1 Residential Charging

Refueling at Home

Residential Charging

Charging at home can be done with either an ordinary 120V or 240V circuit depending on charging speed needed. Speed is indicated in kW or miles per hour of charge time.

	Outlet	NEMA	Volts/ Amps	kW	Charging Speed
Level 1	NEMA 5-15		120V x 12A	1.4 kW	4 mph
Level 1	NEMA 5-20		120V x 15A	1.8 kW	5 mph
Level 2	NEMA 14-30		240V x 24A	5.8 kW	20 mph
Level 2	NEMA 14-50		240V x 40A	9.6 kW	32 mph
Level 2	Hardwire		240V x 80A	20 kW	57 mph

Level 1
120V 15-20 amp circuit
Ordinary house current
Charge cord supplied with car

Level 2
240V 16-80 amp circuit
Dryer or similar NEMA 240V outlet
50 amps or greater must be hardwired

Maximum Current Rating
National Electric Code requires that the continuous current drawn from a circuit not exceed 80% of the circuit's maximum rating. Charger model numbers usually reflect the type of circuit they require, and supply the lower 80% value. For example, the Clipper Creek LCS-30 uses a 30 amp circuit and supplies 24 amps of current at 240V, which is 5.8 kW of power. That will allow a typical EV to travel 20 miles after one hour of charging (20 mph of charge). A 50 amp charger using a 50 amp circuit supplies 40 amps, 9.6 kW, which is 32 mph of charge.

Plug-In vs Hardwire Installation
Almost all residential EV chargers can be purchased with a plug and installed as easily as any other appliance – simply mount it on the wall with the provided screws and mount plate and plug it in to an existing or newly installed 240V outlet. The exception is high power chargers like the 80 amp Tesla HPWC. Chargers 50 amps or greater need to be installed by an electrician and hard-wired to a dedicated circuit.

2 Public Charging

Refueling on the Road

Public Charging

Level 2 Charging Stations
Level 2 charging stations are located throughout communities. Sometimes retail businesses provide charging for free to customers.

Battery electric cars usually recharge at a rate of 20 miles of range per hour of charge. Plug-in hybrid cars usually charge at about 10 miles per hour, but do not require public charging because longer drives can be completed using the gasoline engine.

DC Fast Charging Stations
Quick Charge stations are located at major malls, transportation hubs and other high traffic locations. There are three DCFC standards: CHAdeMO, SAE Combo (CCS) and Tesla Supercharger. Power ratings range from 25kW to 350kW.

- Most Asian cars use CHAdeMO
- Most European and American cars use SAE Combo
- Tesla cars use the Supercharger network and CHAdeMO with an adapter.

Many charge stations have two connectors, one for each standard so all cars that have Quick Charge ports can be charged. Tesla has its own proprietary charge standard called Supercharger, but also offers a CHAdeMO adapter. Cars that are not made by Tesla cannot use Tesla Superchargers.

Most cars will charge to 80% within 30 minutes using DCFC. That will provide 60-200 miles of range. Most Tesla cars can gain 250 miles of range with 45 minutes of charging.

3 Workplace Charging

Refueling at Work

Workplace Charging

Many employers offer workplace charging to their employees to encourage the use of zero emission vehicles.

Level 1

Offering Level 1 charging to employees can be as simple as installing a row of 120v outdoor outlets in a parking lot.

Another option is installing low cost fixed-in-place chargers.

Level 2

Unmetered
Simple Access Control i.e. Key

Network
Monitored
Billable Access
Control

Types of Access Controls

Access Card

Bluetooth App

4 Top Reasons

4 Reasons to Drive an EV

1. Save Money

Lower Fuel Costs
Lower Maintenance Costs
Purchase Incentives
Dealer and Manufacturer Discounts

2. Make a Difference

Zero Emissions Means Cleaner Air
Reduce Your Carbon Footprint

3. Drive a Better Car

Better Performance, More Torque
Quieter Inside and Out
No Vibration, Smoother Ride

4. Charge Conveniently

Charge at Home while You Sleep
Charge at Work while You Work
Public Fast Charging

5 Types of Plug-in EVs

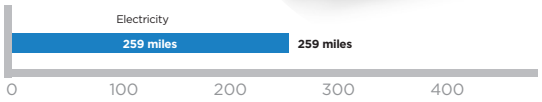
Battery Electric vs Plug-In Hybrid

Types of Plug-In EVs

BEV - Battery Electric Vehicle

Battery electric vehicles get all of their energy from an electrical circuit. This allows them to operate at a very low cost - electricity generally costs the equivalent of less than $1 per gallon of gasoline. When the energy is provided by a utility with low cost EV rates, the cost can be as low as $0.60 per gallon equivalent.

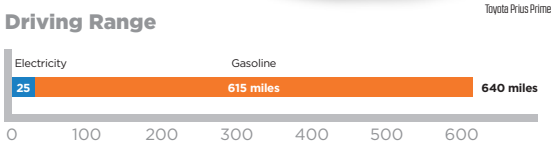
Chevrolet Bolt



PHEV - Plug-In Hybrid Vehicle

Plug-in hybrid vehicles use electricity for the first 17-42 miles of travel and then automatically switch over to the gasoline engine. PHEVs offer essentially unlimited range, with the environmental and cost benefits of an EV for most local in-town driving, like a daily commute.

Toyota Prius Prime

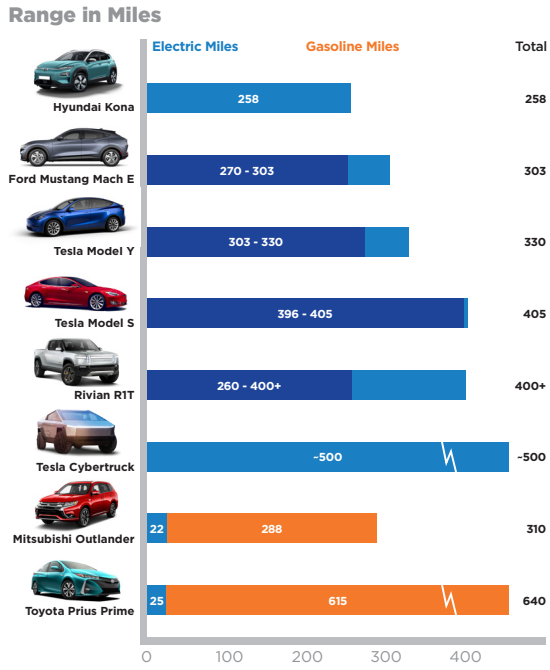


6 Plug-in Hybrid EV Range

How Far Can an Electric Car Drive?

Plug-In Hybrid and Electric Vehicle Range

Battery Electric Vehicles use electricity for all miles of travel. The electricity can be from standard 120V or 240V AC house circuits, 3-phase 208V commercial circuits or 600-850V DC Fast Charge public chargers. Most charging is AC, overnight, at home.

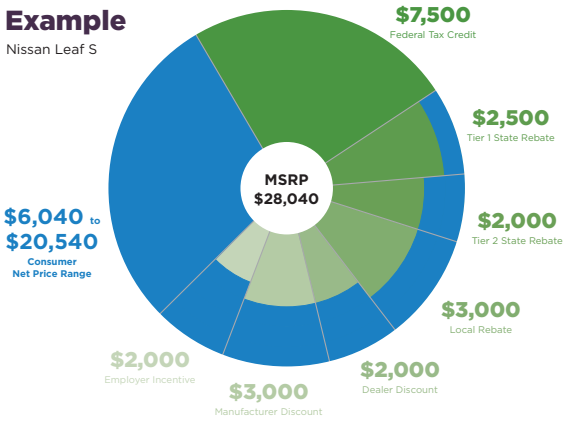


Plug-in Hybrid Vehicles use "mains" electricity for the first 17-42 miles of travel and then automatically switch over to the gasoline engine. PHEVs offer essentially unlimited range with the environmental and cost saving benefits of EVs for most in-town driving. Each Plug-in Hybrid offers a different mix of electric and gasoline ranges.

7 Plug-in EV Incentives & Rebates

Zero Emission Incentives

Plug-In Electric Vehicle Incentives & Rebates



Federal Tax Credit
Starting in 2023, the federal EV incentive will apply to EVs and plug-in hybrids that were assembled in the U.S. with a maximum MSRP of 55K for cars and 80K for trucks and SUVs. Dealers will be able to apply the credit at the time of the sale.

State Rebates & Tax Credits
Ten states offer rebates or tax credits ranging from $500 to $5,000. Several states offer HOV lane access stickers.

Local Rebates
After-purchase tax credits and rebates are offered by some Regional Air Pollution Control Districts and local government agencies. Some utilities offer incentives for EV purchases or EV charger purchases and installation.

Manufacturer Discount
Point of purchase discounts off MSRP are frequently offered by the auto manufacturer for purchases and leases.

Dealer Discount
Dealers frequently offer EVs for sale at prices thousands of dollars lower than the "Sticker Price," which lists the Manufacturer's Suggested Retail Price.

Employer Incentive
Some employers offer additional rebates or vouchers on an EV purchase or lease.

Discount & Rebates Guide
Check Electric Car Insider's Discount and Rebates Guide for a detailed breakout of the discounts available for every electric car sold in the United States.

8 Charging Basics

Charging Basics

Charging Levels

Charging is subdivided into 3 levels based on the amount of power available in the circuit, which in turn affects how quickly your EV will recharge its batteries.

- **Level 1** uses 120V ordinary house current
- **Level 2** uses a higher powered 240V circuit, like your clothes dryer
- **DC Fast Charge** uses dedicated, high-powered 200-450VDC circuits, and is found exclusively at Fast Charging stations

RPH **Range Per Hour:** Maximum miles of range a charging station provides per hour of charging

Level 1	Level 2	DC Fast Charging
5 RPH	12-25 RPH	100+ RPH
1.4kW (on-board) charger 120V	3.3-6.6kW (on-board) charger 240V	45kW (off-board) charger 200-450VDC
Time to Fully Charge: 80-mile Battery 16 Hrs 200-mile Battery 40 Hrs **Where:** Home	**Time to Fully Charge:** 80-mile Battery 3.5 Hrs 200-mile Battery 8 Hrs **Where:** Home, Work, Around Town	**Time to Fully Charge:** Depends on charger and car model, up to 80% in 30-45 minutes. **Where:** DC Fast Charging Stations
Connector: NEMA 5-15	Connector: J1772	Connectors: SAE Combo, CHAdeMO, Tesla

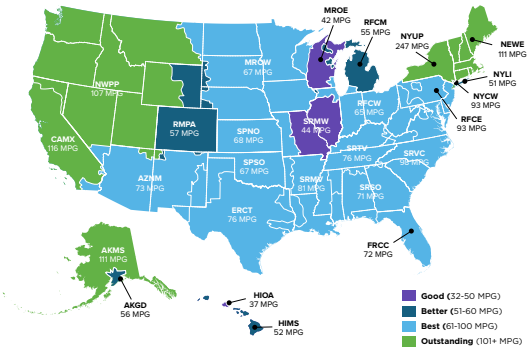
All ranges and times given are estimates and vary based on many factors including specific chargers and car models.

9 Environmental Impacts

How Green Are Electric Cars?

Environmental Impacts of EVs in the US

For 97% of drivers in the US, driving on electricity is cleaner than driving on a 50 MPG gasoline car. Data from the US EPA on power plant greenhouse gas emissions shows that on average, an EV is equivalent to a conventional gasoline car that gets 91 MPG.



US Average (EV sales-weighted): 91 MPG
2022 Union of Concerned Scientists map

Positive Impacts of EVs Include:

- Zero tailpipe emissions
- More energy efficient
- On average, well-to-wheel emissions are half that of a conventional gas car
- As the electricty grid continues to reduce emissions, EVs that plug into the grid become cleaner too

Driving electric vehicles is part of the solution to address climate change.

*Source: Union of Concerned Scientists Report, 2022

10 True EV Cost

Electric Car Cost Savings

Cost of Ownership

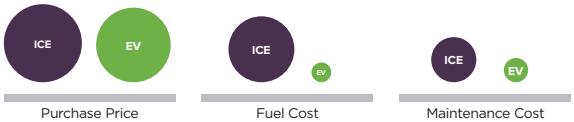
A cost of ownership comparison between two cars with similar performance, an electric car (EV) and a gasoline car (ICE), **over 5 years** shows:

BMW 330i vs Tesla Model 3

Purchase Price	Fuel Cost	Maintenance Cost
EV Savings: $4,320	**EV Savings: $5,785**	**EV Savings: $1,790**
MSRP difference & $7,500 Fed Tax Credit	$4.02 gal vs $1.44 e-gallon (~$0.16kWh)	no oil changes or tuneups

A total of **$11,895** in Savings for EV.

Ford Mustang GT vs Ford Mustang Mach-E



Purchase Price	Fuel Cost	Maintenance Cost
EV Savings: $2,090	**EV Savings: $8,450**	**EV Savings: $1,790**
MSRP difference & $7,500 Fed Tax Credit	$4.02 gal vs $1.44 e-gallon (~$0.16kWh)	no oil changes or tuneups

A total of **$12,330** in Savings for EV.

Toyota Camry XLE V6 vs Tesla Model 3

Purchase Price	Fuel Cost	Maintenance Cost
EV Extra Cost: $3,395	**EV Savings: $5,335**	**EV Savings: $1,630**
MSRP difference & $7,500 Fed Tax Credit	$3.29 gal vs $1.44 e-gallon (~$0.16kWh)	no oil changes or tuneups

A total of **$3,570** in Savings for EV.

Fuel and electricity prices based on USA averages in January 2023 using 12,000 annual miles driven.