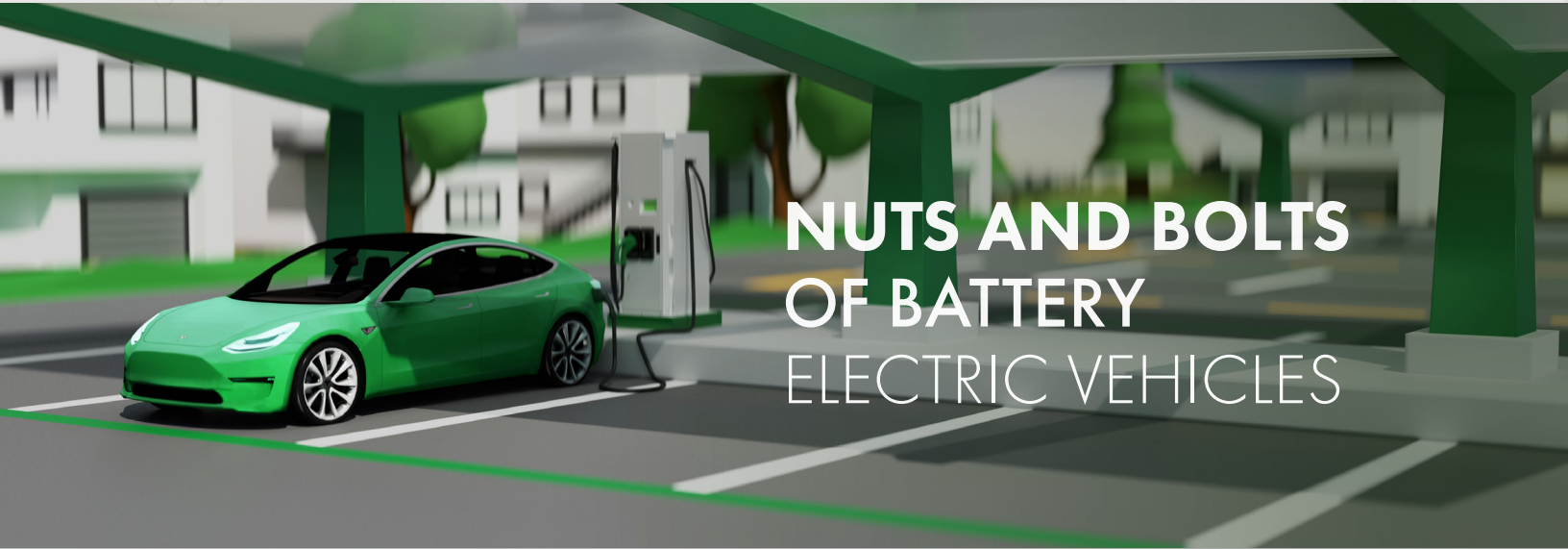




NUTS AND BOLTS OF BATTERY ELECTRIC VEHICLES



As your Touchstone Energy® cooperative, we want to be your source for energy and information. Since electric vehicles (EVs) are becoming more mainstream, we put together a variety of fact sheets and information to help answer questions you might have.

Contact us for more information about EVs.

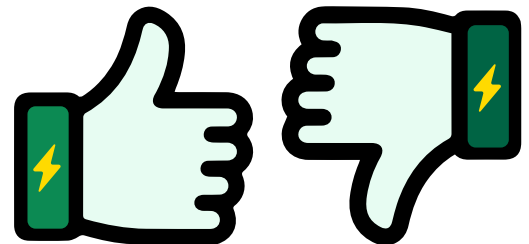
Is a battery electric vehicle (BEV) more expensive than a gas-powered vehicle?

The answer is both “yes” and “no.” The initial purchase price of a BEV may be higher than a similar gasoline vehicle (though look out for tax credits, rebates and other incentives), but BEVs cost less to operate. Driving on electricity is cheaper than driving on gasoline, and BEVs have fewer moving parts, which means less maintenance and fewer repairs.

ADVANTAGES AND DISADVANTAGES OF BEVS

What are the operating cost advantages of BEVs?

- Though specific savings will depend on gas prices and your driving habits, BEVs cost less to operate than gas-fueled vehicles because electricity costs are equivalent to approximately \$1 per gallon of gasoline.
- Electricity prices are far more stable than gasoline prices, which means more consistency in how much you'll pay each month. Furthermore, because the U.S. electric supply does not rely on imported petroleum, the long-term outlook for pricing is better.



What are the energy efficiency advantages of BEVs?

- BEVs are highly efficient, converting about 80% of their energy input into moving the car. In contrast, gas-powered cars are only about 20% efficient; the remaining 80% of the energy input is lost to engine inefficiencies or used to power accessories.
- BEVs use regenerative braking to capture energy and restore it to the battery when you slow down.
- Charging a BEV at home is not a huge power drain. A BEV driven 10,000 miles a year may use between 2,500 and 3,000 kilowatt-hours (kWh) to charge; that is between \$325 and \$390 per year assuming an average residential electricity rate of 13 cents. This is approximately the same amount of energy used to operate an electric water heater for a family of four.

What are the environmental advantages of BEVs?

- BEVs run on locally generated electricity and reduce dependence on fossil fuels.
- The vehicles have a smaller environmental footprint because of their higher efficiency, lower energy consumption and lack of tailpipe emissions.
- Electricity is not a “fuel” in the same way gasoline is. Cooperatives and other utilities produce electricity from many sources, including hydropower, nuclear, natural gas, coal, and increasingly wind and solar. As the source of electricity gets cleaner, so does the vehicle.

What are other advantages of BEVs?

- BEVs require little maintenance beyond changing windshield wipers and tires. They have far fewer moving parts than gas-powered vehicles, so less can go wrong. Even brake pads last longer because of regenerative braking.
- BEVs are quiet, as there is no combustion noise produced.
- BEVs have quick acceleration and are fun to drive.
- BEVs are more efficient during city driving than highway driving.
- BEVs are very safe to operate and charge. The vehicle inlet and charging equipment are required to be safety tested, certified and listed by UL.

What incentives are available when purchasing or operating a BEV?

- There is a federal tax credit worth up to \$7,500 for new BEVs. The amount you'll receive will depend on several factors, including how the vehicle is built, its cost, your income and more.
- There is an additional federal tax credit worth up to \$4,000 for used BEVs.
- Some states and cities offer incentives, including access to high-occupancy vehicle (HOV) lanes and special parking spots.
- Some cooperatives offer special electric rates for charging during off-peak times (such as overnight).
- Some states, cities and cooperatives offer rebates and incentives to offset the purchase of a BEV or charging station.
- To find incentives in your region, visit GoElectricDrive.

What are the disadvantages of BEVs?

- Although vehicle ranges keep improving and charging stations continue to be installed, long-distance travel in a BEV will require more planning.
- If you need to charge partway through a trip, you will be stopped for longer than had you filled up a gas-powered vehicle.
- It may be difficult to find a charging station when and where you need one. Fortunately, this is improving as BEVs become increasingly common and more stations are added. Several apps can help you locate places to charge.

OTHER COMMON QUESTIONS

How often and how long will my BEV need to charge?

There are several levels of charging. How often you charge and where you plug in depend on how far you drive and the charging method.

- **Level 1:** A standard 120-volt home receptacle on a dedicated circuit will provide three to five miles of driving range for every hour of charging.
- **Level 2:** Level 2 charging, which can be installed at home or found in public settings, will provide 12 to 60 miles of range for every hour of charging.
- **DC Fast Charge:** DC Fast Charging, often found along highway corridors, can charge a car to 80% in about 30 minutes.



How safe is charging a BEV?

Safety features are built into BEVs and charging equipment. The charging cable is live only when it is connected to a vehicle. The charger senses that the connection is properly made before the electric current is turned on. Also, the charger has a ground-fault interrupter (GFI). To prevent shocks, charging stops immediately if even a few milliamps of current leak.

If a lot of people plug in to charge their BEVs, will this drain the electric grid?

Charging BEVs will add to electricity demand on the grid but not as much as you might think. Furthermore, BEVs are a flexible load, meaning they can be incentivized and managed to charge during times of low demand for electricity, putting limited strain on the power network.

What factors affect the driving range of a BEV?

- Using heating and air conditioning
- Extreme temperatures, particularly cold
- Your driving style
- The type of driving (city vs. highway) – with the benefits of regenerative braking, BEVs perform better in city driving

What does the future look like for BEVs?

- More production of BEVs should bring down prices.
- As BEVs become more common, so too will public charging locations.
- Advances in design and battery storage will improve the range of BEVs and decrease charging times.

How can my electric cooperative help me?

- When considering a BEV, reach out to your electric cooperative to talk about your purchase and any rebates or programs they offer.
- Utilities, including your cooperative, often have excess capacity at night and during other periods of lower electricity demand. Electricity is cheaper at those times, so some cooperatives offer special electric rates.
- Some cooperatives offer incentives for or assistance with installing a home charger to ensure the process is done correctly and safely.

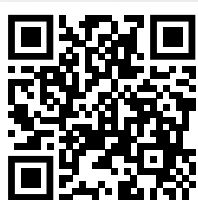
This article was provided by Advanced Energy, a nonprofit energy consulting firm. For more information, visit www.advancedenergy.org.

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ELECTRIC VEHICLE-READY HOMES



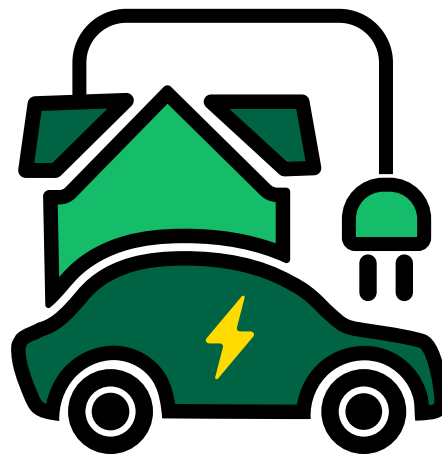
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More and more drivers across the U.S. are starting to refuel at a charging station instead of a gas station. The majority of electric vehicle (EV) charging, however, occurs at home.

“EV-ready homes” is a term used to describe a home that provides safe access to a dedicated power supply for Level 2 charging. Level 2 charging generally uses a 240-volt outlet/NEMA 14-50 receptacle, though stations can also be hardwired to your electrical panel. Level 2 charging delivers 12 to 60 miles of range per hour. In contrast, Level 1 charging uses a standard 120-volt outlet and delivers 3 to 5 miles per hour.

EV-ready homes come with benefits for both homeowners and builders. For homeowners, they save time and money. Making a home EV ready is simple during initial construction, but post-construction upgrades can be expensive. Additionally, residents will be more confident when purchasing an EV knowing they have a convenient and fast place to charge.



Builders see another set of perks. Constructing EV-ready homes adds little to costs, differentiates them from competition, increases home value and attractiveness for buyers, demonstrates a commitment to the environment and shows support for consumer choices.

	LEVEL 1 CHARGING	LEVEL 2 CHARGING
VOLTAGE	120V 1-phase AC	208-240V 1-phase AC
AMPS	12-16	12-80 (typically 32-48)
CHARGING LOAD	1.4-1.9 kW	2.5-19.2 kW (typically 6.6 kW)
CHARGING TIME	3-5 miles per hour of charging	12-60 miles per hour of charging

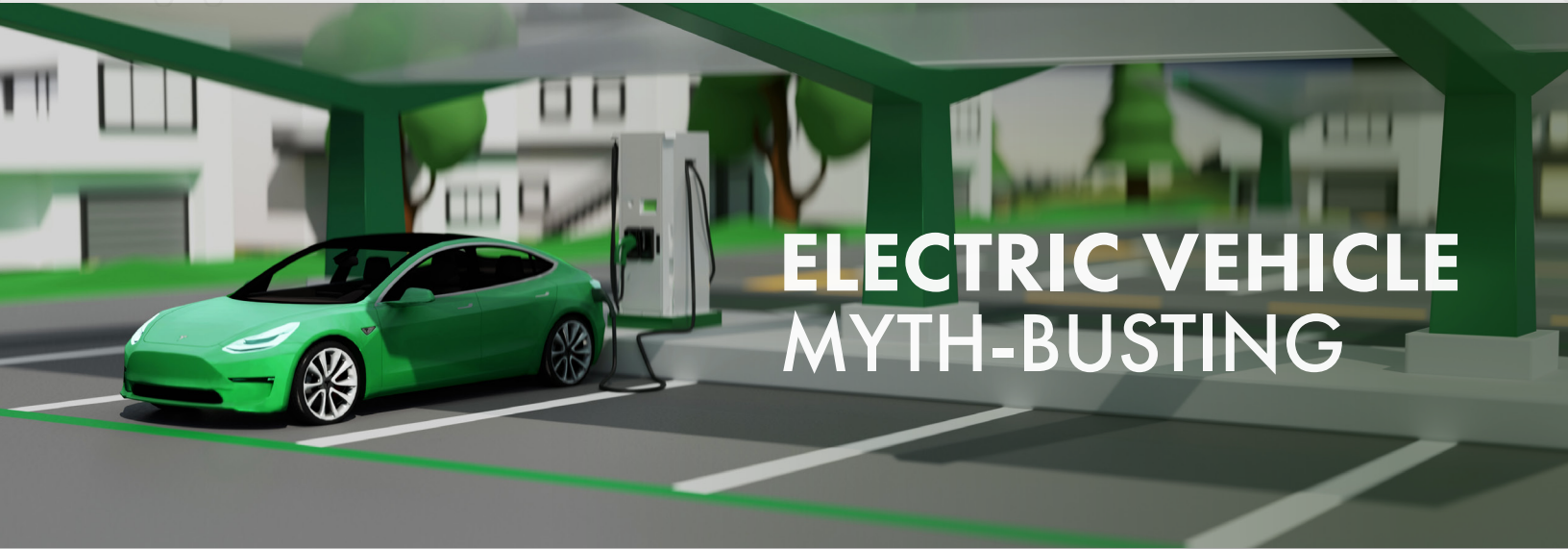
EV Home Charging Levels

To get the most out of a home charging setup, there are a few items to consider. For example, when locating the charging outlet, choose a place near a frequent parking spot, such as in a garage or carport/driveway. If available, garages offer the simplest installation, limit exposure to the elements and prevent unwanted access. No matter where the outlet is placed, make sure there is available space on the floor, walls, and ceilings; be mindful of overhead doors or objects that may obstruct a vehicle’s ability to plug in; and avoid locations that will require the charging cord to be wrapped around or draped over a vehicle.

Many municipalities across the country are now adding EV-ready (sometimes called “make-ready”) language to their building codes, and companies are offering EV charging options in new construction projects. Through EV-ready homes, we can ensure that more people have a convenient, safe, reliable and quick place to charge.

This article was provided by Advanced Energy, a nonprofit energy consulting firm. For more information, visit www.advancedenergy.org.

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ELECTRIC VEHICLE MYTH-BUSTING



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As electric vehicles (EVs) continue to become more mainstream, new myths are popping up about their benefits and how they operate. Here we try to dispel some of the common myths we've heard.

MYTH EVs are more expensive than gasoline cars.

FACTS The upfront cost remains higher for EVs than for similar gas cars; however, prices are expected to reach parity in the coming years, and incentives and rebates are available to reduce initial costs. In addition to federal tax credits for both new and used EV models, look for offerings from your electric cooperative or state. Beyond their purchase price, EVs cost much less to operate because electricity is cheaper than gasoline (its price is also more stable, which can help with budgeting). Drivers can likely expect to save hundreds of dollars per year on fuel alone. With regard to maintenance, EVs have substantially fewer moving parts, so less can go wrong and oil changes are a thing of the past.

MYTH

EVs aren't actually better for the environment than gasoline cars.

FACTS

EVs are much more efficient than gasoline cars. More than 80% of the energy put into an EV is used to propel it. Gasoline vehicles, on the other hand, use only about 20% of that energy. The rest is lost to inefficiencies or used to power accessories. Both battery electric vehicles and plug-in hybrid electric vehicles – when running on electricity – also produce no tailpipe emissions.

When considering the emissions associated with the electricity used for charging, EVs still come out on top. According to the U.S. Department of Energy's Alternative Fuels Data Center, nationally, battery electric vehicles produce 2,817 pounds of carbon dioxide equivalent annually, plug-in hybrid electric vehicles produce 4,824 pounds, and gasoline vehicles produce 12,594 pounds. Even in states heavily reliant on coal to generate electricity, such as West Virginia and Wyoming, EVs produce fewer emissions.

EVs are responsible for more emissions when being built – that's because of the energy intensity of battery assembly. However, they typically make up this emissions deficit after just a couple of years and are cleaner from then on. Furthermore, unlike gasoline vehicles, EVs continue to get cleaner over time as electric cooperatives and other utilities add more low-carbon energy sources to the electric power grid.

MYTH

EVs can't travel far enough to meet my needs.

FACTS

Nearly all new EVs have ranges over 200 miles (and most are at least 250 miles) and can therefore cover the majority of daily driving needs – across the U.S., drivers average about 40 miles of driving per day, according to the Federal Highway Administration. For those that require hauling and towing capabilities, electric pickups have arrived, along with vans, ATVs and UTVs. Road-tripping in an EV also continues to get easier as charging infrastructure expands, particularly along highway corridors. Many apps exist to help drivers locate charging stations and plan longer excursions.

MYTH

There aren't enough places to charge, and the charging that does exist is really slow.

FACTS

New charging stations are being added every day, and there are currently more than 120,000 places to plug in across the country. Also, keep in mind that most charging tends to be done at home, so you'll often wake up with your battery ready to go. When on the road, DC Fast Chargers can provide about an 80% charge in 30 minutes, and as charging and battery technologies improve, charging speeds should increase. One other factor to consider is that charging an EV is generally different from fueling up a gas car: rather than waiting until nearly empty, EV drivers incorporate charging into their daily routes.

MYTH You can't use/charge EVs in the rain.

FACTS EVs are perfectly safe to use and charge in the rain. When using a charging station, electric current flows through the connector only when it is secured to the vehicle. Otherwise, it's not energized. Furthermore, charging stations and vehicles are designed to handle water intrusion.

MYTH There isn't an electric version of the vehicle type I am looking for.

FACTS The diversity of EV models continues to expand – there are more than 50 models available total – and you can now find EVs across many vehicle types and classes, from sedans and hatchbacks to SUVs, minivans and pickups. The medium- and heavy-duty EV market is also growing rapidly.

MYTH Having an EV will raise my electric bill a lot.

FACTS Charging your EV at home will raise your electric bill, but the amount you pay to charge will be significantly lower than what you would have spent on gas. Here's an example. Let's say you drive 1,000 miles per month. In a gasoline car that gets 28 mpg at \$3.50 per gallon of gas, you'll be paying \$125 per month. In an EV that gets 3 miles per kilowatt-hour (kWh) at a price per kWh of 14 cents, you'll be paying just \$47. Over a full year, that's nearly \$1,000 in fuel savings alone.

MYTH EVs have bad performance.

FACTS EVs actually have great performance and are a ton of fun to drive. They have instant torque, producing immediate acceleration, and are more responsive. Additionally, their battery packs are often along the floor of the car, meaning they have a low center of gravity and better handling. Finally, they're much quieter than gas cars, another perk.

MYTH Our electric power grid can't handle so many EVs.

FACTS Electric cooperatives and other utilities are preparing now to ensure that the grid will be able to handle the expected influx of EVs. Grid upgrades will be needed, particularly on a local level and in areas with more rapid EV growth, but one benefit of EVs is that charging is flexible. This means, for example, that it can be done when the grid has excess power, such as overnight. Your cooperative may offer programs or incentives to make it easier and more convenient to charge during these "off-peak" periods.



EV batteries don't last long.



EV batteries are designed to last the life of the vehicle, and all manufacturers offer a battery warranty of at least 8 years/100,000 miles. Over time, batteries do degrade to some extent, but improvements in battery technology and management systems mean that many of the concerns of even a handful of years ago are not as prominent today.

Also, when batteries become unsuitable for propelling an EV – or when the car they're in goes out of service – they can often be moved to other applications, such as stationary energy storage. Batteries are believed to still have approximately 70% capacity at that time. Beyond that, battery recycling is poised to take off as an industry in the coming years and decades. Reusing batteries in other situations before the end of their full operational life and then recycling them can extract additional value.



EVs are more likely to catch fire than gas cars.



Fires in EVs can be more difficult to put out than fires in gas cars; however, despite the media coverage, EVs are no more likely to catch fire in the first place than gasoline cars. In fact, the rate of fire occurrence appears to be lower in EVs than in gas cars. As EVs are still a relatively young technology, more data is needed to get a clearer understanding of fire risks, and continued training for first responders will help with fighting EV fires in safer, more-efficient ways.

This article was provided by Advanced Energy, a nonprofit energy consulting firm. For more information, visit www.advancedenergy.org.

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