Several Options for Going Electric

Below are the types of electric-drive vehicles:

HEVs are powered by a traditional gasoline or diesel ICE and by an electric motor that uses energy stored in a battery. The battery is charged by the ICE and through regenerative braking. The vehicle cannot be plugged in to charge. The electric motor provides extra power during starts and acceleration, allowing for a smaller engine. This results in better fuel economy without sacrificing performance.

PHEVs are similar to HEVs but have a larger battery that allows it to travel on electricity alone. The battery can be charged by plugging in to an electric power source, through regenerative braking, and by the ICE.

Unlike all-electric vehicles, PHEVs don't have to be plugged in before driving. They can be fueled solely with gasoline, like a conventional HEV. However, they will not achieve maximum fuel economy or take full advantage of their all-electric capabilities without plugging in.

EVs run on electricity alone. They are powered by an electric motor that uses energy stored in a battery (larger than the batteries in an HEV or PHEV). EV batteries are charged by plugging the vehicle in to an electric power source and (to a lesser degree) through regenerative braking.

Kia Optima (HEV). *Photo courtesy of Kia Motors America*

Hyundai Sonata (PHEV). *Photo courtesy of Hyundai Motor America*

Ford Focus (EV). *Photo from Ford Motor Company*

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Clean Cities Technical Response Service
800-254-6735 • *technicalresponse@icfi.com*

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At A Glance: Electric-Drive Vehicles

Electric-drive vehicles use electricity as their primary power source or to improve the efficiency of conventional vehicle designs. With the range of styles and options available, there is likely one to meet your needs. The vehicles can be divided into three categories:

- Hybrid electric vehicles (HEVs)
- Plug-in hybrid electric vehicles (PHEVs)
- All-electric vehicles (EVs).

See additional details on page 4.

Electric-drive vehicles can offer several benefits, including improved fuel economy, lower fuel costs, and reduced emissions. *Photo by Dennis Schroeder, NREL 26677*

About the Vehicles

Why consider one?

Electric-drive vehicles cost less to operate, so the higher initial vehicle cost can be offset over the lifetime of the vehicle. That's because electric drivetrains are very efficient and electricity is much cheaper than gasoline or diesel fuel.

- Because they use little or no gas, these vehicles minimize or even eliminate trips to the gas station. With an EV or PHEV, you can instead enjoy the convenience of plugging in at home.
- HEVs and PHEVs produce fewer emissions because of their increased fuel economy, and PHEVs (in all-electric mode) and EVs produce no tailpipe emissions.
- Because electricity is a domestic energy source, using it in vehicles means that America relies less on imported fuels.

What vehicles are available and how much do they cost?

- Search and compare dozens of models from all major manufacturers using the U.S. Department of Energy's (DOE) EV Everywhere Vehicle Search (*energy.gov/eveverywhere/*) and at FuelEconomy.gov.
- Manufacturers' suggested retail prices (MSRP) start at about $20,000 for HEVs (Honda CRZ), $32,000 for PHEVs (Ford C-Max Energi), and $23,000 for EVs (Mitsubishi i-MiEV).

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Public charging stations typically have one or more "Level 2" charging units. *Photo by Dennis Schroeder, NREL 35149*

- A federal tax credit of $2,500-$7,500 is available for PHEV and EV purchases. Depending on your location, you may also be eligible for incentives from your state, city, or utility. Find relevant incentives by searching the AFDC's Federal and State Laws & Incentives database (*afdc.energy.gov/afdc/laws*).

Are these vehicles safe?

- HEVs, PHEVs, and EVs undergo the same rigorous safety testing as conventional vehicles sold in the United States and must meet Federal Motor Vehicle Safety Standards.
- Battery packs meet rigorous testing standards, and vehicles are designed with insulated high-voltage lines and safety features that deactivate electric systems when they detect a collision or short circuit.

What about maintenance?

- Because HEVs and PHEVs have an internal combustion engine (ICE), their maintenance requirements are similar to those of conventional vehicles.
- Electrical systems (battery, motor, and associated electronics) require minimal scheduled maintenance. A manufacturer's warranty of a battery typically covers 8 years/100,000 miles. Expected battery lifetime is 10-12 years under normal operating conditions.
- EVs have less maintenance requirements because they have fewer moving parts and fluids to change.

Did You Know?

Electricity is much cheaper than gasoline or diesel fuel, costing about $1.20 per gallon (of gasoline equivalent) at a nationwide average.

All-electric vehicles are about three times more efficient than ICE-powered vehicles, which have earned these vehicles top spots on FuelEconomy.gov's list of most efficient vehicles (*fueleconomy.gov/feg/topten.jsp*). Most are rated at more than 100 miles per gallon (equivalent).

Regenerative braking allows HEVs, PHEVs, and EVs to capture energy normally lost during braking by using the electric motor as a generator and storing that captured energy in the battery.

Charging Batteries

Where can I charge?

- Most PHEVs and EVs come with a 110-volt "Level 1" cordset that can be plugged in to a typical household outlet (see photo bottom left).
- Homes can also usually be fitted with a 220-volt "Level 2" charging unit.
- More and more workplaces are also installing charging units or making 110-volt outlets available to employees and visitors.
- There are now several thousand public charging outlets across the country, including a growing number of "DC Fast Charge" units. To locate stations, use the Alternative Fueling Station Locator (*afdc.energy.gov/stations*) or download the iPhone app from the Apple App Store.

EV Everywhere
U.S. DEPARTMENT OF ENERGY

EV Everywhere is a Clean Energy Grand Challenge to enable plug-in electric vehicles (PEVs) that are as affordable and convenient for the American family as gasoline-powered vehicles by 2022.

How long does it take to recharge?

- "Level 1" charging units add 2-5 miles of range per hour of charging.
- "Level 2" charging units add 10-20 miles of range per hour of charging.
- "DC Fast Charge" units can fully charge a depleted battery in as little as 20 minutes.

How far can I go on a charge?

The distance an electric-drive vehicle can travel on battery power alone, without recharging, is known as its "all-electric range."

- PHEVs can typically go 10-40 miles on battery power alone; their overall range is determined by the fuel tank capacity since the ICE kicks in when the battery is depleted.
- EVs can typically go 70-100 miles on a single charge, although a few models (e.g., Tesla Model S) can go more than 200 miles.
- Several factors affect actual range including driving conditions, driving habits, and use of climate controls.

A "Level 1" cordset can be plugged in to a typical dedicated, 110-volt household outlet. *Photos by Erik Nelsen, NREL 34794 (left) and 37587 (inset)*

Many EVs come with a Level 1/Level 2 charge port (right) as well as a DC Fast Charge port (left). *Photo by Andrew Hudgins, NREL 19558*