PROJECTING ELECTRIC VEHICLE CHARGING DEMAND
IN NORTH DAKOTA AND MINNESOTA

EERC
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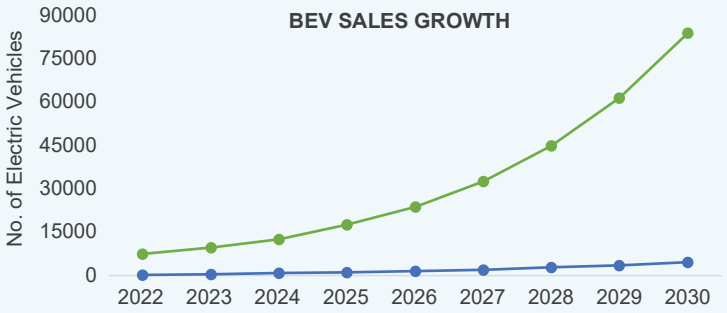
FORECAST OF ELECTRIC VEHICLE (EV) LOAD GROWTH/SHAPE is required for understanding grid impacts and utility planning/operation. The optimal load dispatch of the increased number of EVs in use would enhance the loading of baseload power plants, significantly reducing daily power plant cycling, resulting in lower operational costs. Using the National Renewable Energy Laboratory's Electric Vehicle Infrastructure Projection model, scenarios of regional charging infrastructure have been generated, and EV charging loads in both North Dakota and Minnesota have been estimated.

For All Graphs: NORTH DAKOTA MINNESOTA



EV GROWTH

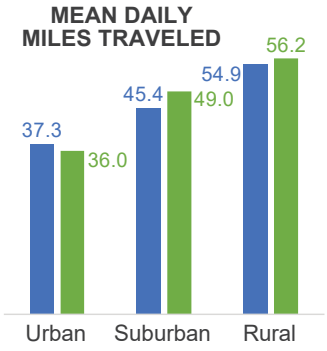
According to aggressive EV sales growth, the total number of battery electric vehicles (BEVs) in use is projected to grow to ~17,000 in North Dakota and ~300,000 in Minnesota by 2030.

CHARGING PARAMETERS

EV charging demand depends on vehicle usage and user preference for charging location and method. Average travel distance per day is a good indicator of an EV's daily energy requirement. Temperature variation provides information on additional energy use by vehicles. Charging location and preference reshape an EV's demand curve.

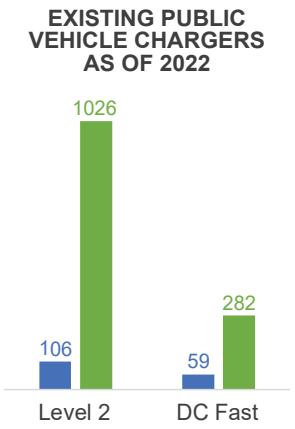
TRAVEL DISTANCE

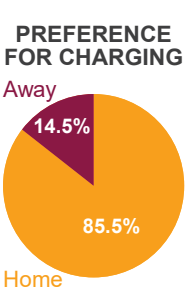
Variation in vehicle usage is a crucial parameter to understand the energy use by the EV. Urban residents travel just over 35 miles per day in both states. The average travel distance increases for suburban and rural areas.



CHARGING LOCATION

Will everyone who purchases an EV have a way to charge the vehicle at home? While the majority of EV users may prefer this, the availability of public chargers will reduce range anxiety. Home charging can be either Level 1 charging, in which the car can plug into a standard 120-volt outlet, or Level 2 charging, which uses 208- to 240-volt outlets like those used by a dryer. A third type of charging, DC fast, is only available at public chargers.





CHARGING STRATEGY

The EV user will choose when and where to recharge the vehicle battery. Users might choose to charge as soon as they get home for the day, which would likely be peak hours, or they might choose to start charging late at night, when electrical grid usage is less and rates are lower.

TEMPERATURE

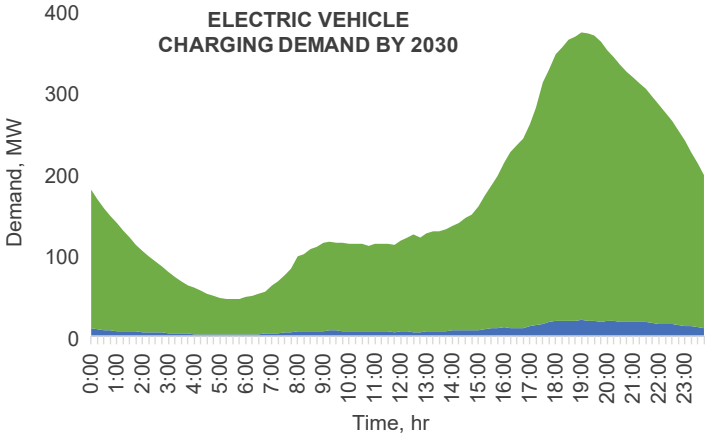
Both extreme cold and extreme heat are hard on batteries. In Minnesota, the average low in winter is 10°F, while in North Dakota, the average temperature in January is as low as 4°F. In both places, summer average highs are in the 80s.

TYPES OF ELECTRIC VEHICLES

- Hybrid Electric Vehicle (HEV)
- Plug-In Hybrid Electric Vehicle (PHEV)
- Battery Electric Vehicle (BEV), also called all-electric vehicles (AEVs)

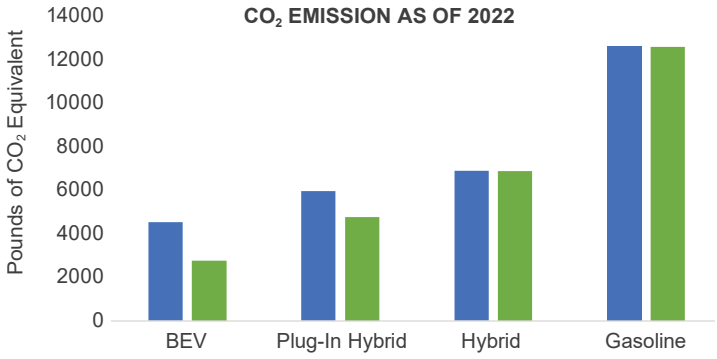
EV CHARGING DEMAND PROJECTIONS

Based on the parameters previously noted, EV charging demand is expected to rise significantly in both states (~19 MW of peak demand in North Dakota and ~352 MW of peak demand in Minnesota).



CO_2 EMISSION

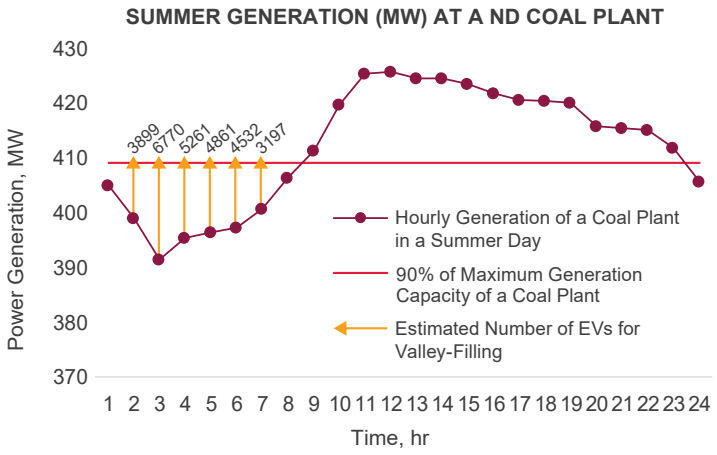
BEVs run from batteries, which store energy that comes from power plants. The source of the electricity has an effect on the emissions of the EV, but the electricity needed to charge one—and the resultant CO_2 emissions from the plant—is still less than the annual CO_2 emissions produced by an internal combustion engine vehicle.



For All Graphs: NORTH DAKOTA MINNESOTA

EVS AND POWER PLANTS

High EV charging demand can be used to increase coal plant utilization. EVs charged during off-peak hours can fill up the valley (low periods of demand) to ensure at least 90% of maximum generation capacity of a coal plant is utilized. However, valley-filling of coal plant generation in the future will depend on EV load management. The numbers on the chart show how many EVs approximately would need to be charging at home to make up the difference.



OTHER PARAMETERS

Although the number of EVs in use is expected to increase substantially, it is worth noting that rare-earth elements are essential materials for numerous EV components. Currently, roughly 60% of the global demand for rare earths is fulfilled by China. A disruption in the supply chain could affect EV production and distribution.

MOTOR	neodymium, praseodymium, terbium, dysprosium
BATTERIES	lanthanum, cerium, praseodymium, neodymium
OPERATING SYSTEMS	praseodymium, neodymium, gadolinium, dysprosium

Sources:

Electric Vehicle Charging Station Location, Alternative Fuel Data Center, October 2022.

North Dakota Electric Vehicle Infrastructure Plan, September 2022 & Minnesota Electric Vehicle Infrastructure Plan, July 2022.

Plugged In: How Americans Charge Their Electric Vehicles, Idaho National Laboratory.

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