Drive Electric MINNESOTA

Bidirectional Charging: Turning Electric Vehicles into Energy Assets

What is bidirectional charging?

Bidirectional charging allows an EV (electric vehicle) to draw electricity from the grid and send it back to other places, such as a home, building, or the power grid itself. This is sometimes referred to as V2X (vehicle to x-item). See table 1 for common acronyms.

TABLE 1. TYPES OF POSSIBLE BIDIRECTIONAL CHARGING, WITH COMMONLY USED ABBREVIATIONS

Type	Purpose	Example
Vehicle to home (V2H)	EV powers a home	Powering a home during an outage.
Vehicle to building (V2B)	EV powers a building	Powering a building during an outage, for example, a hospital.
Vehicle to grid (V2G)	EV sends power to the grid, supporting grid services	A fleet of school buses sending power to the grid when not in use.
Vehicle to load (V2L)	EV sends power to a particular item	Supplying power to camping/construction sites or devices like crockpots/plug-in products.

How bidirectional charging differs from smart charging

Smart charging is a process that allows residents and utilities to determine when and how much energy the charger will distribute from the grid to the vehicle. Bidirectional charging includes this and goes a step further, allowing residents and utilities to determine how much power (and when) the vehicle gives back to the grid. This allows residents to decide how much energy they need to reserve for driving and sell the rest to the grid.

EVs that support bidirectional charging

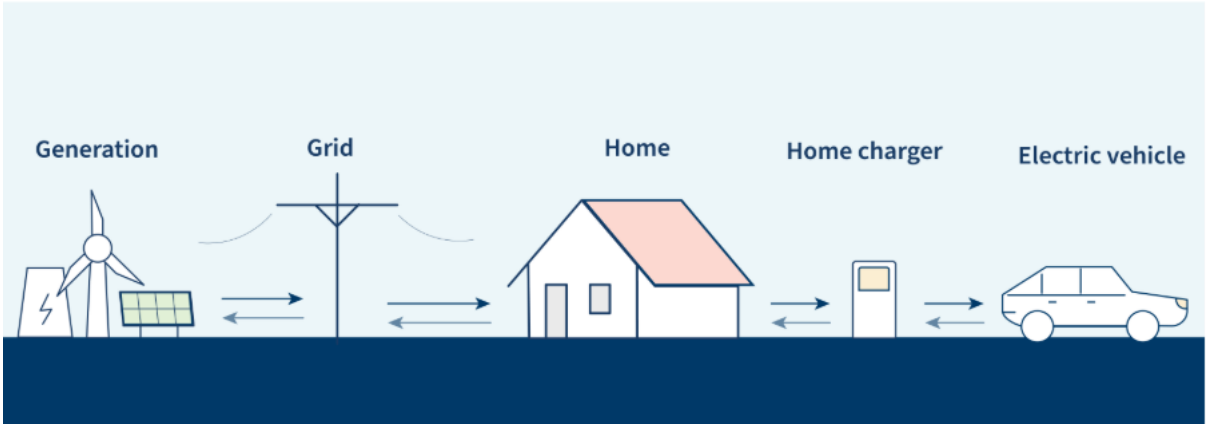
While not all EVs currently support bidirectional charging, more automakers are beginning to incorporate this into their products.[1] Popular models like the Ford F-150 Lightning, Nissan Leaf, and models from Cadillac, Hyundai, Kia, and more now advertise their bidirectional capabilities. For bidirectional charging, the same charger that charges the vehicle can also send power back to the grid. See figure 1 for an example of this and a representation of the energy flow along the power system.

To be successful, two things must happen. First, the vehicle and charger must have bidirectional charging capability, and second, the utility provider must allow these services. While some projects are piloting

1 Brittany Blair and Garrett Fitzgerald, Interconnection Guidance for Residential Bidirectional EV Charging (Smart Electric Power Alliance, September 2025), 5, https://sepapower.org/wp-content/uploads/2025/09/V2X-Interconnection-Regulatory-Brief.pdf.

bidirectional charging programs, utilities in Minnesota are not currently offering it at scale. Residents are encouraged to ask their utilities about bidirectional charging programs available to them.

FIGURE 1. ENERGY FLOW ALONG THE POWER SYSTEM PATH



Source: Great Plains Institute.

Note: Electricity typically flows from the power plants, where it is generated, to the EV. Bidirectional charging enables the EV to send electricity back to the home or the grid.

Benefits and impacts of bidirectional charging

Residents who enroll in bidirectional charging programs benefit from lower electricity costs and revenue-generating opportunities, increased energy resilience, and better integration of renewable energy resources.

Benefits extend beyond residents enrolled in the program. Non-enrolled ratepayers also benefit from peak load reduction, enhanced grid reliability and flexibility, and better integration of renewable energy resources.

ENERGY COST SAVINGS

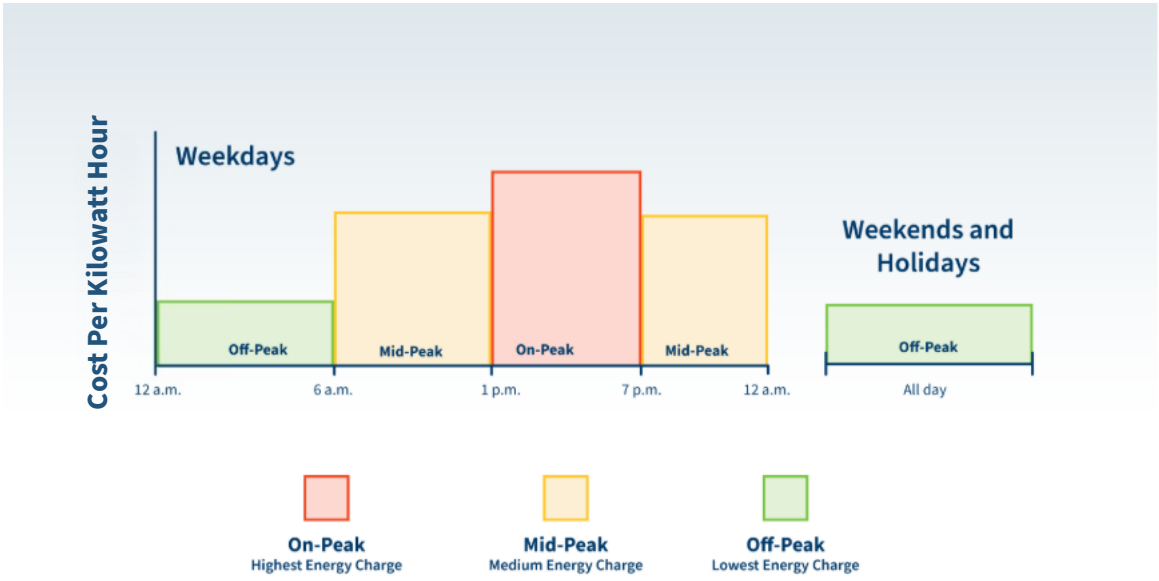
Bidirectional charging can help residents save money and even generate new revenue. Residents with EVs who are enrolled in bidirectional programs can achieve cost savings in two ways.

First, they can draw power for their home from their EVs instead of the grid during peak hours. This reduces peak power demand and overall energy draw, especially during hours when electricity from the grid is the most expensive. This helps lower electricity bills.

Second, some programs allow enrolled residents to sell power back to their utility during certain hours. This enables residents to charge their EV using grid energy during off-peak hours. Alternatively, by using renewable energy-generating assets at home, they can sell excess energy stored in the EV battery to the utility (see figure 2).

While bidirectional charging programs that allow residents to sell back to the grid are not widely available at present, pilot programs are underway in California,[2] Connecticut,[3] and Massachusetts.[4]

FIGURE 2. ENERGY TIME OF USE SCHEDULES



Source: Great Plains Institute.

Note: Time of use programs allow EV owners to charge during off peak periods or from onsite renewables and export stored energy back to the utility when rates are highest.

INCREASED ENERGY RESILIENCE

Another key benefit of bidirectional charging is the added energy resilience it provides for households. This technology enables EVs to act as backup generators during outages, helping households maintain access to electricity when the grid goes down.

Unlike most backup generators, which are stationary, EVs function as mobile battery storage. This mobility enables them to provide backup power to facilities that need electricity most during blackouts, including critical infrastructure such as hospitals and emergency response centers.[5]

2 "Participation Agreement: RDWDS Bidirectional EV Charging Incentive Program (California)," Bidirectional Energy, accessed April 15, 2026, https://www.bidirectional.energy/participation-agreement-ca.

3 Frances Bell, "Bidirectional Energy and Wallbox Launch North America's First Multi-State Bidirectional Charging Program," Bidirectional Energy, October 21, 2025, https://www.bidirectional.energy/blog/press-release-bidirectional-energy-and-wallbox-launch-north-americas-first-multi-state-bidirectional-charging-program.

4 "Vehicle-to-Everything Demonstration Projects," Massachusetts Clean Energy Center, accessed April 15, 2026, https://www.masscec.com/masscec-focus/clean-transportation/electric-vehicle-charging-infrastructure/vehicle-to-everything-demonstration.

5 "Bidirectional Charging and Electric Vehicles for Mobile Storage," US Department of Energy, accessed February 11, 2026, https://www.energy.gov/cmei/femp/bidirectional-charging-and-electric-vehicles-mobile-storage.

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VEHICLE-TO-HOME (V2H) EXAMPLE

As an example of energy resilience, a resident in New Mexico used his EV, a Chevy Bolt, as a backup generator when the power went out. He was able to power his refrigerator, lights, and other necessary devices. This resident used his EV for about one and a half days until the power was restored, but he mentions "it [the vehicle] could have gone much longer."[6]

RENEWABLE ENERGY INTEGRATION

Residents can maximize the benefits of renewable energy generation by pairing it with bidirectional charging.

Bidirectional charging pairs well with renewable energy because it helps manage the natural variability of sources like solar and wind, which do not always produce power when demand is highest.

EVs can absorb excess renewable electricity when it is abundant and low-cost and store it in their batteries. Later, they can provide stored energy to other loads, such as home appliances, other vehicles, or even the grid, when renewable generation drops or electricity demand rises.

By shifting clean energy from the time it is produced to when it is needed, bidirectional charging maximizes the utilization of renewable energy.[7]

Conclusion

Bidirectional charging transforms EVs from mere modes of transportation into powerful energy assets. By enabling EVs to store electricity when it is clean and affordable and deploy it when it is most valuable, bidirectional charging can lower energy costs, strengthen household resilience during outages, and support a more reliable and renewable electric grid.

While adoption is still emerging and programs are limited today, continued pilot projects and utility engagement suggest that bidirectional charging will play an increasingly important role in how residents interact with the energy system in the years ahead.

About Drive Electric Minnesota

Drive Electric Minnesota is a network of electric vehicle champions accelerating Minnesota's electric mobility future. The coalition accelerates the equitable adoption of electric vehicles by providing trusted information, advocating for smart policies, and building a collaborative and inclusive network that drives education, outreach, and market growth. Learn more at DriveElectricMN.org.

6 Michael J. Coren, "Electric vehicles can now power your home for three days," The Washington Post, last updated February 17, 2023, https://www.washingtonpost.com/climate-environment/2023/02/07/ev-battery-power-your-home/.

7 "Bidirectional Charging and Electric Vehicles for Mobile Storage."