charging, includes submetered Level 2 charger in monthly price	Xcel Energy	Approved
19-559	Home EV Service Offering • Full scale rollout of Xcel Energy's Residential EV Service Pilot	Xcel Energy	Approved
20-86	Commercial and Industrial EV Rate Pilot • Part of larger commercial and industrial time-of-use rate design	Xcel Energy	Pilot rates forthcoming

20-711	Multi-Dwelling Unit EV Service Pilot • Charging infrastructure for multifamily homes	Xcel Energy	Approved
20-745	COVID Recovery EV Portfolio • EV Rebates, DC fast charging infrastructure, fleet electrification	Xcel Energy	Pending Approval
21-101	Load Flexibility Portfolio • EV Optimization Pilot and V2G School Bus Demonstration Projects	Xcel Energy	Pending Approval
21-127	Non-Residential and Multi-Family rate pilots • Expands EV rate options for non-residential and multi-family sites	Dakota Electric Association	Approved

APPENDIX B: BEST PRACTICES TO CONSIDER WHEN INSTALLING CHARGING STATIONS

Destination Charging

LOCATION

When determining where to install public charging infrastructure, the daily driving habits and commutes of car owners should be analyzed.[145] Placing charging stations near amenities allows EV owners to pass the time charging their vehicle while supporting local businesses and attractions.[146] Charging infrastructure should also be made widely available in low-income and Black, Indigenous, and people of color communities, which can benefit EV car sharing programs, make owning an EV more feasible, and encourage existing EV drivers to support businesses in those communities near chargers.[147]

INSTALLATION

Once an area has been selected, there are several considerations to keep in mind when installing stations:

- Follow the Americans with Disability Act (ADA) guidelines to provide disabled drivers with easy access to EV charging stations. State agency parking facilities are required to have 1 in 25 parking spaces comply with ADA standards, with a minimum of one stall in compliance. Other guidelines include the size of the parking stall, having ample space around the stall, and installing a cord management system to prevent cord entanglement. For further guidance on ADA in Minnesota, consult the “Installation Requirements for Electric Vehicle Charging Stations” document.[148]
- Make the charging station available to as many cars as possible. For example, consider making the parking space longer to accommodate a variety of vehicle sizes.
- Place the stations close to the building entrance.
- Consult with utilities to determine a location with proximity to a power source.
- Choose well-lit, visible areas to promote personal safety of EV owners, especially women.[149]

USER FEES

Non-networked chargers (commonly referred to as dumb chargers) are the most basic type charging stations. They do not contain technology that tracks usage or collects payment from users.

On the other hand, networked chargers (commonly referred to as smart chargers) can collect payments from users and have numerous other features.[150]

VISIBILITY

Providing visible and accessible charging stations is necessary to ensure high usage and safety. Clearly displaying signage that marks the parking stall as an EV charging station is an effective way to call attention. Signage should be clear, concise, and accessible. Using symbols and colors can also help relay the intended use of the site.[151] Additionally, adding charging stations to websites like PlugShare and Alternative Fuels Data Center informs EV owners of their location.[152]

POLICIES

Implementing policies that streamline the permitting process and utilize right-of-way access for curbside charging can make EV charging more accessible to EV owners and businesses without access to off-street parking.[153] Leveraging existing power sources, such as streetlights and utility poles, can support EV charging deployment in key areas that serve low-income, BIPOC, and renting communities.

The Electric Vehicle-Ready Certification Pilot Program, in development by the Great Plains Institute, supports cities and tribal nations in completing actions that encourage and facilitate EV adoption, especially equitable policy-based actions. Participating in this certification program or a similar program can help local governments design and implement policies that increase EV adoption.

Workplace Charging

Best practices to consider when installing charging stations at workplaces include assessing interest and need, engaging stakeholders, addressing installation decisions, and implementing policies.

ASSESS INTEREST AND NEED

The desire for workplace charging may originate from an employee, a property manager, or the building owner.[154] Assessing the interest level of employees and their charging needs can help determine how many and what type of charging stations to install. A survey is an easy and effective way to complete this assessment.[155] Potential questions to include in the survey are:

- Do you own an EV?
- If you had access to charge an EV at the workplace, would you purchase an EV?
- Are you willing to pay a user fee for charging?
- How many miles do you typically travel in a day?

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