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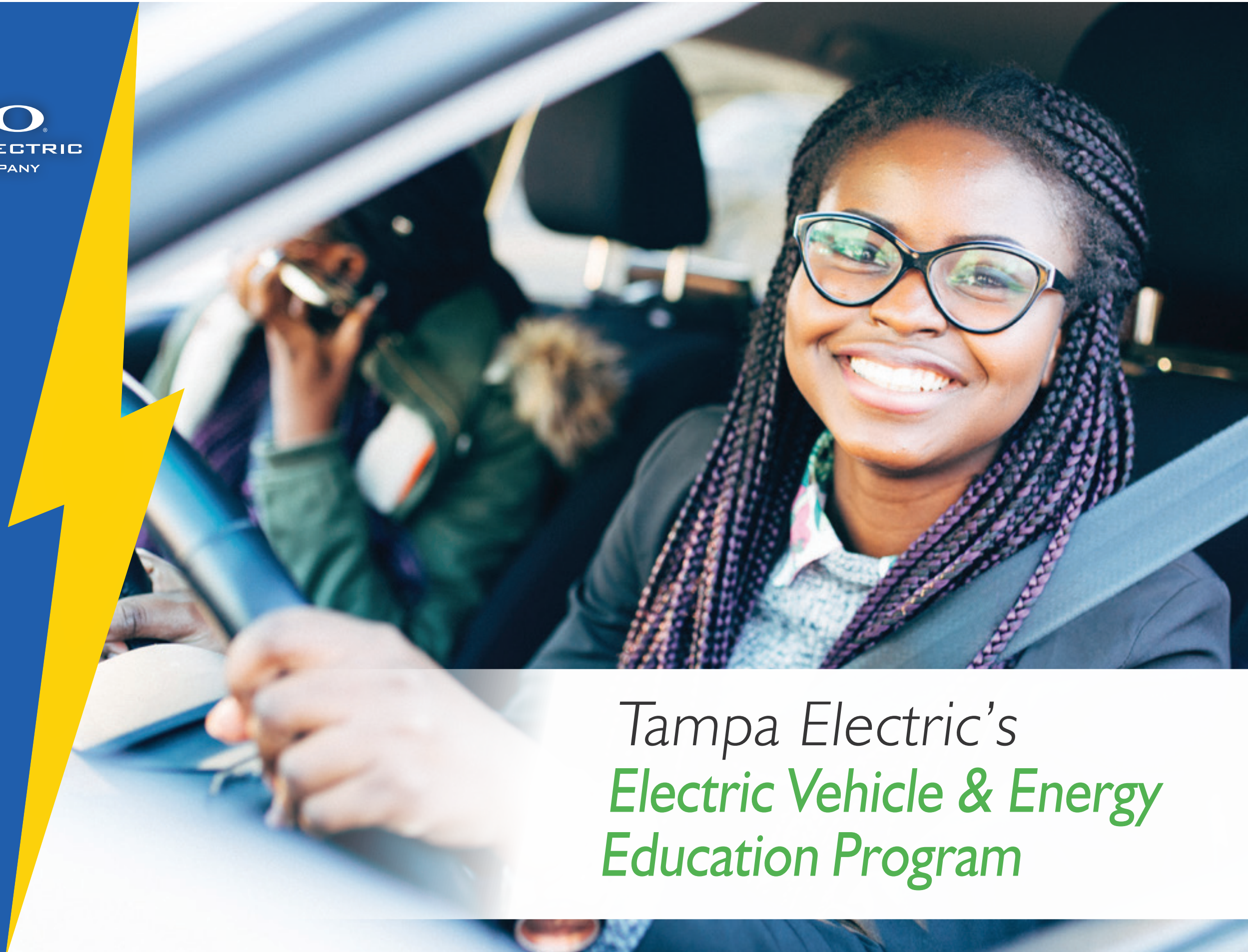


Clean Cities
Tampa Bay

CUTR
CENTER FOR URBAN TRANSPORTATION RESEARCH

Tampa Electric's
Electric Vehicle & Energy Education Program

Welcome to Tampa Electric's Electric Vehicle and Energy Education Program that introduces students to the

Plug-in Electric Vehicle Student Readiness Guide

Tampa Electric is proud to be the first electric utility in the country to partner with the University of South Florida, the Center for Urban Transportation Research and local high schools to offer the Electric Vehicle and Energy Education Program, an innovative energy-education program focused on teaching students about electric vehicle (EV) technology.

This Readiness Guide provides students with information about the various types of EVs on the market, public and private charging options and how to maximize EV mileage with each charge by driving efficiently. In addition, students will learn how saving energy can benefit everyone by deferring or eliminating the need to build costly power plants to satisfy a growing demand for electricity.

Tampa Electric's Electric Vehicle and Energy Education Program was approved by the Florida Public Service Commission (FPSC) in May 2017. For more than three decades, the FPSC has encouraged utilities to promote cost-effective conservation and the use of renewable energy to reduce the use of fossil fuels and defer the need for new power plant construction. The end goal is to ensure utilities utilize a balanced mix of energy resources that enable them to produce reliable and cost-efficient electricity to meet the needs of all consumers.

The FPSC recognizes that consumer choice plays an important role in reducing the growth rates of electrical demand and energy in Florida. Consumers support electric energy conservation through a variety of actions in addition to energy education of EVs, such as constructing smaller, more efficient homes, buying energy-efficient appliances, installing energy-efficiency upgrades to existing homes and installing renewable energy generating systems.

Tampa Electric expects the focus on conservation and renewable energy to continue playing an important role in Florida's energy future.

CONTENTS

More EVs are being added to the roadways every day.

New student drivers need to be familiar with recognizing and understanding the basics of these vehicles. This guidebook provides an introduction to these vehicles as well as an in-depth overview of the energy efficiency benefits of driving electric vehicles.

The guidebook is designed to introduce new student drivers to the basics of electric vehicle technologies, including the vehicles, charging equipment, and important considerations for EV driving and ownership. Provided in the instructor's manual are best practices and planning methods for EV owners.

At the end of this course, students will understand the basic components of EVs, the different types of charging equipment, ways to conceptualize the efficiency of EVs, and guidelines for operating and maintaining EVs to maximize energy efficiency benefits.

The History of the Electric Car

More than 100 years ago, EVs dominated the roads!

During the 1900s, a series of technological developments, from the battery to the motor, led to the first electric cars appearing on the roads.

The first successful EV was introduced in the United States by chemist William Morrison in 1890-91, who designed and engineered a six-passenger vehicle capable of traveling at 14 miles per hour. Battery technology and storage capability continued to develop and improve after Morrison's debut.

By the turn of the 20th century, EVs achieved mass-market appeal, comprising about a third of all passenger cars on the road.

Iowa chemist William Morrison builds the first successful American EV.

Around the same time period, a new type of vehicle was introduced to the market that used liquid fuel, such as gasoline or diesel, to power an internal combustion engine (ICE). Unlike EVs, these liquid fuel-powered vehicles were noisy, emitted exhaust and required the driver to manually change gears.

Compared to the new gasoline-powered cars, EVs were quiet, emission-free and easy to drive. Owning and recharging EVs also became easier as households gained better access to electricity.

Early electric vehicle – 1922 Detroit Electric Automobile

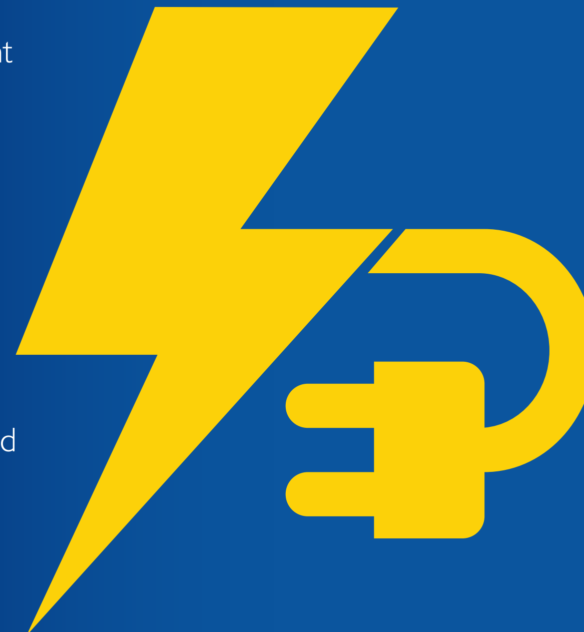
Technology 101

On the surface, electric cars today look like gasoline-powered cars, but instead of powering an internal combustion engine with gasoline or diesel to move the vehicle, EVs run on electricity stored in a battery system that powers the vehicles through electric motors.

There are different types of EVs, ranging from those that supplement an internal combustion engine with an electric motor to models that run, solely on electricity.

Plug-in Hybrid Electric Vehicles (PHEVs)

What makes a plug-in hybrid electric vehicle (PHEV) different from a regular hybrid is the capability to charge the vehicle from an electric power source. PHEVs have an internal combustion engine, which runs on fuel, and an electric motor, which is charged by plugging the vehicle into an external electric power source. Plug-in hybrids can be charged with a charging station or a regular wall outlet, by the internal combustion engine, or by regenerative braking, which allows the vehicle to recapture some of the car's kinetic energy and use it to recharge the battery. The extra energy is stored in the vehicle's battery system and can be used to provide additional power during starts and acceleration. PHEVs use electricity as the main source of power until the battery is completely depleted, then the vehicle switches over to running solely on the combustion engine.



Since PHEVs typically have larger batteries than regular hybrids, they can travel on pure electricity for a limited range (today's models average 10 to 50+miles).

By supplementing with electricity, PHEVs help to reduce harmful tailpipe emissions and petroleum consumption, which makes PHEVs a more environmentally friendly and energy-efficient choice over conventional fueled combustion vehicles.

All-Electric Vehicles (EVs)

All-electric vehicles – sometimes called battery-electric vehicles – operate solely on electricity and do not contain an internal combustion engine. Instead, EVs have one or more electric motors that are powered by energy stored in the vehicle's battery.

The battery pack is charged by plugging the vehicle into an external electric power source. Since EVs have no internal combustion engine, they do not emit any tailpipe emissions and are sometimes referred to as zero-emission vehicles.

An EV's range varies (some of today's versions average between 100 and 250 miles), depending on the vehicle model, the way the vehicle is driven and the driving conditions.

Plug-in hybrid and all electric vehicles come in a variety of different models: low-speed utility vehicles, compact cars, sedans, trucks, transit buses and even high-performance sports cars.

Driving Behavior to Maximize EV Range and Efficiency

The distance (in miles) that an EV can drive on a full battery charge, referred to as EV range, is listed on the EPA fuel economy label of the car. For the vehicle range test, EVs are tested on city and highway driving conditions, assuming that the typical EV will have the battery charged only to 90 percent. Just like with regular liquid-fueled combustion vehicles, the range of an EV can vary significantly based on how the vehicle is driven.

EV range can decrease by 15% to 20% just by increasing the speed from 60 to 70 miles per hour!

The speed at which the vehicle is driven is an important factor that affects the range of the vehicle. Vehicle drag, or wind resistance, is proportional to the square of velocity and impacts a vehicle's efficiency. Even a slight increase in speed results in a significant increase in drag, especially at higher speeds. A vehicle needs more energy to overcome added wind resistance at higher speeds. As a result, fast driving will increase energy consumption and reduce vehicle range. The energy efficiency of an EV usually decreases rapidly at speeds above 50 miles per hour. For example, the range of an EV can decrease by 15% to 20% just by increasing the speed from 60 to 70 miles per hour. So avoiding unnecessarily high speed can help extend the range of an EV.

Fast acceleration also increases energy consumption.

It takes much more momentum and energy to accelerate the car faster than it does to accelerate gradually. Therefore, fast acceleration increases vehicle energy consumption and reduces range for both gasoline and electric cars. The use of cruise control to maintain a constant speed on the highway in most cases will also reduce energy consumption of the vehicle. Accelerating gradually and maintaining steady speed while driving will increase the range of an EV.

All EVs are equipped with regenerative braking systems.

When the brake pedal is pressed on an EV, a regenerative braking circuit switches the electric motor to operate in reverse of the direction of the wheels, thus performing in the same manner as a power generator producing electric energy. The energy is used to recharge the vehicle battery and extend vehicle range.

Keeping a vehicle well-maintained can improve the service life of the vehicle & can extend vehicle range!

In addition to regenerative brakes, all EVs have regular friction brakes as backup. When the driver brakes hard, the regenerative braking is not able to stop the car fast enough, so the friction brakes are applied as well. Friction brakes waste all the energy they produce in slowing the vehicle in the form of heat. Therefore, braking hard in an EV reduces the efficiency of the regenerative braking system and reduces potential vehicle range. To maximize the efficiency of the regenerative braking system and extend the range of the car, drivers should coast to a stop as much as possible instead of braking hard.

Keeping a vehicle well-maintained is a smart approach to improve the service life of the vehicle, but can also extend vehicle range. For example, under-inflated tires add to rolling resistance, requiring more energy to be spent on moving the vehicle and reducing fuel efficiency and vehicle range. Additionally, electric cars with a thermal management system may use coolant to cool the battery. A low coolant level may result in the battery operating at a temperature higher than is required for optimal battery performance. Simply maintaining proper tire inflation and checking fluid levels can extend vehicle range by a few miles each charge.

Heating and air conditioning (A/C) systems require a lot of energy, which can affect the range of the vehicle.

Unlike a regular gasoline vehicle, where only air conditioning affects fuel efficiency while heat comes "free", heating in an EV reduces vehicle range the same way as the A/C. Wise use of climate control and other vehicle accessories that run on electricity (such as the entertainment system) can improve vehicle efficiency and extend vehicle range. For example, to extend the range of the vehicle, EV drivers should avoid driving in extreme weather conditions (if possible), pre-condition or pre-heat the vehicle cabin before taking a trip while the vehicle is still plugged in (this can be done by programming the vehicle or through a smart-phone app), and use seat warmers instead of the cabin heater (which heats the passengers more efficiently).

Modern vehicles allow the driver to switch between several driving modes that control vehicle dynamics and comfort features. One driving mode may maximize vehicle performance – at the expense of fuel consumption – while others can emphasize ride comfort, fuel economy, or other priorities, at the expense of performance. The driver can select the desired driving mode from the vehicle settings menu or sometimes with the press of a button.

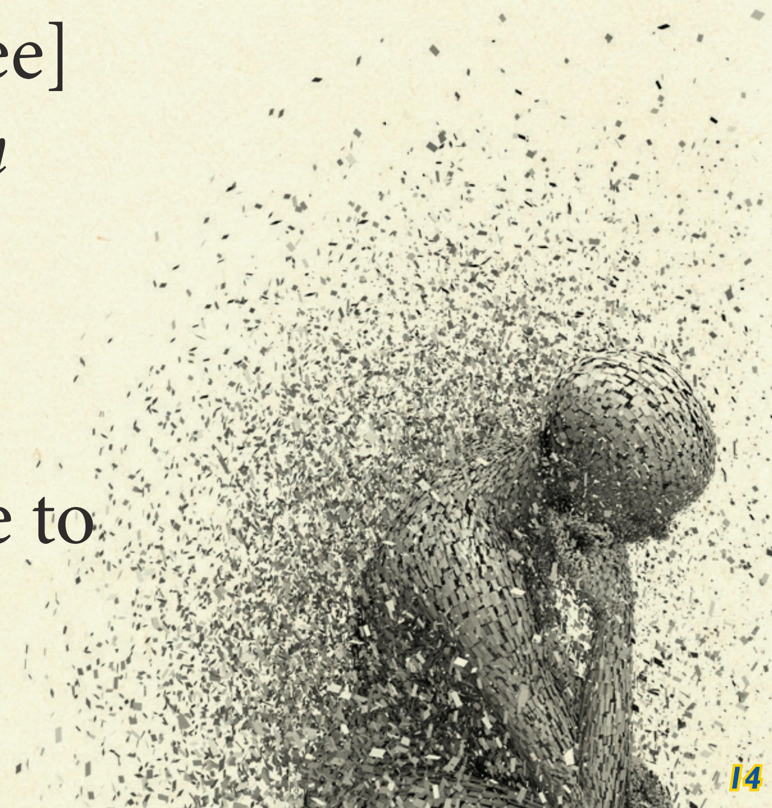
Most EVs come with an economy mode or similar feature that allows the driver to maximize fuel economy and extend vehicle range. Under this mode, the vehicle limits acceleration rate, tones down "gas" pedal response, and may limit other performance features to save energy. Economy mode may also alter A/C and heater functions to optimize energy consumption.
If extending vehicle range is the goal, EV drivers should consider using the economy mode as often as possible.

Range Anxiety:

[reynj], [ang-zahy-i-tee]

plural: **anxieties** *noun*

1. Range anxiety is the fear of not having enough battery charge to reach a destination.



While gasoline vehicles also have a limited range, range anxiety is used primarily in reference to EVs.

Range anxiety is often cited as one of the major obstacles to EV adoption. Range anxiety is often cited as one of the major obstacles to EV adoption. Although EVs have lower range, require longer recharging time and have fewer locations for charging verses the number of gasoline stations, many studies suggest that the anxiety over EV range is over exaggerated. Most of the personal daily trips in the U.S. can be accomplished by the currently available EVs on a single battery charge, without a need to recharge the vehicles during the day. According to the National Household Travel Survey, an average driver in the U.S. drives 29 vehicle-miles per day. Most EVs on the market today have a range well above that number.

Range anxiety will become less of an issue as charging infrastructure expands and battery technology improves.

EV drivers can use the following tips to reduce the fear of running out of charge –

Trip planning: Fully charge the EV before a trip; plan the route minding trip distance, required stops, and the availability and location of charging infrastructure along the route, if needed.

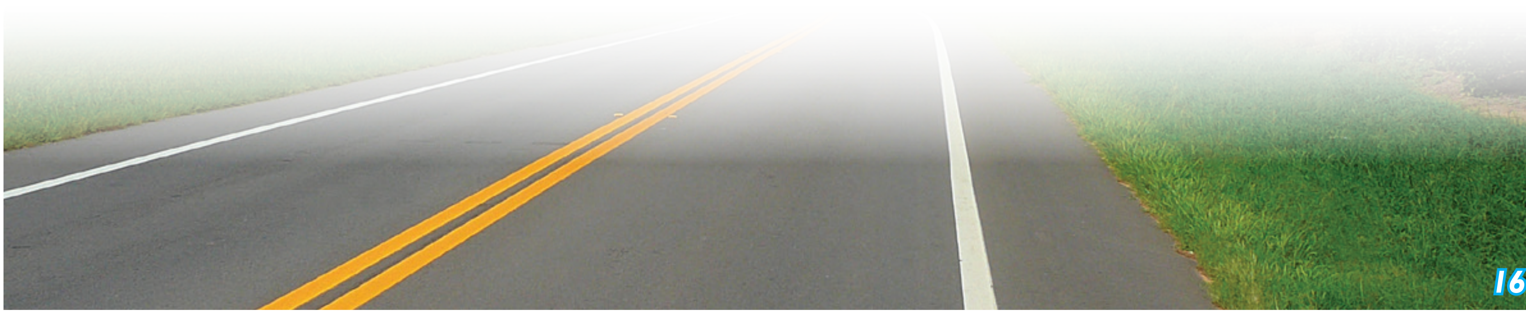
Learn to interpret state of charge information provided by the car: All electric cars display dynamic information on the battery state of charge in the form of an estimated range of the vehicle under the current driving conditions. This information coupled with route familiarity can provide adequate confidence to the driver about the vehicle's capabilities.

Use strategies to maximize vehicle range: Use accessories wisely (A/C, heating, entertainment system, etc.); avoid driving in extreme weather conditions if possible; use economy mode; avoid fast acceleration and hard braking; do not drive unnecessarily fast; avoid hauling cargo on the roof; remove excess weight; and other strategies discussed earlier.

One key point to keep in mind about the built-in EV range display is that the displayed range represents an estimate.

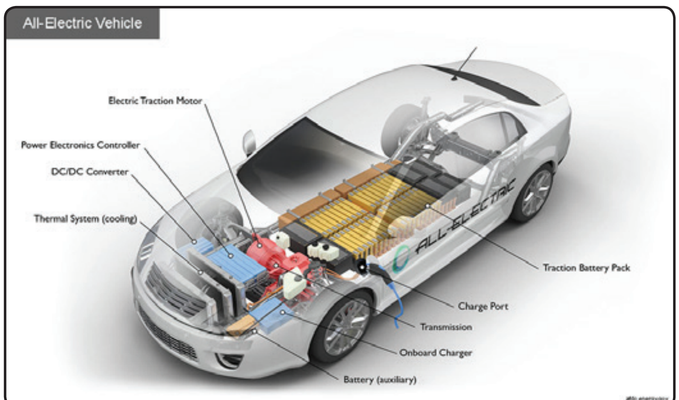
This estimate is calculated based on a number of factors including battery capacity, climate conditions, terrain, vehicle dynamics and driving style. The estimate may lead to an inaccurate prediction, especially if any of the above parameters change.

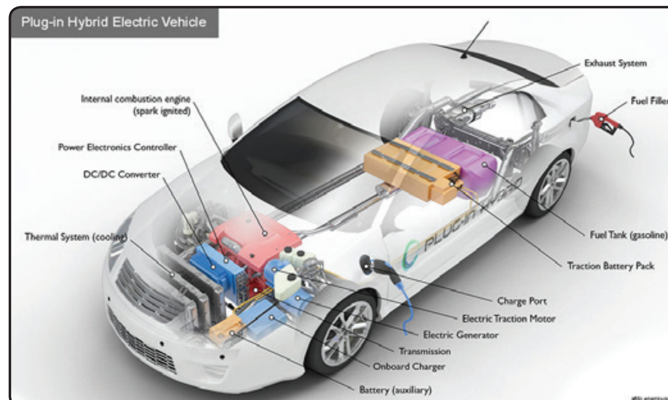
For example, the remaining range of 40 miles on a level road may not be enough to reach a destination 20 miles away that is on the top of a steep hill. Knowing how dynamic vehicle range is estimated and learning to interpret the information provided by the vehicle is essential to getting the most out of the EV charge.



Vehicle Drive Components: EV vs. Internal Combustion Engines

EVs and regular liquid fuel-powered combustion vehicles differ significantly in the number of moving parts. An electric motor has only one moving part, the shaft, rotated by an electric magnet and requiring little or no maintenance. An internal combustion engine, on the other hand, has hundreds of moving parts including pistons, valves, a crankshaft, fan belts, a timing belt, an oil pump, a fuel pump, fuel injectors, a cooling pump, a thermostat and other parts. None of those parts are necessary in an EV. However, the components of plug-in vehicles (the electric system including battery, motor, and electronics) will require some maintenance, which is discussed in detail below.





Regular liquid fuel–powered combustion vehicles use multi-speed transmissions since internal combustion engines generate usable torque and power in a rather narrow spectrum of engine speed. Therefore, a multi-speed transmission with varying gear ratios is required to keep the engine in its optimal power band. Electric motors, on the other hand, generate maximum torque at relatively low speeds and have a much wider band of usable power. As a result, EVs often have no gearboxes but use a single lowering gear ratio. This does not mean that electric cars cannot have multiple gears; they are simply not necessary.

Because of this, much simpler drive-train design and fewer moving parts, EVs typically require less maintenance than vehicles with internal combustion engines. Since electric cars use regenerative braking, the brakes last much longer and require less maintenance on EVs than on regular gasoline vehicles.

Overall, EVs are simpler, have fewer moving parts, are more energy-efficient, and are typically lower in maintenance.

Battery maintenance in electric cars may vary based on the specific cell chemistry and design. Some vehicle manufacturers use liquid cooling systems to maintain an optimal operating temperature for the batteries. These cooling systems may require regular scheduled maintenance. The batteries used in EVs have a limited number of charging cycles, after which battery performance and capacity degrades significantly, however batteries are generally designed to last the expected life of the vehicle. Several manufacturers offer battery warranties up to 100,000 miles.

EV Driving Experience

In addition to energy efficiency and environmental benefits, electric motors offer a performance advantage over internal combustion engines.

Internal combustion engines have a lag in reaching maximum engine rotation.

When an accelerator in a gasoline powered vehicle is pressed (even when it is floored), the engine speed slowly rises to its maximum torque threshold before it can deliver maximum performance and accelerate the car. Electric motors, on the other hand, deliver maximum torque at low speed and provide no delay in torque delivery. Due to this low-end torque and no lag in throttle response, EVs accelerate very quickly.

Since EVs do not typically use multi-speed gearboxes, they provide a much more efficient torque delivery (i.e., with less torque loss) from the motor to the wheels. Some electric drive systems use several motors (two to four) that are attached directly to the wheels. This design allows for the elimination of drive shafts and differentials, as well as minimizes the mechanical losses between the motor and the wheels.

Electric motors also operate much quieter than their ICE counterparts.

The noise produced by a moving vehicle is a combination of engine, tire and wind passage noise. While EVs have no engine noise, they still produce tire and wind noise, especially at high speeds. However, at low speed, EVs can be extremely quiet.

EV Safety

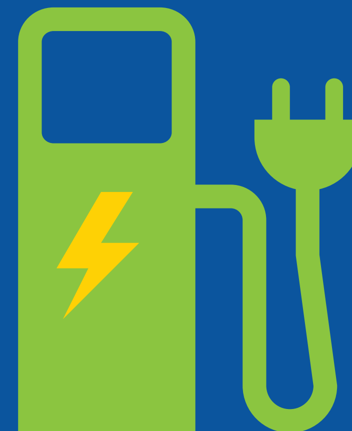
EVs are so quiet that in 2016 the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) required all newly produced light-duty and hybrid EVs to make audible noise when traveling forward or in reverse, at speeds up to 19 miles per hour. This law is meant to improve pedestrian safety due to the increased risk of pedestrians failing to hear an approaching EV due to its low noise level.

With regards to other safety considerations, plug-in vehicles have to follow all the same safety standards as conventional vehicles. In addition to those standards, manufacturers are required to comply with requirements unique to plug-in cars, such as measures to reduce chemical leaks, protecting battery packs in the event of an accident and separating the chassis – the vehicle's frame – from the electric system to prevent the transfer of electric energy to the passenger or outside through touching the body of the vehicle. In the event of an accident involving a PHEV, the vehicles are manufactured with features that automatically shut down the high-voltage electric system to ensure the safety of the passengers and emergency first responders.

Types of Charging Stations

EVSE comes in three different levels of charging:

- **Level 1**
- **Level 2**
- **Direct Current (DC) Fast Charger**



The different charging levels are determined by the rate of charging, or the time it takes to charge the vehicle's battery. Charging times depend on a few factors, including the size of the battery, the type of battery and level of charge.

Level 1 and 2 charging provide alternating current (AC) electricity to the vehicle, and the vehicle's on board charger converts that AC to DC, which is used to charge the battery system. DC fast charging uses an inverter to first convert alternating current electricity from the utility to direct current that is then sent directly to the vehicle's battery.

Level 1 Charging

Level 1 EVSE use a 120-volt (V) AC plug, and most EVs will come standard with a Level 1 cord set. A standard three-prong household plug (a NEMA 5-15 connector) is on the end of the cord, which is plugged into the outlet. On the other side of the cord is a J1772 standard connector, which is used to plug into the EV. This lower level of charging can be done from an ordinary household outlet, or comparable outlet at a business or even a motel.

Level 1 charging offers the slowest charging rates, and is best suited for overnight charging. While different factors affect the rate of charging (including battery type and vehicle), Level 1 adds about 2 to 5 miles of range to a plug-in EV per hour of charging time.

Level 2 Charging

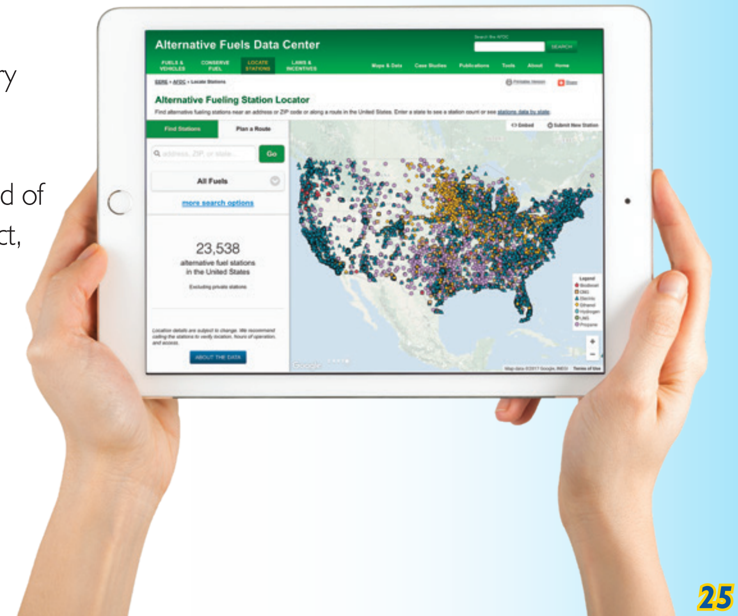
On the vehicle, there is no difference between the Level 2 and Level 1 charging equipment connector. However, Level 2 charging equipment uses 240 volts or 208 volts, which requires a different outlet than an ordinary household outlet. Depending on the type of battery, charger, and circuit capacity, Level 2 charging inputs between 10 to 20 miles of range to a plug-in EV per hour of charging time.

Level 2 charging is ideal for home, workplace, or public charging, and on average can fully charge a depleted battery within several hours.

DC Fast Charging

Direct current fast charging (DCFC) equipment, which charges through either a 208- or 480-volt input, allows for vehicles to charge at a much faster rate than Level 1 or 2 charging. Many EV's models are equipped with the capability to charge with DC fast charging, which makes it easy to add significant range to an EV in a short amount of time. Because DCFC allows for rapid charging, DCFC stations are typically found in areas with heavy traffic to allow EVs to travel longer distances.

With fast charging, the speed of charging is very different when charging an empty battery versus a full battery. When the battery is almost depleted, electricity can flow quickly and recharge the battery at a much faster rate. As the battery fills up, the rate of charging decreases. Charging the battery to around 80% instead of a full charge preserves the life and efficiency of the battery. In fact, some DC fast charging stations automatically stop the charging process when the battery reaches that level.



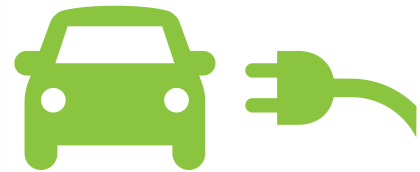
Thousands of public EV charging stations are available all around the United States. To locate public access charging stations, drivers can download the Alternative Fuel Data Center (AFDC) Station Locator mobile application. The AFDC Station Locator can also be accessed online at **https://www.afdc.energy.gov/locator/stations**.

Charging Costs: *Charging an EV at Home*

Many EV drivers will be able to complete their daily trips by charging their vehicle at home overnight, using either Level 1 or Level 2 charging.

The cost of charging an EV depends on the size of the vehicle battery, while the cost per 100 miles is determined by the energy efficiency of a particular model. However, with an average energy efficiency of 30 kilowatt-hour (kWh)/100 miles for current EVs on the market, and an average residential electricity cost of 10 cents per kWh, it will cost an EV owner, on average, around $3.00 to put 100 miles-worth of charge in an EV charged at home. To compare, if a combustion vehicle fueled with gasoline has a fuel efficiency of 20 MPG, and gasoline is priced at $2.50 per gallon, it will cost the owner of that vehicle, on average, $12.50 to go 100 miles.

It costs an EV owner, on average, around $3.00 to put 100 miles worth of charge at home.



The electric rate applied to home charging the vehicle is the same rate for each kWh used for all the other electric uses in the home (e.g., lighting, cooking, water heating, air conditioning, TV, cell-phone charging). Many electric utilities offer programs with rates that vary throughout the day. Some energy-savvy customers have already figured out that controlling or altering the time when they use energy results in significant savings, even when they do not own an EV. They lower their overall electric bill by taking advantage of time-of-use rates or ***dynamic pricing rates***, which mimic the real-time price of power. These customers maximize their savings by making simple adjustments to use more energy during off-peak hours and in exchange for this, the electric utility provides lower rates for using electricity during these times.

Charging Etiquette

While charging infrastructure continues to expand across the U.S., there are still plenty of areas lacking enough public charging stations to accommodate EV growth. Lack of infrastructure, combined with the longer time to fuel EVs compared to gasoline-powered vehicles, makes it necessary to establish best practices for fair sharing of EV charging infrastructure. The following informal rules of charging etiquette were developed by the EV community in order to ensure fair and considerate use of charging resources.

1. Safety first

Practice safe charging. Tuck the cord under the car while charging to avoid creating a tripping hazard and always return the connector back to its holster after unplugging the car. Avoid overstretching the cord and/or driving over it.

2. Leave charging site as clean (or better than) when you arrived

Do not leave trash at the charging site. Be courteous to other users. Consider wiping down the charging station after use with a clean cloth or paper towel.

3. EV spots are for EVs

EV charging spots are designated exclusively for EV use (EVs or plug-in hybrids). Regular vehicles with internal combustion engines are not allowed in EV spots, regardless of how frequently the EV spots are used.

4. Charge only when necessary

Do not charge if you do not need a charge. Leave the spot available for an EV driver who might need a charge to complete his or her trip.

5. Don't occupy an electric car charging space if you are not charging

Only occupy a charging spot when your car is being charged. Once the car is fully charged or sufficiently charged to reach your destination, unplug and move your car. Charging spots are not intended for parking.

6. All electric vehicles are equal

Priority is not given to one type of EV over another when accessing the charging station. Owners of all-electric often feel they should get preferential treatment over PHEVs since plug-in hybrids have gasoline-powered engines as back-up. Owners of battery-EVs do not have the right to unplug PHEVs. Charging preference is given to the vehicle that arrives first. An EV driver can politely ask the driver of a plug-in hybrid to trade places in line if needed.

7. It's OK to ask for a charge

If a charging spot is being used and you are able to park next to it, you can leave a note to the driver asking to plug in your EV when he or she is done. Leaving your vehicle's charge port open when parked next to an occupied charging spot is a common signal to plug in your vehicle after the other driver's charging session is complete. This rule mostly applies to free public charging stations. When some form of payment or the use of a membership card is required, this rule may not be appropriate.

8. Do not unplug someone else's EV

Do not unplug another driver's vehicle unless the charge is complete, which can be seen by a blinking green state of charge indicator on the dashboard.

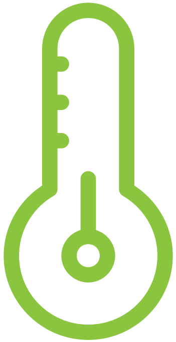
Just as with good manners, these rules are informal, suggestive in nature and based on common sense. However, some large employers offering EV charging facilities to their employees have adopted similar etiquette rules for participants in their workplace charging programs.

When it comes to efforts to conserve energy in your house, are you doing your part?

Do you walk through the house turning every light on, or leave video games running after moving on to a new activity? If you or your family members are like this, consider following some of these simple tips to start conserving energy and keep more money in your pocket.

Heating and Cooling

- When cooling your home, set the temperature between 78-80°F
- Set the temperature at 68-70°F for heating
- When away from home, set the thermostat a few degrees higher
- Close exterior doors when leaving the home at any time
- Close windows to the outside when cooling or heating
- Use ceiling fans in occupied rooms only
- Set fans at low speed and rotate clockwise in winter
- Change filters monthly and make sure they are installed correctly (look for the airflow direction arrow on the filter)
- Close shades and drapes during the day to help keep heat outside during the summer and open them in the winter to assist in heating
- Turn off lights when not needed as they produce additional heat in the home
- Try to minimize the amount of cooking/baking, clothes drying, or using the dishwasher in the heat of the day
- Close your chimney damper when not in use

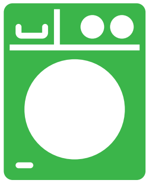


Water Heating

- Turn down the water heater temperature to 120°F (140°F if you have a dishwasher)
- Take showers instead of baths
- Take shorter showers
- While brushing your teeth, use cold water and turn the water off while you are actually brushing
- Once a year, flush the sediment out of the bottom of your water heater
- Turn off your water heater when your home is vacant for two or more days

Kitchen

- Check your refrigerator and freezer settings, then set to the manufacturer's recommended temperature
- Close the refrigerator and freezer doors and minimize the amount of time they are open
- Clean refrigerator and freezer coils regularly
- Wipe down the seals of the refrigerator and freezer to prevent cold air from escaping
- Unplug unused refrigerators or freezers
- Use a microwave for cooking if possible
- Run the dishwasher when fully loaded



Laundry

- Do only full loads of laundry
- Clean your dryer's lint trap before each load
- Wash clothes in cold water

Lighting

- Use natural daylight if possible
- Turn off lights when you leave the room
- Turn off unnecessary lighting

Miscellaneous Ways to Conserve

- Turn off computers, monitors, and electronics when not in use
- Check and adjust irrigation and/or pool pump timers for appropriate run times during seasons

VII. Renewable Energy

We use energy for just about everything.

We use it to drive to school, surf the internet, take a warm shower and even to play video games. But did you know that most of the energy that we use today is non-renewable? This means that it is not endless; it will eventually run out! We must be careful about how much we use.

Tampa Electric is a leader in Solar

By 2021, Tampa Electric will invest $850 million to build 10 new solar projects that generate 600 megawatts – enough electricity to power more than 100,000 homes. When complete, nearly 7 percent of Tampa Electric's energy generation will come from the sun – a higher percentage of solar than any other Florida utility. Visit **tampaelectric.com/solar** to learn more about all the company's solar initiatives.

Big Bend Solar Facility

More solar solution for you

Sun Select℠ – Tampa Electric's latest solar program offers you a simple but meaningful way to support solar, even when a rooftop system isn't an option for you. Sun Select lets you purchase local solar power to match some or even all of the electricity you use.

Sun to Go℠ – Turn your event green by purchasing bocks of solar-generated electricity – and announce that your function is powered by 100% solar. You can also purchase one or more blocks each month. Sun to Go offers two easy ways to go green.

Solar in the Community – Since 2000, Tampa Electric's community-sited solar arrays have been teaching the public about the benefits of solar technology. Check out the company's educational displays located throughout the community.

Visit **tampaelectric.com/solar** to learn about these and other Tampa Electric solar initiatives.

Best Practices

Following these common practices will help drivers make the most of their EVs.

1. Observe the speed limit

The fuel efficiency of most EVs declines significantly at speeds above 50 MPH. Unnecessarily fast driving not only increases fuel cost, but is also unsafe.

2. Avoid fast acceleration

Fast acceleration increases energy consumption and reduces fuel efficiency of the vehicle. Avoiding fast acceleration and other aggressive driving habits will improve fuel efficiency and extend driving range.

3. Do not brake hard

Anticipate braking and whenever possible, coast to a stop. This will maximize the efficiency of an EVs regenerative braking system and extend driving range.

4. Keep the vehicle well-maintained

Proper maintenance habits, including maintaining proper tire pressure, fluid level checks, and battery upkeep, will allow the battery and electric drive components to operate to their full capacity, ensuring best performance and fuel economy of the vehicle.

5. Use climate control wisely

Intensive use of heating or air conditioning significantly reduces vehicle range. Consider pre-heating or pre-conditioning the vehicle before a trip while the vehicle is still plugged in. Avoid driving in extreme weather conditions that require intensive use of climate control.

6. Use economy mode when driving

Economy mode reduces EV fuel consumption and maximizes vehicle range by optimizing the vehicle's performance and climate control features. Economy mode can often be engaged with the press of a button.

7. Plan your trip

Prepare to fully charge the battery before a trip, and know the trip distance and availability of public charging stations along the route. Remember, you can use the AFDC Station Locator app to find the closest public charging stations.

8. Learn to interpret the built-in range display

All EVs have a built-in display that shows the remaining range of the vehicle. While the displayed range represents an estimate, this information coupled with route familiarity can provide adequate driver confidence and avoid range anxiety.

9. Charge the vehicle off-peak

Charging the vehicle during off-peak hours, preferably at home, helps drivers take advantage of the lowest electricity rates, thus reducing EV driving cost per mile. Additionally, off-peak charging helps utility companies balance demand, reduce societal energy costs, and generate environmental benefits.

10. Follow charging etiquette rules

Be courteous to fellow EV drivers and respectfully share limited EV charging infrastructure.

Key Terms and Definitions

All-electric vehicles/battery-electric vehicles
Vehicles that operate on 100 percent battery-electric power.

Alternating current
A type of electric current that reverses direction a number of times per second.

Alternative Fuel Data Center (AFDC) Station Locator
Online and mobile mapping application that identifies alternative fueling stations near an address or zip code.

Alternative fuel vehicles
Vehicles that are powered by at least one non-petroleum based fuel, which includes electricity, hydrogen, natural gas, propane, biodiesel, and ethanol. A full list of alternative fuels can be found at https://www.afdc.energy.gov/fuels/.

CHAdeMO
Proprietary name for a quick charging method for battery-EVs.

Charging cycle
The process of charging and discharging a rechargeable battery.

Charging Rate
The rate of charge at which an electric charging station can recharge the vehicles' batteries. Charging rate is measured in miles of range provided to the vehicles' batteries per hour of charging.

Chassis
The basic frame of a vehicle.

Daily Range
The mileage, on average, that a vehicle is used on a daily basis.

DC Fast Charging
A charging process that uses direct current to rapidly charge a plug-in vehicle. Also referred to as DC quick charge, Level 3 charging, and Level 4 charging.

Direct current
Electric current that runs continually in one direction and can be produced by a battery or another electric source.

Dynamic pricing rates
Different rates are offered by the utility based upon preset times of the day. During off-peak times, the prices will be lower versus during on-peak, when the price could be substantially higher.

Economy mode
When a vehicle is in economy mode—not all vehicles are equipped with this mode—it changes the way the vehicle operates to maximize fuel economy and extend range.

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Electric vehicle supply equipment
All the equipment used to supply electricity to a vehicle, including electrical wiring, grounding equipment, the EV connectors, attachment plugs, and any equipment used to transfer energy from an external power source to a vehicle.

Hybrid vehicles
Vehicles that are powered by an internal combustion engine and an electric motor. Regular hybrid vehicles cannot be plugged into an electric power source for recharging.

Inductive charging
A process that uses wireless technology and an electromagnetic field to transfer energy between two objects.

Internal combustion engine
An engine that creates power by burning liquid or gaseous fuels such as gasoline or diesel.

Kilowatt-hours (kWh)
A measure of electrical energy.

Level 1 Charging
Provides charging to a plug-in vehicle through a 120-volt alternating current plug and circuit. Using a household plug to charge a vehicle is a form of Level 1 charging.

Level 2 Charging
Supplies charging to a vehicle using 208 volts or 240 volts, which is the same voltage that an electric clothes dryer or household oven requires.

MPG illusion
A misperception about fuel efficiency that the amount of fuel consumed by a vehicle changes as a linear function of MPG.

Plug-in hybrid electric vehicle
Hybrid vehicles that have both an internal combustion engine and an electric motor that can be charged by plugging into an electrical outlet or charging station.

Range anxiety
The fear of not having enough battery charge in an EV to reach a destination.

Regenerative braking
A process that allows the EV to recapture some of the car's energy and use it to recharge the battery.

SAE Combo Charging System
A fast charging method for battery-EVs that sends a high-voltage direct current using a special connector.

Tailpipe emissions
Air pollutants that are released through a vehicle's tailpipe.

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Tesla Supercharger
A proprietary fast charging method used solely by Tesla, an EV manufacturer.

Torque
A measure of force acting on an object that causes that object to rotate.

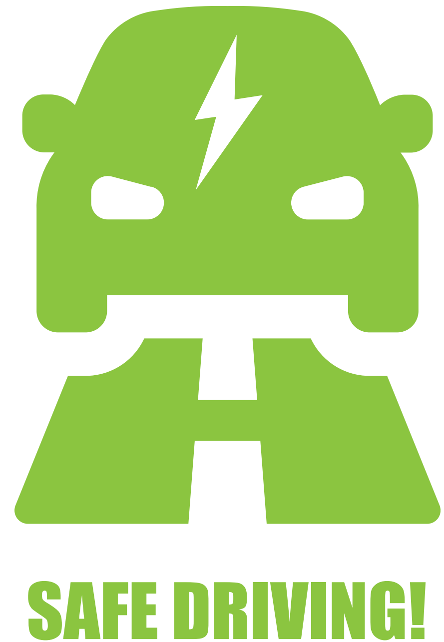
U.S. DOT National Highway Traffic Safety Administration
An agency of the executive branch of the United States government that addresses vehicle transportation-related safety considerations and regulations.

U.S. Environmental Protection Agency
An agency of the executive branch of the United States government that develops and enforces regulations regarding human health and the environment.

Vehicle propulsion energy
The way that vehicles create force resulting in movement, which involves a source of mechanical power (such as an engine or motor) and the way the vehicle uses this power to create force.

Vehicle range
The distance a vehicle can travel before needing to be refueled or recharged. For EVs, this refers specifically to the distance an EV can travel on a full charge.

Zero-emission vehicle
A vehicle that emits no tailpipe pollutants.



Notes

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