

A CONSUMER'S GUIDE TO PLUG-IN ELECTRIC VEHICLES



Today's Choices in Cars

Late in 2010 the first mass-produced plug-in electric vehicles hit dealer showrooms, bringing car buyers a new, electric option. In coming years, buyers will see even more plug-in electric vehicle options.

Plug-in electric cars offer performance, safety and versatility, and can be charged from the electric grid, providing convenient, low-cost, at-home charging. At the U.S. national average price of 11.9 cents per kilowatt-hour (kWh), buying electricity is approximately equivalent to buying gasoline at \$1 per gallon. With time-of-use rates offered by some utilities, plug-in electric vehicle drivers can save even more. Displacing gasoline with electricity also lowers emissions and decreases petroleum use. On a typical day, half of all drivers drive fewer than 25 miles, so plug-in electric vehicles, if widely adopted, could reduce petroleum fuel consumption by 70% to 90%.

Consumers today can choose between hybrid vehicles, which do not plug in, and plug-in electric vehicles, including plug-in hybrid electric vehicles and battery electric vehicles. Buyers should evaluate their own driving needs to determine how the different vehicle technologies can work for them.

Hybrid vehicles

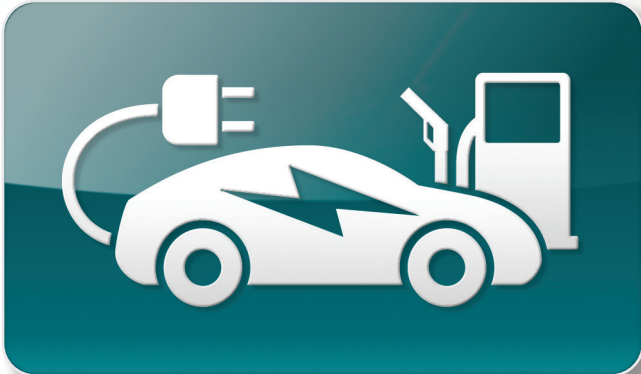


Hybrid vehicles are powered by an internal combustion engine assisted by a battery and electric motor(s).

Hybrids are not plug-in electric vehicles.

Hybrid vehicles, such as the Toyota Prius and the Ford Fusion hybrid, operate like conventional vehicles and are fueled with gasoline or diesel. A battery, charged by the gasoline engine and when the driver applies the brakes, provides additional power during acceleration. Hybrid vehicles cannot be recharged from the power grid. Generally, hybrids are more efficient than conventional vehicles since they use technologies that turn off the gasoline engine at a stop and use regenerative braking, which captures braking energy and stores it in the battery for use during acceleration. Further, hybrids improve miles per gallon by enabling the internal combustion engine to operate at a higher efficiency. Because hybrids are not plug-in electric vehicles, they are not covered in this guide.

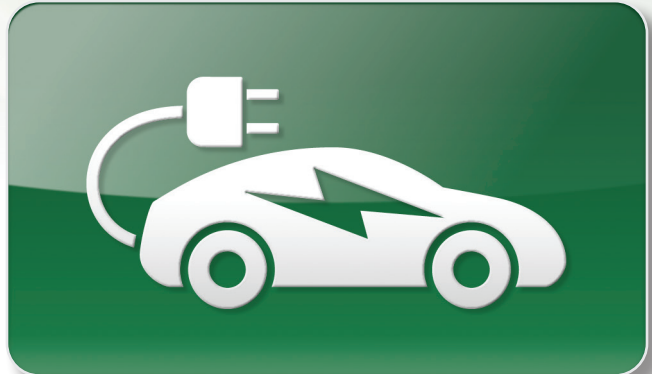
Plug-in hybrid electric vehicles



Plug-in hybrid electric vehicles are powered by an internal combustion engine and electric motor(s). They have a larger battery pack than hybrid vehicles, and can be recharged from the grid.

This combination allows the vehicle to drive on electricity alone using battery energy, and after the battery is discharged, continue driving using gasoline much like a hybrid vehicle. The Ford C-MAX Energi and Chevrolet Volt are examples of plug-in hybrid electric vehicles; Chevy calls the Volt an extended-range electric vehicle. A vehicle with a 38-mile electric range such as the Volt operates on electricity for most daily driving—as long it is plugged in to recharge the battery. When driven this way, it will use up to 70% less gasoline than a hybrid vehicle. A plug-in hybrid will not save as much gasoline if it is not regularly plugged in to recharge the battery. Charge time for 38 miles of range is roughly 10 hours with a conventional 120V wall outlet, or 3 to 4 hours with a 240V connection.

Battery electric vehicles



Battery electric vehicles are powered by an electric motor and battery alone. Battery electric vehicles can travel farther on electricity alone than plug-in hybrids, but their range is limited by the size of their batteries.

Battery electric vehicles never use gasoline. Most models, such as the Nissan LEAF, are designed to travel 80 to 100 miles between charges. This range is greater than the distance driven by average Americans on over 90% of driving days, but it could be a limitation for people who frequently drive long distances. The Tesla Model S travels more than 200 miles on a charge. Most people charge their electric vehicle at home overnight, using a 240V charging station. Some simply use a standard 120V wall socket since their daily driving patterns use only a portion of the battery's energy. With 120V charging, the full recharge time is much longer—roughly 15 to 20 hours, though many consumers simply charge overnight at home. While the availability of public and workplace charging infrastructure is currently limited, many cities, states, and companies are working to provide charging locations so plug-in electric vehicles can charge when they need to. In addition, fast charging infrastructure is growing, allowing properly equipped vehicles to recharge to 80% full in roughly 30 minutes.

Available Today



2014 BMW i3

Introduced in 2014, the i3 battery electric vehicle is the first of BMW's new "i" brand. It is the first volume mass-produced car to use carbon fiber for the body instead of aluminum or steel to enhance strength and reduce weight. The i3 recharges in 3 to 4 hours with a dedicated 240V charging station and in about 20 hours with a 120V outlet. The i3 is fast-charging capable. It can also be ordered with a small range-extender gasoline engine; this model is the i3 REX.

EPA electric range (i3): 81 miles

EPA electric range (i3 REX): 72 miles

EPA total range (gas + electric REX): 150 miles



2014 Cadillac ELR

Introduced in 2014, the ELR is a luxury coupe plug-in hybrid that GM calls an extended-range electric vehicle. The ELR delivers a driving experience that is both sporty and environmentally friendly; it drives on electricity using the battery alone for the first 37 miles when fully charged. The range-extender engine uses gasoline to create electricity to power the electric drive system. The ELR recharges in about 5 hours using a dedicated 240V charging station and in about 12.5 to 18 hours using a 120V outlet.

EPA electric range: 37 miles

EPA total range (gas + electric): 340 miles



2014 Chevrolet Volt

The Volt is a type of plug-in hybrid electric vehicle that GM calls an extended-range electric vehicle. It drives on electricity solely using the battery for the first 38 miles when fully charged. The range-extender engine uses gasoline to create electricity to power the electric drive system. The Volt recharges in about 4 hours using a dedicated 240V charging station and in about 10 to 16 hours with a 120V outlet.

EPA electric range: 38 miles

EPA total range (gas + electric): 380 miles



2014 Ford Focus Electric

The Focus Electric is a battery electric version of the Focus powered by a liquid-cooled, lithium-ion battery. It features technology to maximize regenerative braking and an "eco-conscious interior." The Focus recharges in about 3 to 4 hours using a dedicated 240V charging station and in about 20 hours using a 120V outlet.

EPA electric range: 76 miles



2014 Ford C-MAX Energi

The C-MAX Energi is a plug-in hybrid version of the C-MAX hybrid. It relies on its battery alone for the first 20 miles or so of driving and features an EV Now button, which allows the driver to control the car's operation among three electric-drive modes. The C-MAX Energi recharges in about 2.5 hours using a dedicated 240V charging station and in about 7 hours using a 120V outlet.

EPA electric range: 21 miles

EPA total range (gas + electric): 620 miles



2014 Ford Fusion Energi

The Fusion Energi is a plug-in hybrid version of the Fusion midsize and hybrid sedans. It operates much like the C-MAX Energi, with an EV Now button, which allows the driver to control the car's operation among three electric-drive modes. The Fusion Energi recharges in about 2.5 hours using a dedicated 240V charging station and in about 7 hours using a 120V outlet.

EPA electric range: 21 miles

EPA total range (gas + electric): 620 miles



2014 Mercedes-Benz B-Class Electric Drive

Introduced in limited markets in July 2014, the B-Class Electric Drive is a battery electric version of the B-Class hatchback sold overseas. Nationwide availability is to be announced in 2015. Options include a range-extending charging function. The B-Class Electric Drive recharges in about 3.5 hours using a dedicated 240V charging station and in about 30 hours using a 120V outlet.

EPA electric range: 87 miles



2014 Mitsubishi i-MiEV

The i-MiEV is a battery electric city car that was introduced in the United States in 2012. The 2014 model features a price reduction and several interior and exterior enhancements, and is fast-charging capable. The i-MiEV recharges in about 6 hours using a 240V charging station and in 14 to 22 hours using a 120V charging cord with switchable power levels.

EPA electric range: 62 miles



2014 Nissan LEAF

The LEAF was the first battery electric vehicle to enter the U.S. market in 2010. The updated LEAF comes in three trim levels and features driver-controlled regenerative braking modes. Depending on trim level, the LEAF recharges in 4 to 8 hours using a 240V charging station and in about 20 hours using a 120V outlet. The LEAF SL is fast-charging capable.

EPA electric range: 84 miles



2014 Porsche Panamera S E-Hybrid

The Panamera S E-Hybrid is a performance plug-in hybrid version of the Panamera. As a parallel plug-in hybrid, it can operate on electricity alone at speeds of up to 83 mph, or on a combination of electricity and gasoline at higher speeds or when the battery is depleted. The Panamera S E-Hybrid recharges in about 2.5 hours using a dedicated 240V charging station and in about 8 hours using a 120V outlet.

EPA electric range: 16 miles

EPA total range (gas + electric): 540 miles



Tesla Model S

The Model S is a full-size, five-door high-performance battery electric sedan. It comes in two trim levels, with different battery sizes, a universal charging connector to allow 110V and 240V charging from a Tesla charging station, fast-charging capability, and adapters to enable charging from non-Tesla stations.

EPA electric range: 265 miles with 85 kWh battery

EPA electric range: 208 miles with 60 kWh battery



2014 Toyota Prius Plug-in

The Prius Plug-in is a plug-in hybrid version of the popular Prius hybrid. The Prius Plug-in uses primarily battery power at low speeds and relies on its hybrid system and efficient gasoline engine at higher speeds. The Prius Plug-in recharges in about 1.5 hours using a dedicated 240V charging station and in about 3 hours using a 120V outlet.

EPA electric range: 11 miles

EPA total range (gas + electric): 540 miles

Available Today in Limited Markets

Some plug-in electric vehicles are available only in limited markets. Availability varies by state and manufacturer.



2014 Chevrolet Spark Electric Vehicle

Battery electric version of the Spark subcompact.
EPA electric range: 82 miles



2014 Honda Accord Plug-in Hybrid

Plug-in hybrid version of the Accord sedan.
EPA electric range: 13 miles
EPA total range (gas + electric): 570 miles



2014 Fiat 500e

Battery electric version of the 500 mini-compact.
EPA electric range: 87 miles



2014 smart fortwo Electric Drive

Battery electric version of the fortwo two-seater.
EPA electric range: 68 miles



2014 Honda Fit EV

Battery electric version of the Fit small station wagon.
EPA electric range: 82 miles



2014 Toyota RAV4 EV

Battery electric version of the RAV4 small SUV.
EPA electric range: 103 miles

Available Soon



2015 Audi A3 Sportback e-tron®

Plug-in hybrid version of the A3. Available in 2015.

Estimated electric range: 31 miles

Estimated total range (gas + electric): 584 miles



2014 BMW i8

Plug-in hybrid performance coupe. Available in September 2014.

Estimated electric range: 22 miles

Estimated total range (gas + electric): 310 miles



2015 Kia Soul EV

Battery electric version of the Soul small SUV. Available in limited markets in third quarter 2014. Fast-charging capable.

Estimated electric range: 92 miles



Mitsubishi Outlander Plug-in Hybrid

Plug-in hybrid version of the Outlander mid-size SUV. Expected in 2015. Fast-charging capable.

Estimated electric range: 25 miles

Estimated total range (gas + electric): 500



Tesla Model X

Battery electric SUV offered with a 60 kWh or 85 kWh battery. Available summer 2015. Fast-charging capable.

Estimated electric range: 208 to 265 miles depending on battery size



2015 Volkswagen e-Golf

Battery electric version of the Golf compact. Available in limited markets in late 2014. Fast-charging capable.

Estimated electric range: 70 to 90 miles

Answers to important ques

How far do plug-in electric vehicles go on a charge?

It all depends on what kind of vehicle you choose.

The advertised range for plug-in hybrid electric vehicles varies from 11 to 38 electric-drive miles between charges, depending on battery size and vehicle design, and about 300 to 600 miles on gasoline. If the vehicle is plugged in every day, as recommended, it may be possible to drive 1,000 to 2,000 miles or more between gasoline fill-ups.

The advertised range of battery electric vehicles varies by model from about 84 miles (Nissan LEAF) to 265 miles (Tesla Model S). Each driver's experience is different. Range depends heavily on the driver's individual driving habits, weather, and environmental conditions. As a starting point, a new battery electric vehicle driver can expect to achieve about 80% of the advertised range.

Studies show that limited range is less problematic for most battery electric vehicle drivers than they initially expected. Most drivers find their daily driving is well within the vehicle's range. On days with more driving, they use public or workplace charging during the day or swap cars with another member of their household. Many drivers become comfortable enough with the vehicle's range to drive for a couple of days between charges.

What environmental factors could affect vehicle performance?

Ambient air temperature affects driver and passenger heating and cooling needs, requiring the use of energy otherwise available to power the plug-in electric vehicle. In cold weather, electricity is needed to heat the passenger cabin and defrost or defog the windows—plus the vehicle's battery is a little less efficient at low temperatures. In hot weather, significant electricity is needed for the air-conditioning system, although its energy use is less than that required to accelerate the vehicle and maintain highway speeds. In short, during very hot or very cold weather, and in certain driving conditions such as being stuck in traffic, the range of a plug-in electric vehicle will be reduced. Automakers continue to make progress on technologies that reduce the extreme temperature effect.

Windshield wipers, headlights, and similar accessories do not have a significant effect on range and should always be used to ensure safe driving.

What sizes and styles of plug-in electric vehicles are available?

Currently, most battery electric vehicles and plug-in hybrid electric vehicles are compact or mid-size cars, but manufacturers plan to introduce more mid-size models as well as delivery vans and SUVs. The plug-in electric vehicle market will evolve, as has the hybrid market over the last decade. For example, today, hybrid vehicles are available in nearly all classes.

Are all vehicles available for purchase throughout the United States?

It is common for manufacturers to introduce new vehicle technology slowly and methodically. Given early production limitations and the need to train and equip dealers and service technicians, manufacturers will often roll out plug-in electric vehicles in select markets, then expand availability in response to market demand and readiness. Many models are available now in all 50 states. Others are available only in California, Oregon, and some Northeast states.

How, when, and where will I charge my vehicle?

Plug-in electric vehicles can be charged from a standard 120V outlet like most household appliances. While vehicles typically come with a 120V charging cord, many owners choose to install

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a dedicated 240V charging station at home for faster charging. Dedicated 240V charging stations with capacities of 3kW to 7kW—about the same power draw as a residential clothes dryer or an air conditioning system—are available and can fully charge most vehicles in 3 to 8 hours, or about 8 to 12 miles per hour of charging. All vehicles except Tesla are equipped with standard J1772 connectors. (Tesla has its own connector.)

You can charge your vehicle's battery any time you have access to a standard outlet or charging station but you'll probably find it most convenient to charge at home, in fact, many drivers simply plug-in when they arrive home at night. Many utilities offer lower time-of-use or special plug-in electric vehicle rates to encourage charging overnight when electricity is plentiful.

Sometimes drivers need to recharge during the day, away from home. The number of public and workplace charging stations is growing rapidly, especially in markets where plug-in electric vehicle sales are robust. Today's plug-in electric vehicle drivers can use the services of one of many subscription charging service providers, such as ChargePoint or Blink, and take advantage of a wide array of in-vehicle software and external smartphone apps that locate charging stations and guide them to the nearest station from their current location. Many cities and regions have proactively developed public infrastructure to support plug-in electric vehicles. In some regions, however, public charging infrastructure does not currently exist and will not likely be common for some time.

In addition to 120V and 240V charging, commercial-grade fast-charging station networks are expanding across the country – in the Pacific Northwest, California, and elsewhere. A fast charger can charge a properly equipped battery electric vehicle to 80% full in 30 minutes or less. Not all vehicles, however, are fast-charging capable. Tesla has developed its own Supercharger fast-charging network exclusively to serve Tesla drivers.

What incentives are available?

The federal government offers a tax credit of up to \$7,500 toward the purchase of a qualified plug-in electric vehicle. Many states and even some counties offer vehicle purchase incentives and rebates. In some regions of the country, incentives are also available for the purchase or installation of a charging station. In some urban areas, plug-in electric vehicles are granted access to carpool lanes with a single driver. Other perks, such as free or priority parking and free charging are available in many cities. All of these incentives, which are designed to entice consumers to consider purchasing a plug-in electric vehicle, are subject to limitations and may change over time as the market develops.

What should I consider in making a purchase?

Consider driving needs and lifestyle. Plug-in hybrids, for example, provide a worry-free transition to electrically powered vehicles thanks to the back-up internal combustion engine. This eliminates concerns about running out of battery power. If you have a second place to charge during the day, typically at work, you can effectively double the electric range of your plug-in hybrid. If you have only one car, or often drive long distances, a plug-in hybrid could be a good choice.

Battery electric vehicles have much larger batteries than plug-in hybrids and can usually drive more electric miles per day. The limited range of the battery, on the other hand, requires drivers to carefully consider their driving habits. As the public charging infrastructure develops over the next few years, many areas will have sufficient locations for battery electric vehicles to charge when necessary, alleviating concerns about range. If you have a predictable commute, access to a second car for long trips, or if the idea of a gasoline-free driving experience appeals to you, a battery electric vehicle could be a good choice.

Consider costs and benefits. With manufacturer lease options, utility time-of-use rates, and government purchase incentives, plug-in electric vehicles can be less expensive to operate over their lifetime despite costing more upfront. For more information, read EPRI publication, "Total Cost of Ownership for Current Plug-In Electric Vehicles: Update to Model 2013 and 2014 Model Year Vehicles" (Product ID 3002004054).

Consider environmental benefits. Plug-in electric vehicles have lower emissions than gasoline-powered vehicles, even in areas where much of the electricity is generated by power plants that use fossil fuels such as coal or natural gas. For more information, read EPRI publication, "Environmental Assessment of Plug-In Hybrid Electric Vehicles" (Product ID 1015325).

How can I learn more?

Explore automakers' websites for product updates and check your local electric utility website for information about plug-in electric vehicles. Other sources:

Electric Drive Transportation Association

www.electricdrive.org and www.goelectricdrive.com

U.S. Dept. of Energy Alternative Fuels Data Center

www.afdc.energy.gov/fuels/electricity.html

Plug In America

www.pluginamerica.org

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