



AN INFORMED CONSUMER'S GUIDE TO ELECTRIC CARS:

The Benefits of and Facts about
Electric Vehicles (EVs)



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Table of Contents

Introduction

Electric Car Basics

City vs Highway Driving Efficiency

Winter Weather Questions

Car Charging Basics

Direct Benefits of Driving an EV

Benefits to All

Comprehensive EV FAQS

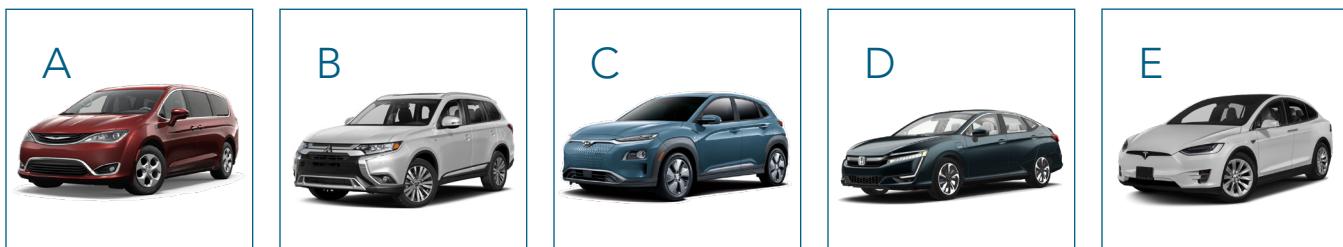
Additional Resources

Introduction

Getting behind the wheel of a plug-in electric vehicle and experiencing the control, handling and acceleration first hand is an experience that most drivers find very compelling. The growing variety of plug-in vehicle choices means that there is now an electric vehicle that fits nearly every driver's lifestyle

and transportation requirements. Therefore, drivers are more apt to find an electric vehicle that meets their functional and emotional needs. When drivers get better informed of the longer-term personal and financial benefits of EV ownership, polling shows few want to go back to driving a gasoline only vehicle.

Which of the following is a plug-in electric vehicle (EV)?



You'd be correct if you said... All of the above!

Now there's an electric choice to match nearly any lifestyle, including yours! Find out more at ev.ene.org

In this guide, we'll start by introducing you to the important basics about electric cars and charging that every consumer should know. Then we'll unpack the many benefits of electric vehicles and why they make sense. This includes not only benefits to the individual EV driver household, but also to everyone – in all, a basket of benefits that more EVs on the road will provide. Next, we'll answer common questions and concerns that the public has expressed interest in when it comes to comparing plug-in electrics to the legacy fueled vehicle they drive now.

Finally, we'll provide some additional resources to connect and learn more about local incentives, electric vehicle events, and the growing community of EV drivers.

We hope you find this guide to be both comprehensive as well as easy to reference –

Everything you **E**Ver want to know about **E**Vs! 😊

Electric Car Basics

WHAT IS THE DIFFERENCE BETWEEN A HYBRID AND AN ELECTRIC CAR?

A hybrid car derives some of its power from a conventional gasoline engine, and all of its energy from gasoline. A hybrid's battery is typically only recharged from regenerative braking energy when the car slows being put back into the battery.

On the other hand, an **electric car** gets driving power from an electric motor, and that energy is from a battery that has been recharged from the grid or another external source.

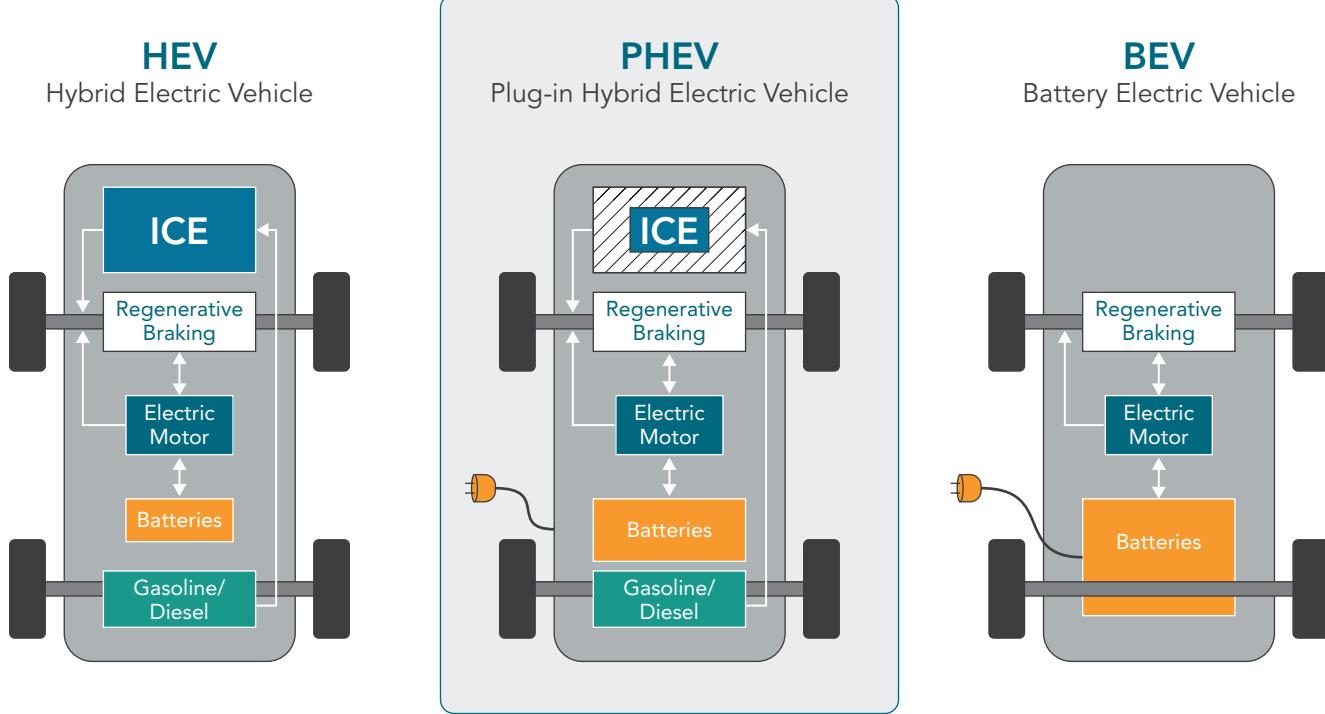
There are two types of electric cars, or plug in electrified vehicles (PEVs): Battery electrics (BEVs) which run on electricity only, and plug in hybrid electrics (PHEVs) which can first run on electricity from the battery for a shorter range (often the distance of a daily commute, or more), then seamlessly switch to a full tank of gasoline if the

battery gets low. PHEVs therefore will always have the range you need, and can be driven and fueled just like the car you drive now. Today's BEVs have more range than 90% of commuters drive daily. Some models are available in either BEV or PHEV.

Most BEVs have a range of between 114 and 315 miles depending upon the model. BEVs must be recharged when the battery gets low, which can be done at home (typically overnight while you sleep) or more quickly using a public fast charging station. Most often, they are charged conveniently at home, overnight while you sleep.

Today's PHEVs have a battery range between 14 and 114 miles, and then typically a full tank of gasoline range, 300-500+ miles. When operating in hybrid mode, they also get better gas mileage than comparable gasoline only vehicles.

Barrier Removal: Technology



Source: Image courtesy of Gary Kendall, PhD.

City vs Highway Driving Efficiency

Gasoline only vehicles get their best fuel economy (and therefore best total range) in highway driving, and less efficiency when driving in the city, particularly in stop and go traffic. The opposite is true of electric and hybrid vehicles. This is in part because these vehicles have regenerative braking that returns some of the energy to the battery that would otherwise be lost as friction brake heat. For some EV drivers, this efficiency means even greater monthly savings on "fuel" costs.

Conversely, as any vehicle travels at higher speeds, it requires more total energy to maintain speed and push against the effects of drag from the air. Therefore, almost any vehicle will get lower than rated efficiency when driving at 75 mph or greater.

For example, in typical low speed driving, real world experiences have shown that an electric vehicle can exceed its rated efficiency and range by 25% or more, something very few gasoline only vehicles can ever do in normal type of driving at any speed. Conversely, if driven at very high speeds (75 mph or greater), an EV will typically get 25% less efficiency and range than it would at moderate highway speeds. This efficiency and range loss is also true at these very high speeds for gasoline only vehicles, but somewhat less noticeable as most gasoline only vehicles still have a greater total range than most electric only vehicles. Electric Vehicles are most efficient at low speeds, whereas ICE powered vehicles are least efficient at low speeds.

WINTER WEATHER QUESTIONS: How good are electric cars in the cold? How about in snow?

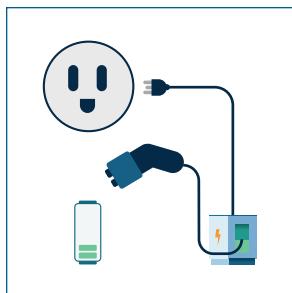
All vehicles, including gasoline only vehicles, get lower efficiency in cold temperatures and inclement weather. According to fueleconomy.gov, "Cold weather and winter driving conditions can reduce your fuel economy significantly. Fuel economy tests show that, in short-trip city driving, a conventional gasoline car's gas mileage is about 12% lower at 20°F than it would be at 77°F. It can drop as much as 22% for very short trips (3 to 4 miles)."

Similarly, the efficiency of electric vehicles is decreased in the cold weather. This may be to a greater degree as the cabin heating systems also draw from the same battery that propels the car. Fleet and driver data indicate that electric vehicles will get between 20% and 40% lower efficiency in extreme winter weather.

As for electric car performance on snowy and slushy roads, most EVs have better weight distribution and a low center of gravity due to the location of the battery. This results in more weight distributed to the tires and better traction and handling in those inclement winter conditions.

Car Charging Basics

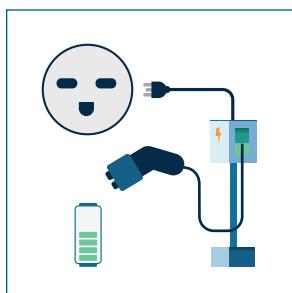
For most drivers, charging an electric car is as simple as charging a cell phone. Most charging (over 85%, according to EV driver polling) happens at home, overnight, while the driver sleeps. You just plug in your car when you get home and it's typically re-charged back to full before you even wake up the next morning. It's the car that "refuels" while you sleep! Most cars also allow you to program the time to start charging. There are three levels of charging speed to choose from, depending upon your needs and lifestyle.



LEVEL 1 CHARGING | "REGULAR" SPEED

Typical Use: At home, overnight

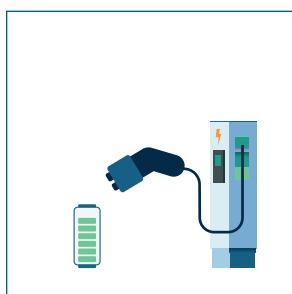
In many cases, all you need is the charging adapter included with the vehicle and a standard outlet to recharge for the daily range you need – no "charging station" required! The adapter comes with a cord and charger head that plugs into your EV. Once it is plugged in, either inside your garage or in an exterior outlet next to your parking space, it is always ready and on standby - so then it only takes a few seconds to plug it in to your car in each night. It really is that easy! Level 1 works best for plug-in hybrid electrics (PHEVs) with small batteries, and/or people who do not drive much each day, as it adds range of between 3 and 6 miles per hour of charging, or up to around 50 miles overnight.



LEVEL 2 CHARGING | "PLUS" SPEED

Typical Use: At home, overnight, at work, or destination spots like train stations or airports

A Level 2 charging system consists of a 240-volt wiring circuit from your home's electrical panel to either a NEMA 14-50 outlet (much like the outlet into which you'd plug an electric stove or clothes dryer), or hard-wired to a wall-mounted EV charging station. The most common type of charging, both private and public, Level 2 can add up to 30 miles of range per hour, depending upon the vehicle and station type. This means that even the longest-range electric cars will always get a full charge overnight using properly matched Level 2 equipment. Home Level 2 charging equipment can be purchased from around \$300 up to \$1,000, depending on power and features, such as cable length and wireless network connectivity. The installation may only require minor work by an electrician or may require some upgrades to your panel or wiring. Check out our Home Installation Help section and FAQ to learn more.



LEVEL 3 CHARGING | "PREMIUM" SPEED

Typical Use: Highway rest stops, community hubs and destination spots

Also known as public DC Fast Charging, Quick-charging, and Super-charging, Level 3 can add hundreds of miles of range per hour of charging. Today a typical fast charger will add between 50 and 150 miles in a 30-minute stop. Some vehicles are already capable of adding 180 miles of range in under 30 minutes. The next generation of vehicles (2020) and chargers will cut that charging time to less than half, or around 200 miles in just 10 minutes! Many new public fast charging sites are being added every year. To get a handy online map and mobile app to find charging station near you, visit PlugShare or install their mobile app.

ABOUT PUBLIC CHARGING EQUIPMENT AND NETWORKS

Charging in public can be a positive experience with a little bit of research and preparation in advance. There are many brands and models of public charging units, as well many different charging networks both nationally and regionally. There are basically two types of stations:

1. **Smart charging stations**, also known as networked charging stations or connected stations. This typically require either membership, a card, or an app to access. They may or may not have a fee. The two most common EV charging network providers are **Chargepoint** and **EVgo**.
2. **Non-networked charging stations**. These do not require any membership to activate, and usually are free and just connect when you plug in, or may require an access code.

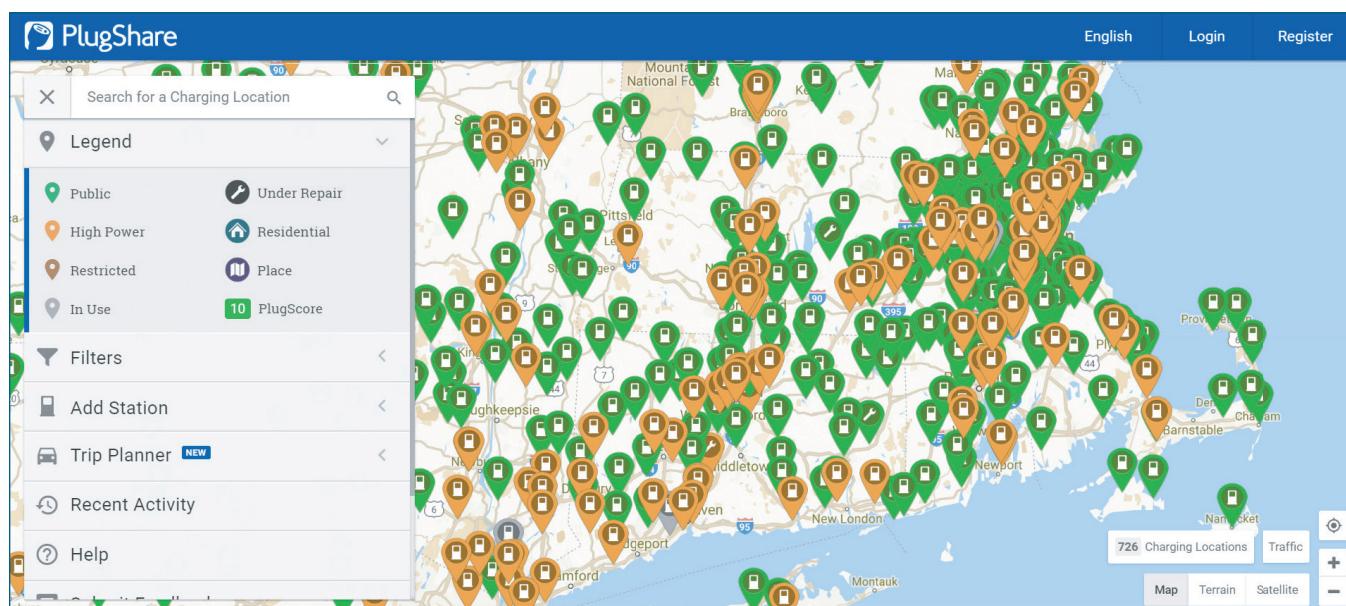
Many people do not realize the number of charging stations that are actually already around as they may blend unnoticed into the landscape. Finding out in advance where these stations are by using PlugShare or another app can help you find public charging is near you and your home.

WHAT IS PLUGSHARE?

The leading app for EV drivers, **PlugShare**, is a community-based tool that guides users to public charging locations throughout the world. A powerful mobile application and online tool, PlugShare allows electric car owners to locate and optimize the use of EV charging stations.

PlugShare has a comprehensive and up-to-date database of electric vehicle charging stations that automatically pulls down information from the country's biggest EV charging networks, updating station info every few minutes.

Because it is also crowd-sourced, PlugShare gives EV owners the ability to add, review, and edit station information, as well as, add their own private residential charging station. This makes PlugShare an indispensable tool for practically every EV owner. The PlugShare mobile app is available for free for Android and iOS devices or you can visit PlugShare.com on any web browser. You can zoom into any address by using the search field.



Direct Benefits of Driving an EV

1. PERFORMANCE

Any electric motor has more torque, or tire-turning rotational force, than its equivalent internal combustion engine car. Unlike a gasoline car, an EV has instant response, and no hesitation when you press on the accelerator. In addition, most electric cars also offer inherently better handling and ride due to their superior weight distribution and low center of gravity – a (lower-case) driving experience that hugs the corners! And finally, the ride is further improved by reduced overall cabin noise and less vibration.

2. RELIABILITY

“EVs have 10-times fewer moving parts than a gasoline powered car,” says advocacy group Plug in America. This means lower maintenance requirements and fewer things that can mechanically wear out or fail, which results in higher long-term reliability. And because electric cars all have regenerative brakes, the brake pads and rotors don’t wear as quickly, and may even last the life of the vehicle with little or no maintenance.

3. CONVENIENCE

An EV provides far greater convenience than the way we drive and fuel now. You charge an electric car like a cell phone — overnight, while you sleep. It’s sort of like having a gas pump in your garage, but without the mess. So, with an electric car you wake up back on “Full” and always ready to drive. And for many drivers, the car comes with all you need to get started, as charging can be done with the included adapter and a standard accessible outlet that most households already have in their garage or on the side of their house near a driveway. You can even program your car to automatically start charging later in the evening, and finish just before your morning departure – a potential benefit to the electric grid and to the utility, and can even save you more money if there are incentives or discount rates to charge during this “off peak” period.

4. SAVINGS

Electric cars offer long term cost savings that often can’t be beat. In many cases, after federal, state and other incentives are factored in, an EV costs less total to own over five years than a comparable gasoline only vehicle. This is in part because the average long-term price of electricity is less than half of what gasoline would cost for the same mileage, and also because maintenance costs are much lower.

“FUEL” TYPE	BEV	PHEV	GASOLINE ONLY
MSRP	\$29,990	\$27,300	\$20,950
Home charging station	\$1,150	0	0
Federal tax credit	(\$7,500)	(\$4,502)	0
State incentive	(\$1,500)	0	0
Electricity	\$3,000	\$1,316	0
Gasoline	0	\$1,934	\$6,250
“Fuel” Total	\$3,000	\$3,250	\$6,250
Maintenance & Repairs	\$2,963	\$3,300	\$3,637
Insurance	\$1,058.50	\$1,058.50	\$1,058.50
TOTAL	\$29,162	\$30,407	\$31,896

Image: Total Cost of Ownership (TCO) comparison of a mid-range BEV (151 miles all-electric range), PHEV (25 miles electric range + 450 miles hybrid range), and a popular “economy” gasoline only compact hatchback.

Benefits to All

1. DOMESTIC REINVESTMENT

Much of our oil used to make gasoline is still imported, as it is a global commodity. Money spent on electricity is not sent out of the country to foreign economies. This means that money stays in the domestic or even our local economy, which in turn equates to better local economic prospects for all.

2. ENERGY SECURITY

Much of the global supply of oil also comes from unstable regions of the world, and/or from nations that our relationship is more adversarial than friendly. Our military must protect the global oil supply routes around the world from threats of war, sabotage and terrorism at a cost of billions of dollars. Increased EVs adoption reduces this threat.

3. HUMAN HEALTH

Not to be confused with the environmental concerns that affect our planet, this is about public health issues and associated costs which affect us all. Switching to an electric car drastically reduces the pollution and other toxins from the drilling, transport, refining, and burning of petroleum. This is not only a societal concern for the wellbeing of everyone's lungs, but also a financial concern as tailpipe and refinery emission related health problems have a hidden economic burden.

4. CLIMATE RESPONSIBILITY

As confirmed by peer-reviewed analysis, EVs already reduce CO2 emissions that contribute to Climate Change impacts caused by AGW (Anthropogenic, or man-made Global Warming) by at least 50% (Source: [Union of Concerned Scientists](#)), and by at least 70% with New England's power mix.

Comprehensive EV FAQS

1. HOW MANY MILES DOES A TYPICAL EV GET PER CHARGE?

The driving range of Battery electrics (BEVs) and plug in hybrid electrics (PHEVs) vary greatly depending upon the design and/or cost. Most BEVs have a range of between 114 and 315 miles depending upon model. They must be recharged when the battery gets low, and can be done at home (typically overnight while you sleep) or more quickly using a public fast charging station. PHEVs typically have a much shorter range (often the distance of a daily commute) as they seamlessly switch to a full tank of gasoline if the battery gets low, typically for use on long trips. Today's PHEVs have a battery range between 14 and 114 miles. When operating in hybrid mode, they also get better gas mileage than comparable gasoline only vehicles.

2. IS A BEV OR PHEV RIGHT FOR ME?

The most important question to answer to see if a plug-in car is right for you is: Do you have dedicated access to a place to charge, preferably at home overnight, or secondarily at work? The second important question is: Which model of plug-in vehicle meets my functional needs for passenger and cargo space, and other functionality you might require? Therefore, which electric car you'll want, whether a BEV or PHEV, depends on how many miles you typically drive per day, what types of long trips you plan to take in your vehicle, and what vehicle features are important for you. Answering these three personal questions before car shopping will also lead you to the electric models that best fit your lifestyle and needs.

3. HOW LONG DOES IT TAKE A CAR TO CHARGE?

It depends on the car's capability and what level charger is being used. Most charging is done overnight, so the charging speed in that case is not very important. The amount of your time that's required is only a few seconds to plug the car in, and then it's typically back to a full charge before you even wake up. Total time using home Level 2 charging is typically 4 to 8 hours from "empty" (typically adding around 25 miles of range per hour of charging), and less if topping off from higher state of charge.

The second most common place to charge is at the workplace. Since most people are at work for 7 or more hours, the time to charge is also not typically a concern.

The third most common charging happens at a place you can catch an "Opportunity Charge": Typically, a shopping area, restaurant, or recreation destination where you'd already planned to visit for one or more hours. Already numbering in the tens of thousands, more Workplace Charging and Opportunity Charging sites are being added every year. These Level 2 charging sites which add 12 to 70 miles of range per hour, depending upon the vehicle and station type.

In other situations, such as charging in public or at a rest stop on a long trip, charge time can be important and is fastest when it is the Level 3 charging, also known as DC fast charge. This type of charging can add up to 100 miles or more of range in 20-30 minutes, and improves with each new generation of vehicle and charging equipment.

4. CAN I TAKE MY EV ON LONG TRIPS?

Choosing a PHEV (Plug in Hybrid Electric) means you can drive and refuel on any trip just as you do now, conveniently at the next gas station rest stop. But you can still charge up as well, whenever it's convenient to do so. It's the best of both worlds, as you can still drive electric miles every day while take very long trips.

Choosing a BEV (Battery only Electric) means you'll want to look for fast charging (also known as Level 3) along your route and/or overnight destination charging (such as hotels that have charging) where you'll stay or plan your trips to look for fast chargers along the route.

Today's fast charging can add from 60 up to 180 miles of range in under 30 minutes, depending on model and station. Recently, automakers are offering more and more higher range BEVs. Thousands of fast chargers and destination chargers are being added every year, and the next generation of fast charging coming in just a few years will add twice the range in half the time! To get a handy online map and mobile app to find charging station near you, visit PlugShare or install their mobile app.

5. WHAT WOULD MY COST TO BUY OR LEASE BE?

In Massachusetts, an electric car can be as affordable to buy or lease as a comparable gas fueled car. This is due to the available state and federal incentives, combined with special local deals this Drive Electric program can connect you with.

Massachusetts State Rebate: The Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) Program issues rebates to help MA consumers purchase or lease a new vehicle. Any Massachusetts resident is eligible for a rebate of up to \$1,500 after the purchase or lease an eligible electric vehicle. This program is slated to end on October 1st of 2019.

Federal EV Tax Credit: The federal government also offers a tax credit for qualifying electric vehicles to qualifying tax payers. The tax credit offsets up to \$7,500 of your tax liability for the year of purchase.

Local group-buy and dealer-incentive programs: There are additional local incentives that can lower the monthly payment costs even further, sometimes to under \$200 a month and with no money down. In some cases, combined incentives can mean up to \$15,000 off MSRP. To learn more about how to take advantage of each of these rebates, incentives and special offers, contact us.

6. HOW MUCH WOULD I SAVE IN FUEL AND MAINTENANCE COSTS?

On average, the cost of electricity to charge and drive an electric car is significantly lower than gasoline. In areas served by a municipal electric utility, the average cost of this electric "fuel" is even lower! In addition, electric cars require far less regular maintenance than their gasoline only cousins, saving you hundreds more due to fewer or no oil changes, filters, belts, etc. Even the brakes on electrics last longer, thanks to regenerative braking.

In fact, over the life of an EV it will cost significantly less than an average "economy" gasoline only car – by thousands of dollars! Just how much you'll save depends on how many miles you drive a year and what vehicle you select. For a free assessment of your estimated personal cost savings, contact us.

7. CAN I EXPECT GOOD RELIABILITY FROM AN ELECTRIC CAR?

Electric cars are actually more reliable on average than their gasoline only counterparts. An electric vehicle's motor has basically just one moving part, and most of the rest of the drive train uses solid state electronic devices with no moving parts, that require little or no maintenance for the life of the vehicle. Therefore, EVs require far less scheduled maintenance and are inherently more reliable because there are fewer mechanical systems to maintain or that could break down. EVs still require an annual safety inspection, but this only takes a few minutes because there is no exhaust system to analyze.

8. WILL THE BATTERY PERFORM WELL FOR THE LIFE OF THE CAR?

Every new electric car's battery carries a minimum replacement warranty of 8 years or 100,000 miles. Several brands of plug-in electrics (BEVs and PHEVs) are already proving that they in fact will perform very well for hundreds of thousands of miles, and even go beyond the warranty period while showing very little to no noticeable loss of the original electric range.

DID YOU KNOW: There are already owners of multiple brands of EVs who have had their vehicle for over 8 years and put over 160,000 miles on the original battery?

9. DOES AN ELECTRIC CAR PROVIDE ME WITH ENOUGH DRIVING POWER?

The amount of sheer acceleration that an electric car has will vary from model to model, but the universal truth is that electric cars typically have more instant power from a full stop, than a gasoline-only equivalent – in fact, often by 50% or more. This is because an electric motor reacts instantly and has more torque.

10. IS AN ELECTRIC CAR AS SAFE AS THE CAR I DRIVE NOW?

Most electric cars have an overall 5-star crash safety rating from the National Highway Transportation Safety Administration (NHTSA). Any high voltage wires are colored bright orange, and most manufacturers install battery kill switches in easily accessible locations on their vehicles. First responders regularly complete training on hybrid and electric vehicles to ensure they know how to handle them. While any vehicle contains a large amount of potentially hazardous and/or flammable energy in its "fuel" system, a typical gasoline only car has a greater amount of potential energy and higher volatility. In fact, a 2017 NHTSA study concluded the propensity and severity of fires and explosions from battery electric cars are "expected to be less because of the much smaller amounts of flammable solvent released and burning in a catastrophic failure situation." (Lithium-ion Battery Safety Issues for Electric and Plug-in Hybrid Vehicles, NHTSA, 2017).

11. HOW MUCH LOWER ARE THE EMISSIONS ON AN ELECTRIC CAR?

According to EPA power plant data for New England electricity generation, driving electric already reduces carbon emissions by at least 70% versus driving a comparable gasoline only vehicle. Emissions impacts have also been assessed independently as significantly lower by several prominent institutions.

12. WHAT ARE THE ENVIRONMENTAL IMPACTS FROM MANUFACTURING AN ELECTRIC CAR AND ITS BATTERY?

The [Union of Concerned Scientists](#) concluded in its 2015 analysis that even accounting for the impacts of battery manufacturing, EVs already reduce life cycle emissions by at least 50%. While any manufactured product has a variety of potential environmental and social impacts, the batteries used in electric cars do not contain any toxic materials nor any rare-earth metals, and are increasingly being incorporated into end of automotive life reuse and/or recycling programs. In addition, automakers and battery manufacturers are increasing their supply chain diligence to ensure that battery raw materials are responsibly sourced from areas with ethical labor and environmental practices. Read more about the [Responsible Minerals Initiative](#).

Additional Resources

Energy New England (ENE) Electric Vehicle Consumer Information Web Portal: ev.ene.org

MA MOR-EV state consumer site. Purchase or lease an eligible electric vehicle and apply for your rebate today!
mor-ev.org

EV Connecticut state consumer site:

https://www.ct.gov/deep/cwp/view.asp?a=2684&q=525234&deepNav_GID=2183

CHEAPR rebate program/Drive Clean CT offers up to \$3,000 point-of-purchase rebate at the dealer when you buy or lease an electric car. https://www.ct.gov/deep/cwp/view.asp?a=2684&q=525234&deepNav_GID=2183

Drive Green with Green Energy Consumers Alliance is an electric vehicle (EV) discount program to make choosing an EV easier for you. greenenergyconsumers.org/drivegreen

The New England Electric Auto Association (NEEAA) is one of over 30 Electric Auto Clubs throughout the U.S. and Canada. NEEAA is associated with the national Electric Auto Association. They hold monthly meetings throughout New England to promote the adoption of EVs through education and advocacy. neaaa.org

ABOUT ENE

Energy New England (ENE) is the largest wholesale risk management and energy trading organization serving the needs of municipal utilities in the northeast. We currently manage the power supplies of over twenty municipal electric systems, and work with numerous businesses, residents, and utilities to help promote the principles of conservation, efficiency, and environmental stewardship.

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