VIRGIN ISLANDS ENERGY OFFICE

ELECTRIC VEHICLES

ELECTRIC VEHICLE BASICS

Electricity is considered an alternative fuel under the **Energy Policy Act of 1992** and can be produced from a variety of energy sources, including coal, hydropower, natural gas, nuclear energy, solar and wind energy, and stored in batteries, which are the energy storage systems used in electric vehicles (EVs).

In EVs, onboard batteries store energy to power one or more electric motors. These batteries are charged using electricity from the grid and energy recaptured during braking, known as **regenerative braking**, which recaptures some of the vehicle's kinetic energy by charging the battery while improving the overall efficiency of the vehicle and extending the life of the braking system.

The cost to maintain an EV, especially a battery-powered model, is generally much lower than gasoline vehicles as the EV powertrain consists of fewer components than an internal combustion engine. Powering EVs with electricity is currently cost effective compared to using gasoline, but EVs typically cost more to purchase. However, initial vehicle costs can be offset by energy cost savings, federal tax credits, and state or local incentives. The cost is dependent on the price of electricity, which can vary by region, type of generation, time of use, and EV charging access points.

The total cost of ownership per mile comparison between EVs and gasoline vehicle types in the USVI can be found in the **U.S. Virgin Islands Transportation Electrification Roadmap**.

The benefits of EVs:

- Price
- Fuel economy
- Maintenance
- Batteries
- Performance
- Flexible charging options
- Zero or low emissions

ELECTRIC VEHICLE TYPES

All-Electric

All-electric vehicles, also referred to as battery electric vehicles (BEVs), use a battery pack to store the electrical energy that powers the motor. The batteries are charged by plugging the vehicle into an electric power source.

Plug-In Hybrid

Plug-in hybrid electric vehicles (PHEVs) are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. PHEVs can operate in all-electric mode.

Hybrid

Hybrid electric vehicles (HEVs) are powered by an internal combustion engine and one or more electric motors that uses energy stored in a battery. The vehicle is fueled with gasoline to operate the internal combustion engine, and the battery is charged through regenerative braking, not by plugging in.

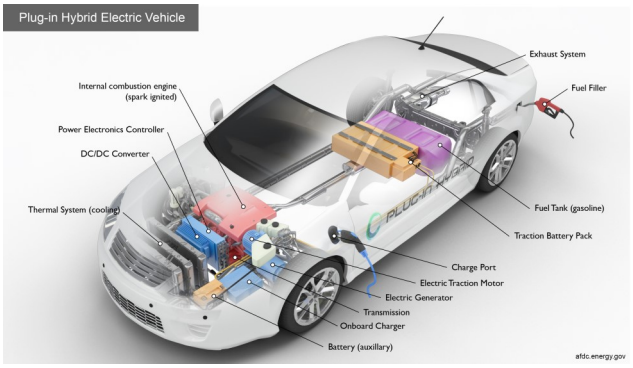


Figure 1. Plug-In Hybrid Electric Vehicle (PHEV).

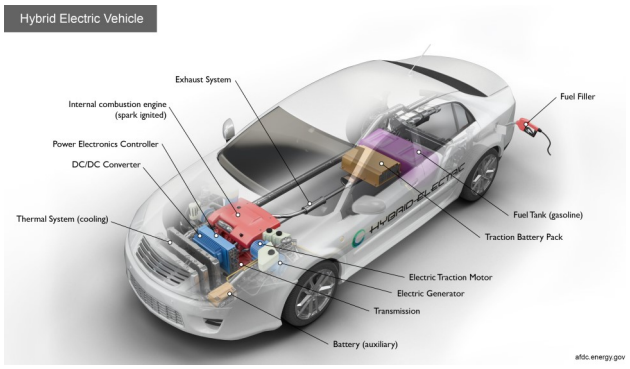


Figure 2. Hybrid Electric Vehicle (HEV).

KEY COMPONENTS OF AN ALL-ELECTRIC CAR

Batteries

The following energy storage systems are used in all-electric vehicles, plug-in hybrid electric vehicles, and hybrid electric vehicles. Battery prices are expected to decline as battery technologies improve and production volume increases.

Lithium-ion batteries have a high power-to-weight ratio, high energy efficiency, good high-temperature performance, and low self-discharge. Most of today's all-electric vehicles and PHEVs use lithium-ion batteries.

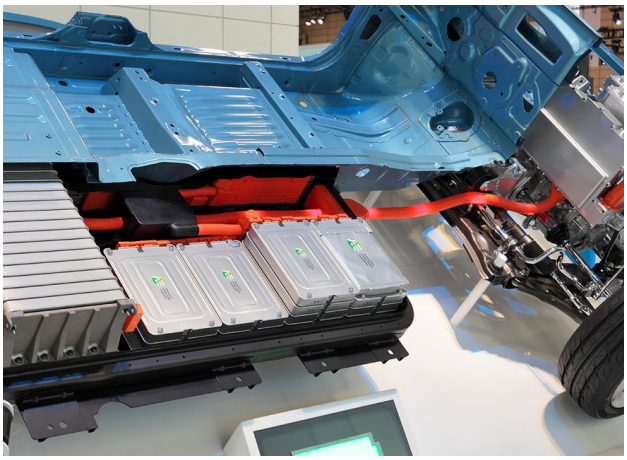


Figure 3. Nissan LEAF® cutaway showing part of the battery.

Nickel-metal hydride batteries have a much longer life cycle than lead-acid batteries and are safe and abuse tolerant. These batteries are widely used in HEVs.

Lead-acid batteries can be designed to be high power and are inexpensive, safe, and reliable. However, low specific energy, poor cold-temperature performance, and short lifecycle impede their use.

Ultracapacitors store energy in a polarized liquid between an electrode and an electrolyte. Energy storage capacity increases as the liquid's surface area increases. Ultracapacitors can provide vehicles additional power during acceleration and hill climbing and help recover braking energy.

Charge port allows the vehicle to connect to an external power supply to charge the traction battery pack.

DC/DC converter converts higher-voltage DC power from the traction battery pack to the lower-voltage DC power needed to run vehicle accessories and recharge the auxiliary battery.

Electric traction motor drives the wheels using power from the traction battery pack.

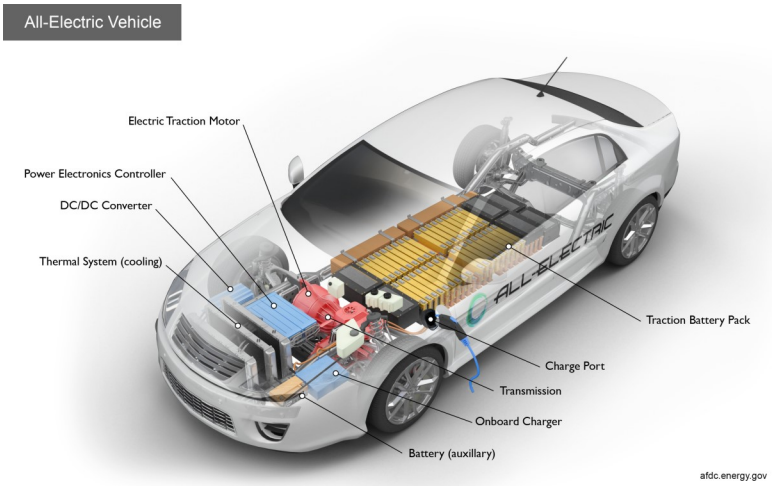


Figure 4. Diagram of All-Electric Vehicle components.

Onboard charger takes the incoming AC electricity supplied via the charge port and converts it to DC power for charging the traction battery.

Power electronics controller manages the flow of electrical energy delivered by the traction battery, controlling the speed of the electric traction motor and the torque it produces.

Thermal system (cooling) maintains a proper operating temperature range of the engine, electric motor, power electronics, and other components.

Traction battery pack stores electricity for use by the electric traction motor.

Transmission (electric) transfers mechanical power from the electric traction motor to the drive wheels.

CHARGING AN ELECTRIC VEHICLE

Charging Equipment

Charging equipment is classified by the rate at which the batteries are charged. The **Alternative Fueling Station Locator** *(https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC)* allows users to search for public and private charging stations.

Charging times vary based on how depleted the battery is, how much energy it holds, the type of battery, and the type of charging equipment.

Level 1 charging is typically used when there is only a 120 V outlet available.

Level 2 offers charging through 240 V or 208 V electrical service.

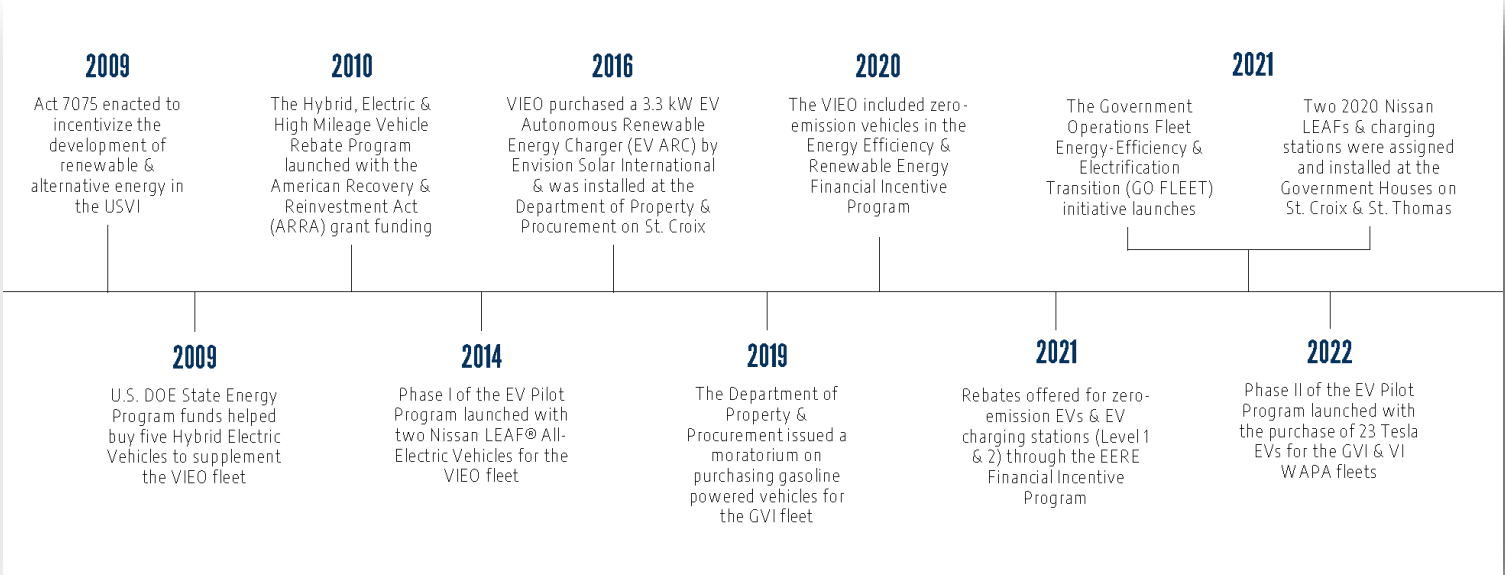
All commercially available EVs in the United States can charge using Level 1 and Level 2 charging equipment.

Direct-current (DC) fast charging equipment (typically a three-phase AC input) enables charging along heavy traffic corridors at installed stations.

Figure 5. Nissan LEAF® EV charging.

USVI ELECTRIC VEHICLE EVOLUTION

The USVI Transportation Electrification Roadmap



It is a coordinated effort between the Virgin Islands Energy Office (VIEO), Electrification Coalition, Government of the Virgin Islands (GVI), VI Water and Power Authority (VI WAPA), and other local organizations that supports actions for the adoption of plug-in electric vehicles throughout the Territory with the ultimate goal of increasing the electric load and revenue for the utility and promote emissions-free transportation for the GVI and community. With limited geographic space for driving, it is easier to develop an accessible EV charging network.

In 2021, the VIEO and VI WAPA received $2.15 million under the Energizing Insular Communities (EIC) Grant Program, which supported the formation of the Government Operations Fleet Energy-Efficiency & Electrification Transition (GO FLEET) initiative to support the GVI fleet electrification and construction of a territorial EV charging network. This initiative also supports the mandates set forth in USVI Law Act 7075 relative to the development of renewable and alternative energy technology in the Territory.

INCENTIVES

Rebates

The Virgin Islands Energy Office offers $5,000 rebates on EVs and EV charging stations purchased in the USVI.

Tax Credits

Some all-electric and plug-in hybrid vehicles qualify for a $2,500 to $7,500 federal tax credit. Many states also offer additional incentives for purchasing new and used EVs.

Additional information can be found at the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy's Vehicle Technologies Office—Alternative Fuels Data Center and the Electrification Coalition USVI Transportation Electrification Roadmap.