HOW TO

Charge Your Electric Vehicle At Home & Away

Information and Tips from Efficiency Maine

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This manual provides easy-to-use, practical information about how to charge your **electric vehicle (EV)** at home and away from home, including:

- **different types of charging stations;**
- **comparison of charging at home to charging away from home;**
- **how to find public charging stations;**
- **how to pay for use of public chargers;**
- **EV charging best practices;**
- **how to maximize your charge; and**
- **considerations for driving and charging in hot and cold weather.**

To learn more about electric vehicle technology visit efficiencymaine.com/ev or call 866-376-2463.

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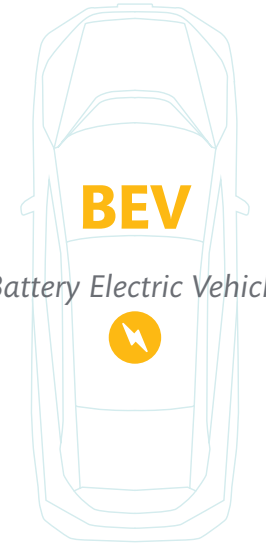
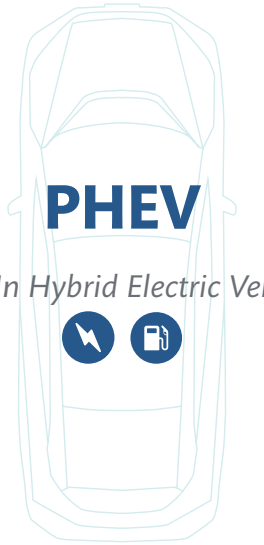
Types of Electric Vehicles

Electric vehicles can be solely powered by an electric motor with a battery (a battery electric vehicle or BEV, also known as an all-electric vehicle) or by a combination of both an electric motor and a gasoline engine (a plug-in hybrid electric vehicle or PHEV).

Most BEV models can travel farther on electricity alone than PHEVs because BEVs have larger batteries. However, BEVs do not have a backup gas engine, so when the battery is exhausted, the only way to continue driving is to recharge the battery.

PHEVs have a longer total driving range because they can be powered by the gasoline engine after their battery is depleted, but they have a shorter range on electricity alone.





BEV *Battery Electric Vehicle*		PHEV *Plug-In Hybrid Electric Vehicle*
Electricity	FUEL TYPE	Electricity Gasoline
100 – 380 miles	RANGE	20 – 50 all-electric miles 400 – 600 combined miles
No oil changes and fewer repairs	MAINTENANCE	Similar to internal combustion engine (ICE) cars
Less than ½ of typical cost of fueling an ICE car	FUEL COSTS*	Approximately ½ the cost of fueling an ICE car
No tailpipe emissions	EMISSIONS	No tailpipe emissions in all-electric mode

* Based on five-month average New England retail gas price of $3.93/gallon as of June 6, 2022 (Energy Information Administration), Maine state average electricity rates of $.226/kWh as of June 6, 2022 (Maine Public Utilities Commission) and 11,500 miles driven per year.

Charging Levels

There are three types of EV charging: Level 1, Level 2, and Level 3 (DC fast) charging.

LEVEL 1

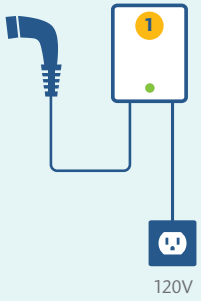
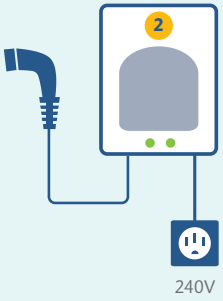
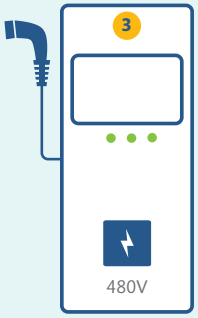
Level 1 charging cords are typically included with the purchase of a new EV. One end plugs into any standard 120-volt (V) outlet and the other end plugs directly into the car. Level 1 charging cords are the least expensive and also the slowest way to charge your EV. Level 1 charging provides approximately 5 miles of range per hour of charging.* A person who drives 30 miles per day could replenish that distance in six hours using a Level 1 charger.

LEVEL 2

If you routinely drive long distances, you may want to consider a Level 2 charger, which will charge your car faster. Level 2 chargers may be purchased with the car or separately. These chargers plug into a 240V outlet or can be hardwired to a 240V line, and have a universal SAE J1772 connector. This connector is compatible with all EVs in North America, although Tesla cars require a SAE J1772-to-Tesla adaptor that comes with the vehicle. Level 2 charging provides about 25 miles of range per hour, depending on the amperage of the charger and the acceptance rate of your vehicle.

LEVEL 3

Level 3 charging, also known as DC fast charging, is the fastest method of charging. These chargers typically are installed in public places with nearby amenities (such as a convenience store, gasoline station, or highway rest stop) and can charge a BEV battery from 20% to 80% in 30 minutes or less.** Most PHEVs are not equipped for DC fast charging. The way you use a Level 3 charger is exactly the same way you use a Level 2 charger, although fast chargers typically cost more to use than Level 2s. Fast chargers have three types of plugs: Combined Charging System (CCS), CHAdeMO, and Tesla. Most non-Tesla EVs use CCS, with the exception of the Nissan LEAF, which uses CHAdeMO. Both plug types work the same way. Drivers should check their owner's manual to see which type their car uses.

LEVEL 1	LEVEL 2	LEVEL 3
120V	240V	480V *DC Fast Charge*
		
USAGE HOME	**USAGE** HOME COMMERCIAL	**USAGE** COMMERCIAL
CHARGE TIME Adds 5 miles per hour of charge* Charge from 20-80% in 20+ hours	**CHARGE TIME** Adds 25 miles per hour of charge* Charge from 20-80% in 7 hours	**CHARGE TIME** Adds 100-200+ miles per 30 minutes of charge* Charge from 20-80% in 15-30 minutes

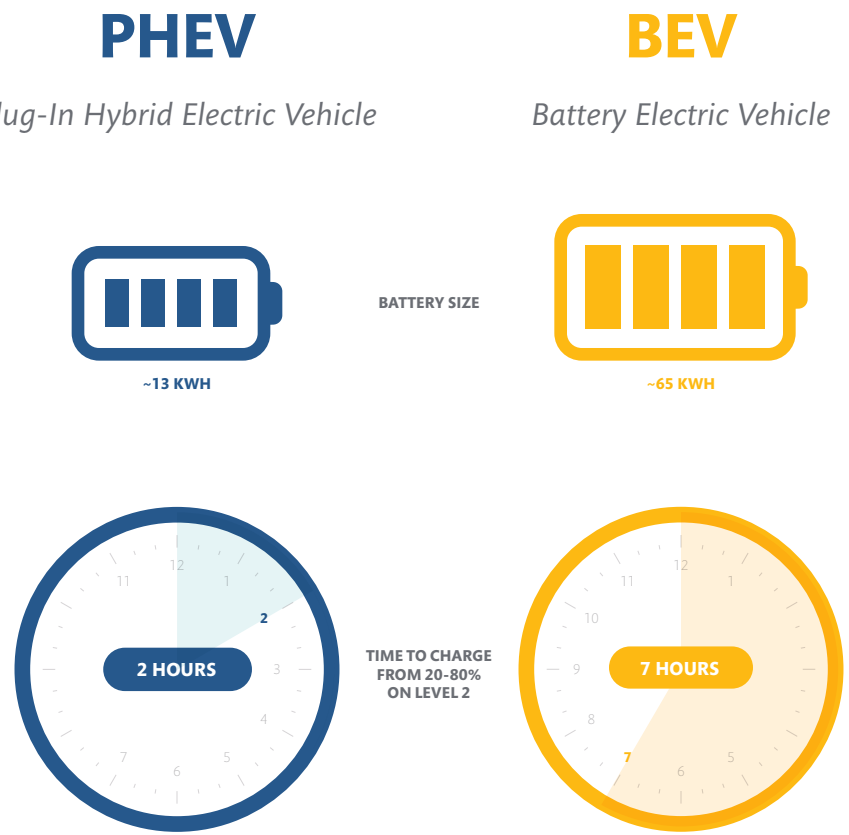
* Estimated. Actual charge times will vary depending on charger amperage and acceptance rate of vehicle.

* Alternative Fuels Data Center: Developing Infrastructure to Charge Plug-In Electric Vehicles. (2019). Energy.gov. https://afdc.energy.gov/fuels/electricity_infrastructure.html

** Electric Vehicle Charging Time Calculator. (5/19/2021). EVgoforth. https://evgoforth.com/electric-vehicle-charging-time-calculator/

Charging Speeds of BEVs versus PHEVs

Both BEVs and PHEVs can be charged at home using a Level 1 or Level 2 charger. PHEVs will reach a full charge faster because they have smaller batteries, but will require more frequent charging compared to BEVs. PHEVs typically take about two hours to charge from 20% to 80% using a Level 2 charger, depending on the battery size.* BEVs can take about seven hours to charge from 20% to 80% on a Level 2 charger, also depending on the battery size. Based on typical driving habits, many drivers will be able to fully charge their vehicle while they sleep.



* Electric Vehicle Charging Time Calculator. EVgoforth. (8/26/2021). https://EVgoforth.com/electric-vehicle-charging-time-calculator/

Benefits of Charging at Home

Charging at home is convenient and economical. For those reasons, 90% of Maine EV drivers charge at home using either a Level 1 or a Level 2 charger.*

EV drivers are able to charge their vehicles in the evenings or overnight from the comfort of their home. This avoids straining the grid during periods of "peak" demand. Check with your electric utility to see if they offer rates that would lower your charging costs if you charge during "off-peak" hours (typically after 8:00 PM). Drivers can consult their car's owner's manual to set default charging to off-peak hours.

For most households and businesses, an EV's range is more than enough for their travel needs. Fifty percent of Mainers commute less than 10 miles a day.** Since most new EVs have a range of 150 to 300 miles, you can likely charge overnight and go several days without needing a recharge.

To learn more about home charging, download our guidebook:

How to Select and Install a Home Electric Vehicle Charger

* Natural Resources Council of Maine. (2022). Maine Electric Vehicle Owner Survey. https://www.nrcm.org/programs/climate/cleaner-transportation/2022-maine-electric-vehicle-survey/

** U.S. Census Bureau OnTheMap. https://onthemap.ces.census.gov/

Benefits of Charging Away from Home

LONG-DISTANCE TRAVEL

EV drivers have increasing options to enjoy long-distance travel in an EV. The federal government, the State of Maine, EV manufacturers, and others are investing in an expanded EV charger network that will provide DC fast chargers every 50 miles along major routes in the next few years, making high-speed chargers available at highway rest stops and major intersections for drivers who need to recharge quickly and get back on the road. Level 2 chargers will be found at lodging accommodations and municipal parking lots for those who are taking a longer break or staying overnight.

EV drivers can find conveniently located chargers across New England that enable them to take longer trips while stopping to charge along the way.* EV charging vendors provide smartphone apps that allow drivers to search specific areas for public chargers. Learn more in our "How to Plan an EV Trip" section on page 16.

CONVENIENCE

Many EV chargers are located where you can charge your EV while going about your daily activities, such as doing your grocery shopping or taking a lunch break during a road trip.

* https://www.efficiencymaine.com/charging-station-locator/

Public Charging Stations

HOW TO FIND PUBLIC CHARGING STATIONS

As of November 2022, Maine has over 700 public charging plugs – and counting! Several smartphone apps make it easy to find a convenient public charging station along your route. Some apps show only chargers in a specific network, such as EVGo, ChargePoint or Tesla. This is helpful if you have a membership in that network and are looking for a specific type of charger. Other apps show a larger selection of chargers, regardless of the network or brand. One example is the PlugShare app, which shows you all the public chargers along your route, the type of charger that's available, and how much it might cost to charge.

Find a list of apps that can help you locate EV charging stations at efficiencymaine.com.

Some apps allow drivers to check the real time availability of charging stations. Some chargers even allow users to reserve a spot in line if a charger is currently in use. Checking availability and making reservations can all be done easily on the respective app by selecting or searching for specific charging stations.

CHARGING AT WORK

Many employers offer EV charging as a benefit to employees and as a way to reduce their company's environmental impact. If you don't have chargers at your workplace, ask your employer if they have considered installing Level 2 chargers to help employees make the switch to clean transportation.

How to Plan an EV Trip

EV drivers have several options when it comes to planning an EV trip. Some apps that offer a "trip planning" function are: PlugShare, A Better Route Planner, ChargeHub, and Tesla. The "trip planning" feature allows drivers to see all the charging stations along their route and to pick the stations that work best for them depending on range, availability, and amenities.

Find a list of apps that can help you plan your next trip.

How to Pay to Use a Public Charging Station:

Some EV chargers are free, while others require payment. Free charging is sometimes offered as an amenity at a business, hotel, or workplace. "Networked chargers" often require payment online using a mobile app, website, or card reader at the station.

Once you pull into an EV charger parking spot, determine which type of charger is available. If it is a free charger, remove the plug from the charging unit, open your charging port, and plug in the vehicle.

For chargers that require payment, there are lots of easy ways to pay for EV charging while you're on the go.

Option #1: If you have a smartphone, you can pay for your charge through a mobile app that also helps you find other chargers along your route. Some charging station providers have their own apps. You may want to download more than one so you can be prepared to use more than one brand of charger. These apps also let you track your charging session in real time, showing the miles added to your range and the price of the service.

Option #2: Another way to pay is with an RFID (Radio-Frequency Identification) card. With some providers, you can request to have a payment card or a swipe card mailed to you when you sign up for an account online or through their app. Many chargers will accept payment with the simple tap of this card.

Option #3: More and more charging networks have "Plug and Charge" capability. This means that you can pull up to a station, plug in your vehicle, and immediately begin charging without the use of an app or card. Before you can use this type of charging station, however, you need to subscribe to the charging network's membership plan. If you subscribe, you'll be asked to provide a credit or debit card number to associate with your account. When you use any station in their network, payment can be made automatically from your account. Many networks also have roaming agreements that allow drivers to use their membership to pay for a charge on a different service network.

Option #4: A credit card can often be used if you're not already registered with a charging network. Not all charging stations will have a credit card reader, but you can usually call the customer support number and provide your credit card information over the phone.

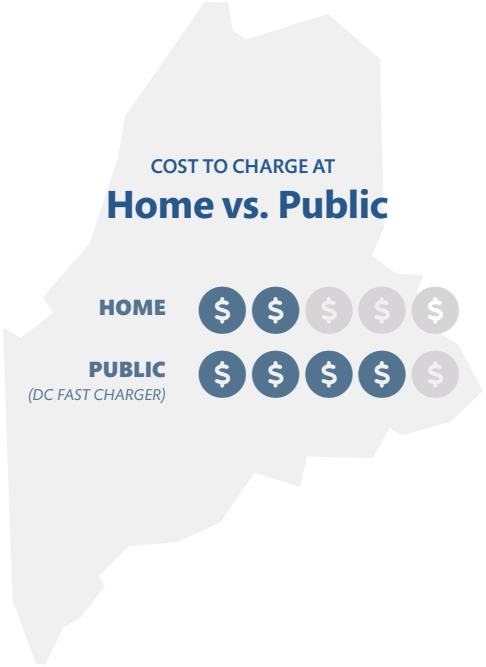
How Much Does It Cost to Use a Public Charger?

The price of public EV charging varies, depending on the station and the owner. Both the charger's screen and the phone app will display the charging price. Fees can be assessed by the minute, per kilowatt hour (kWh), or per session. Level 2 chargers generally cost less to use than DC fast chargers, and some are free.

To illustrate the costs of using a DC fast charger, if the charger has a fee of $0.43/kWh, you can expect to pay $12.90 to get 30 kWh, which is about half a charge for a vehicle that has a 60 kWh battery. For a full charge, you would pay $25.80. Keep in mind that it's rare to charge a battery all the way from empty to full on a DC fast charger. Most sessions will be to "top off" the battery so you can get to your next destination.

How Much Does It Cost to Charge at Home?

In Maine, the average price of one kWh of electricity in 2022 was 21 cents ($0.21). If your EV has a 60 kWh battery, you would pay about $12.60 at that price to fully charge the battery. Fast charging is convenient while on the road, but charging at home is the most economical option.



EV Charging Best Practices

Cost-Effective Charging

Take advantage of your utility's off-peak (or "time of use") electricity pricing.

You can check with your electric utility to see if they offer rates that would lower your charging costs if you charge during "off-peak" hours.

Charging off-peak will also reduce the strain on the grid.

Consider a Level 2 charger to avoid higher costs.

If you are charging in public and have the time, consider using a Level 2 charger to avoid the possible higher cost of charging with a Level 3 charger.

Maintaining Battery Health

Avoid storing your vehicle's battery at very high or low levels of charge.

Consult your vehicle owner's manual for advice on how often and how full to charge your EV. Some manufacturers recommend keeping the battery within a certain range when possible, such as between 20% and 80% state of charge (SOC).

If parking for extended periods of time, consider outside temperature.

When possible, park in the shade or a cool area during warmer months and in a heated area during the colder months. This practice will maximize your battery's lifespan.

Charging in Extreme Temperatures

Expect slower charge times in extreme temperatures.

Expect slower charge times when charging in extreme temperatures, such as below 32 degrees Fahrenheit or above 90 degrees Fahrenheit. Extreme cold and heat slow the chemical and physical reactions that make batteries work, and therefore will increase the charging time.

Account for winter range loss.

It's important to make sure you have some extra charge in cold temperatures. In colder temperatures, an EV's battery will be depleted faster because additional energy is required to warm up the battery itself as well as the cabin of the car.

Tips to Maximize Your EV Charge

HERE ARE SOME TIPS TO MAXIMIZE YOUR VEHICLE'S RANGE AND GET THE MOST OUT OF YOUR CHARGE:

1. **Limit driving at high speeds, accelerating or decelerating rapidly, and hauling heavy loads.** All of these practices reduce an EV's efficiency and range.

2. **Limit use of heating and cooling in the cabin.** You can increase your vehicle's range by avoiding heavy use of heating or cooling inside the cabin. Instead, drivers can rely on heated seats and lower air settings.

3. **Program your car to charge overnight** so you can wake up in the morning to a full battery. You can use your car's onboard software, your smart charger, or an app on your smartphone to program your car's charging schedule.

4. **Use regenerative braking.** Regenerative braking both increases your EV's range and gives your brakes a rest. When EV drivers choose a setting called "one pedal driving," they engage regenerative braking, which allows the car to slow itself down as soon as they take their foot off the accelerator. This allows drivers to slow down without braking, thus extending an EV's range and brake life.

5. **Keep your tires properly inflated.** Experts estimate that tires lose 2% of air pressure for every 10 degrees the temperature drops.* Underinflated tires can reduce the efficiency of your battery range.

* How Does Temperature Change Affect Tire Air Pressure? (n.d.). TireRack.com. https://www.tirerack.com/tires/tiretech/techpage.jsp?techid=73&

Temperature Considerations

WINTER BATTERY CONSIDERATIONS

Keep in mind that an EV's range decreases in cold temperatures. According to an American Automobile Association study, average driving ranges fall by 12% in 20-degree weather when the car's cabin heater is not used, and may fall by considerably more in extreme cold temperatures. When the heater is turned on, the range can decrease by 41%.*

Avoid letting your battery get too low while on the road. Make sure you always have at least a 20% charge. You'll need that reserve to warm the car inside and to warm up the battery. While your EV is still plugged in, use the utility grid as your source of power (instead of the battery) to precondition the car before heading out.

SUMMER BATTERY CONSIDERATIONS

Extreme hot weather will have an impact on battery range and performance, as well. In very hot weather, take the same precautions as you would in cold weather to preserve your battery's range.

* AAA Electric Vehicle Range Testing. (2019). American Automobile Association. https://newsroom.aaa.com/wp-content/uploads/2019/06/AAA-Electric-Vehicle-Range-Testing-Report.pdf

About This How-To Guide

Maine has established aggressive requirements to reduce carbon emissions. It also is a Zero Emission Vehicle (ZEV)* state, creating an expectation that in the next several years Maine consumers will be purchasing and driving tens of thousands of EVs.

At Efficiency Maine, we are committed to helping the state reach its long-range targets to reduce greenhouse gases while lowering energy costs for Maine drivers and helping transform the marketplace toward lower-cost, lower-carbon vehicles.

To that end, Efficiency Maine administers programs to expand availability of EV charging infrastructure and the adoption of electric vehicles in Maine. Its programs provide instant rebates for eligible vehicles (BEVs and PHEVs) at participating car dealers in Maine and grants to fund the installation of EV charging infrastructure in public areas, workplaces, and multi-unit dwellings in Maine.

Efficiency Maine received funding for this "how-to" manual through a grant from the Maine Public Utilities Commission pursuant to An Act to Support Electrification of Certain Technologies for the Benefit of Maine Consumers and Utility Systems and the Environment.** This manual is part of Efficiency Maine's initiative to develop and distribute a comprehensive suite of educational materials about EVs, including "how-to" manuals and videos, as well as a list of eligible vehicles, available rebates, charging station locator, and vehicle cost calculator that can be found at efficiencymaine.com/ev.

For an online version of this "how-to" manual, visit efficiencymaine.com/docs/Charging-at-Home-and-Away-Guide.pdf or call 866-376-2463.

* The aim of the Zero Emission Vehicle (ZEV) program is to help states achieve their emissions goals by requiring that a certain percentage of vehicles use the cleanest available technologies, including battery electric and plug-in hybrid electric vehicles. ZEV has been a major contributor to the successful commercialization of hybrid-electric vehicles and ultra-low-emission technologies. To date, 13 states have adopted the ZEV Program (California, Colorado, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, Vermont, Virginia, and Washington).

** Public Law, Chapter 365, LD 1464, 129th Maine State Legislature.

Glossary of Terms

AC (alternating current): A form of electricity that regularly changes direction, which is the kind of power that comes from a power plant to homes and businesses.

BEV (battery electric vehicle): Also known as "all-electric" vehicles, BEVs use energy that is stored in rechargeable battery packs. BEVs must be plugged into an external electricity source in order to recharge.

CCS connector: One of two common Level 3 charging connectors. Used with many North American-made vehicles.

CHAdeMO connector: One of two common Level 3 charging connectors. CHAdeMO is used on a small number of EV models in North America, most notably the Nissan LEAF.

Charging plug: The specific piece of equipment on a charging station that connects the charger to the vehicle. Also called a "connector."

Charging port: The system within a charger that charges one EV. A charging port may have multiple connectors, but it can only provide power to charge one EV through one connector at a time.

Charging station/EV charger: A piece of equipment that supplies power for electric vehicles in the form of electricity that charges the vehicle's battery.

DC (direct current): A form of electricity that flows in one direction and is the type of power that comes from a battery.

EV (electric vehicle): A broad category that includes all vehicles that can be fully powered by an electric motor.

ICE (internal combustion engine): An ICE is powered by combustible fuels, such as gasoline or diesel fuel, which are liquids derived from fossil fuels.

Kilowatt-hour (kWh): Unit used to measure electrical energy usage.

Level 1 charger: Charges your EV using a common household outlet up to 120V. Level 1 is the slowest method of charging and can take up to 24 hours or more to fully charge your EV. A Level 1 charging cord typically comes with the purchase of a new EV.

Level 2 charger: Charges your EV at 240V using an installed outlet or hardwired to a 240V power supply. Depending on your EV model and charger, a Level 2 plug can charge a vehicle five times faster than a Level 1 plug.

Level 3 charger: Also known as a DC fast charger, a Level 3 charger is the fastest method of charging compatible EVs. It can charge a BEV battery to 80% in about a half hour. Most plug-in hybrid electric vehicles (PHEVs) are not equipped for DC fast charging.

PHEV (plug-in hybrid electric vehicle): PHEVs contain a battery that can be charged with an external electric power source as well as an engine powered by gasoline or diesel.

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