

Electric-Car-Insider.com

Electric Car

I N S I D E R

ELECTRIC VEHICLE BASICS



Electric Vehicle Reference

ESSENTIAL CONCEPTS

Electric Automobile Matrix

Specification Quick Reference



BATTERY ELECTRIC

Make	Model	Yr Intro	Battery kWh	Range (mi)	MPGe	MSRP Base	Fed Tax Credit
Audi	Q4 e-tron	2022	82	265	103	\$49,800	--
Audi	Q8 e-tron	2019	95-114	~305-373	--	~\$75,000	--
Audi	e-tron GT	2022	93.4	238	82	\$104,900	--
BMW	i4	2022	70.2-81	256-301	~100	\$52,000	--
BMW	iX	2022	105.2	305-324	86	\$84,100	--
BMW	i7 xDrive60	2022	105.7	296-318	83-89	\$119,300	--
Cadillac	LYRIQ	2022	102	312	89	\$62,990	--
Chevrolet	Blazer EV	2023	--	247-320	--	\$44,995	--
Chevrolet	Bolt EUV	2022	65	247	115	\$27,800	\$7500
Chevrolet	Bolt EV	2016	65	259	120	\$26,500	\$7500
Chevrolet	Equinox EV	2023	--	250-300	--	\$30,000	--
Chevrolet	Silverado EV	2023	--	~400	--	\$39,990	--
Fisker	Ocean	2023	--	250-350	--	\$37,499	--
Ford	F-150 Lightning	2022	98-131	240-320	66-70	\$55,974	\$7,500*
Ford	Mustang Mach-E	2020	70-91	247-312	--	\$45,995	\$7,500*
Genesis	Electrified G80	2022	87.2	282	97	\$79,825	--
Genesis	Electrified GV70	2023	77.4	--	--	--	--
Genesis	GV60	2022	77.4	235-248	95	\$59,290	--
GMC	Hummer EV Pickup	2022	246.8	329-350	43	--	--
GMC	Hummer SUV	2023	--	300	--	--	--
Hyundai	IONIQ 5	2022	58-77.4	220-303	101-114	\$41,450	--
Hyundai	IONIQ 6	2023	53-77.4	270-361	103-140	--	--
Hyundai	KONA Electric	2019	64	~258	120	\$33,550	--
Jaguar	I-Pace	2018	90	246	76	\$71,300	--
Kia	EV6	2022	77.4	206-310	79-117	\$48,700	--
Kia	Niro EV	2019	64.8	253	113	\$39,550	--
Lexus	RZ 450e	2023	71.4	220	--	\$59,650	--
Lucid	Air	2022	112	406-520	111-140	\$87,400	--
Mercedes-Benz	EQB SUV	2022	70.7	243	96-101	\$54,500	--
Mercedes-Benz	EQE Sedan	2022	90.6	260-305	82-98	\$74,900	--
Mercedes-Benz	EQS Sedan	2021	107.8	350	95-103	\$102,310	--
Mercedes-Benz	EQS SUV	2022	108.4	305	77-85	\$104,400	--
Mini Cooper	SE	2020	32.6	114	110	\$34,225	--
Nissan	ARIYA	2022	63-87	216-304	98-103	\$43,190	--
Nissan	LEAF	2010	40-60	212	104-111	\$28,040	\$7,500
Polestar	2	2020	78	260-270	89-107	\$48,400	--
Polestar	3	2023	111	270-300	--	\$83,900	--
Porsche	Taycan	2019	79.2-93.4	208-246	75-83	\$86,700	--
Rivian	R1S	2020	162-163	260-321	64-71	\$78,000	\$7,500*
Rivian	R1T	2020	162-163	260-400	64-73	\$73,000	\$7,500*
Subaru	Solterra	2022	72.8	222-228	102-104	\$44,995	--
Tesla	Cybertruck	2023	100-200	250-500	--	--	--
Tesla	Model 3	2017	50-75	272-358	131-132	\$43,490	\$7,500*
Tesla	Model S	2012	100	396-405	116-120	\$94,990	--
Tesla	Model X	2015	100	333-351	98-102	\$109,990	--
Tesla	Model Y	2020	74 or 81	303-330	111-123	\$54,990	\$7,500*
Toyota	bZ4X	2022	71.4	242-252	102-119	\$42,000	--
Volkswagen	ID.4	2021	62-82	209-275	99-107	\$38,995	\$7,500*
Volvo	C40 Recharge	2021	75	226	87	\$55,300	--
Volvo	EX90	2023	111	300	--	~\$80,000	--
Volvo	XC40 Recharge	2020	--	223	85	\$53,550	--

-- Dashes in the matrix represent specs not available at time of printing. * Only with certain options and trim levels.

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BY CHRISTOPHER ALAN

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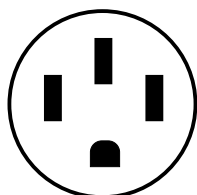


114 - 520 miles

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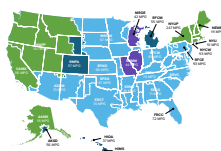
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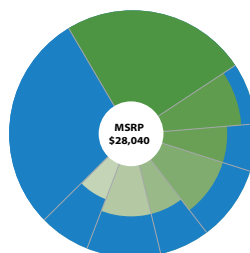
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Electric Car Cost Savings

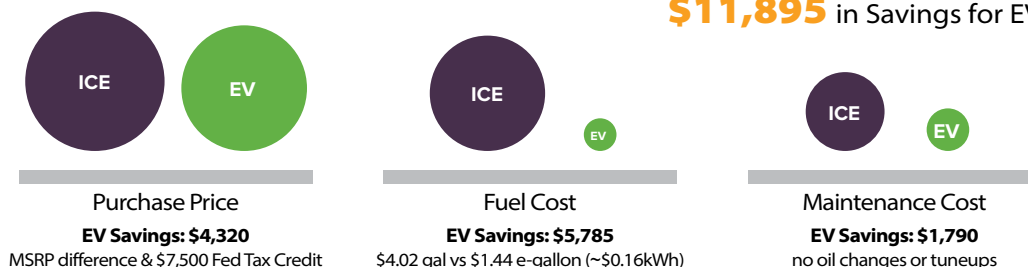
Total Cost of Ownership - EV vs ICE

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



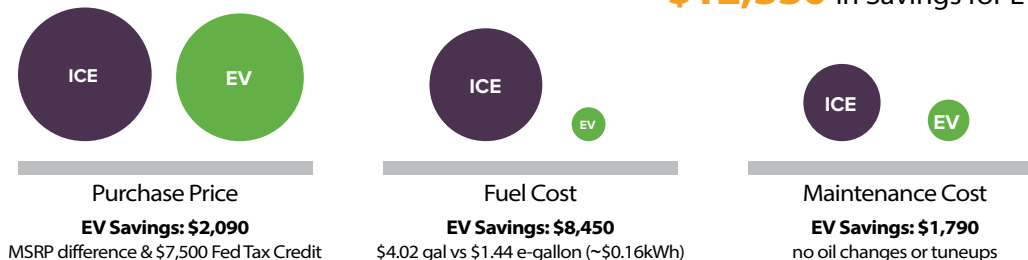
\$11,895 in Savings for EV



Ford Mustang GT vs Ford Mustang Mach-E



\$12,330 in Savings for EV



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



Electric cars provide substantial monthly operating cost savings. Discounts, tax credits and rebates may also make acquisition costs lower.

Battery Electric vs Plug-in Hybrid

Types of Plug-In Electric Vehicles

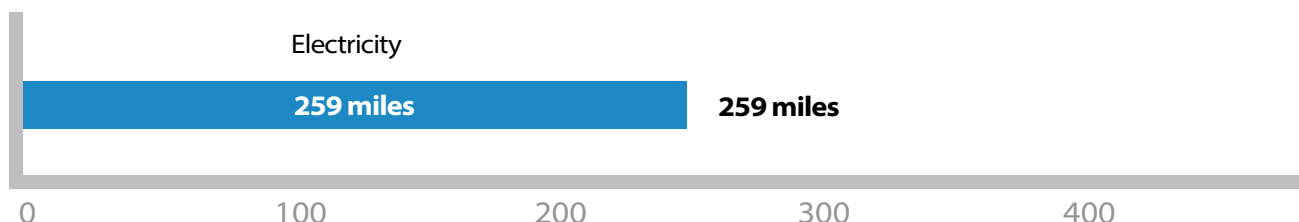
BEV - Battery Electric Vehicle

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

Driving Range



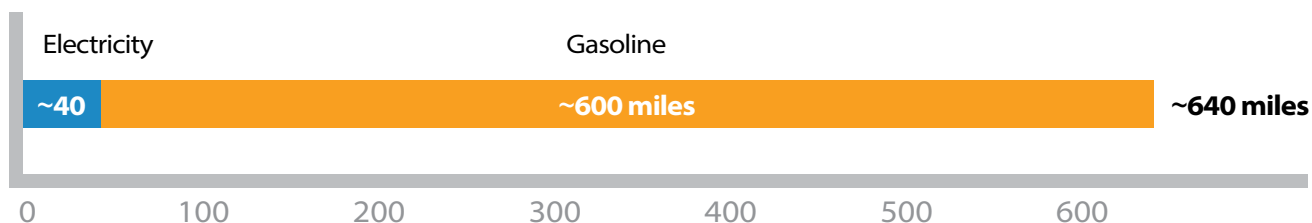
PHEV - Plug-In Hybrid Electric Vehicle

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 gasoline refueling for longer trips, with the environmental and cost benefits of an EV for most local in-town driving, like a daily commute.



Toyota Prius Prime

Driving Range



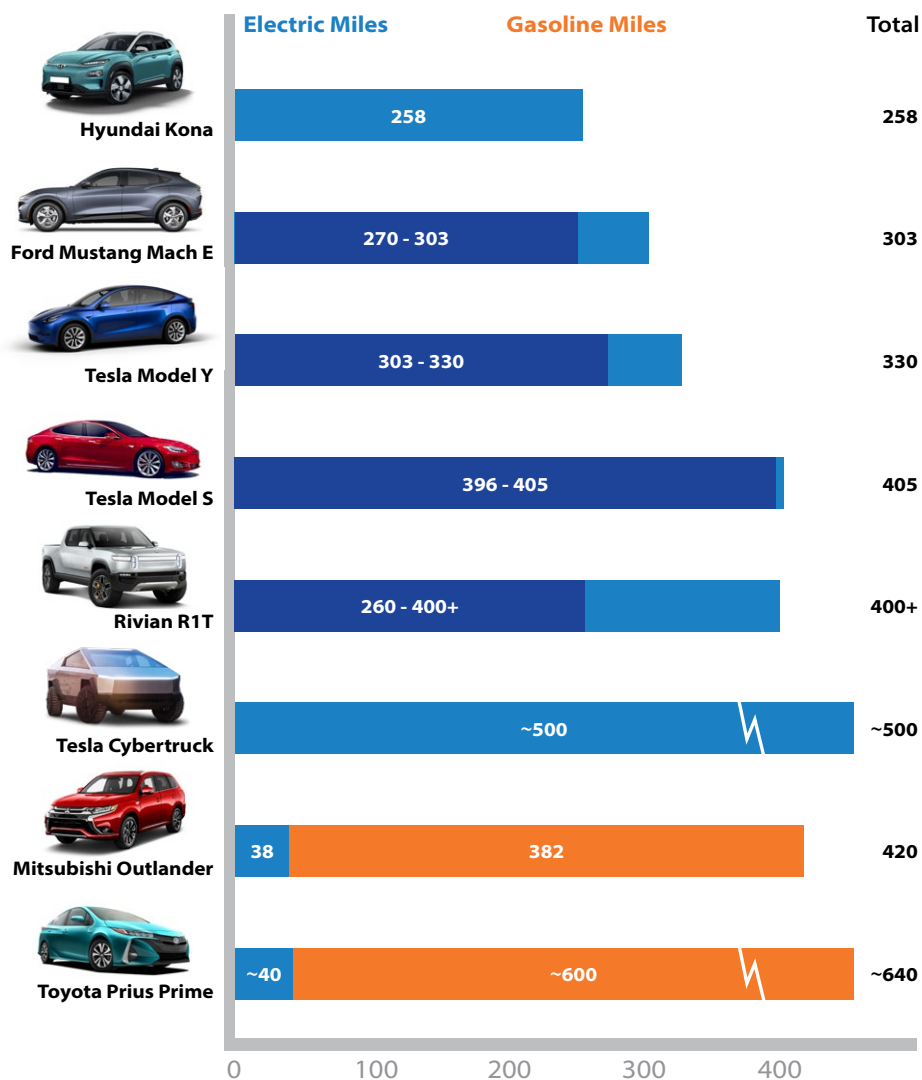
Battery electric cars use only electricity as fuel. Plug-in Hybrid Vehicles use electricity first, then gas for extended range.

How Far Can an EV 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 200-800VDC Fast Charge public chargers. Most charging is AC, overnight, at home.

Range in Miles



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 gasoline refueling for longer trips, 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.



Each automaker offers a slightly different mix of electric and gasoline ranges.

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 200-800VDC circuits. It is found exclusively at Fast Charging stations.

Level 1	Level 2	DC Fast Charging
5 MPH	12-25 MPH	up to 1,000 MPH
1.4kW (on-board) charger 120V	3.3-6.6kW (on-board) charger 240V	25-350kW (off-board) charger 200-800VDC
Time to Fully Charge: 80-mile Battery 16 Hrs 200-mile Battery 36 Hrs	Time to Fully Charge: 80-mile Battery 3.5 Hrs 200-mile Battery 8 Hrs	Time to Fully Charge: Depends on charger and car model, 15-20 minutes for most trips.
Where: Home	Where: Home, Work, Around Town	Where: DC Fast Charging Stations
Connector  J1772	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.



MPH

Miles Per Hour: Miles of range a charging station provides

Refueling at Home

Level 1 and Level 2 Charging

Charging at home can be done with either ordinary house current or a dedicated 240V circuit depending on charging speed needed. Speed is indicated in 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
	NEMA 5-20		120V x 15A	1.8 kW	5 mph
Level 2	NEMA 14-30		240V x 24A	5.8 kW	20 mph
	NEMA 14-50		240V x 40A	9.6 kW	32 mph
	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 amps 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.



Almost all residential EV chargers can be purchased with a plug and installed as easily as any other appliance.

Refueling at Work

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-BASED



BLUETOOTH APP BASED



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

Refueling on the Road

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.



Some retail businesses provide electric refueling free of charge as a way to attract customers and reward loyalty.

4 Reasons to Drive an EV

1. Save Money

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

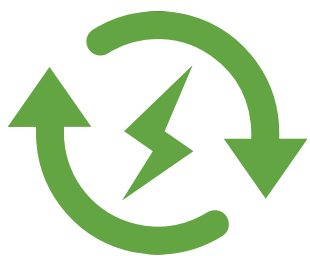


2. Make a Difference

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

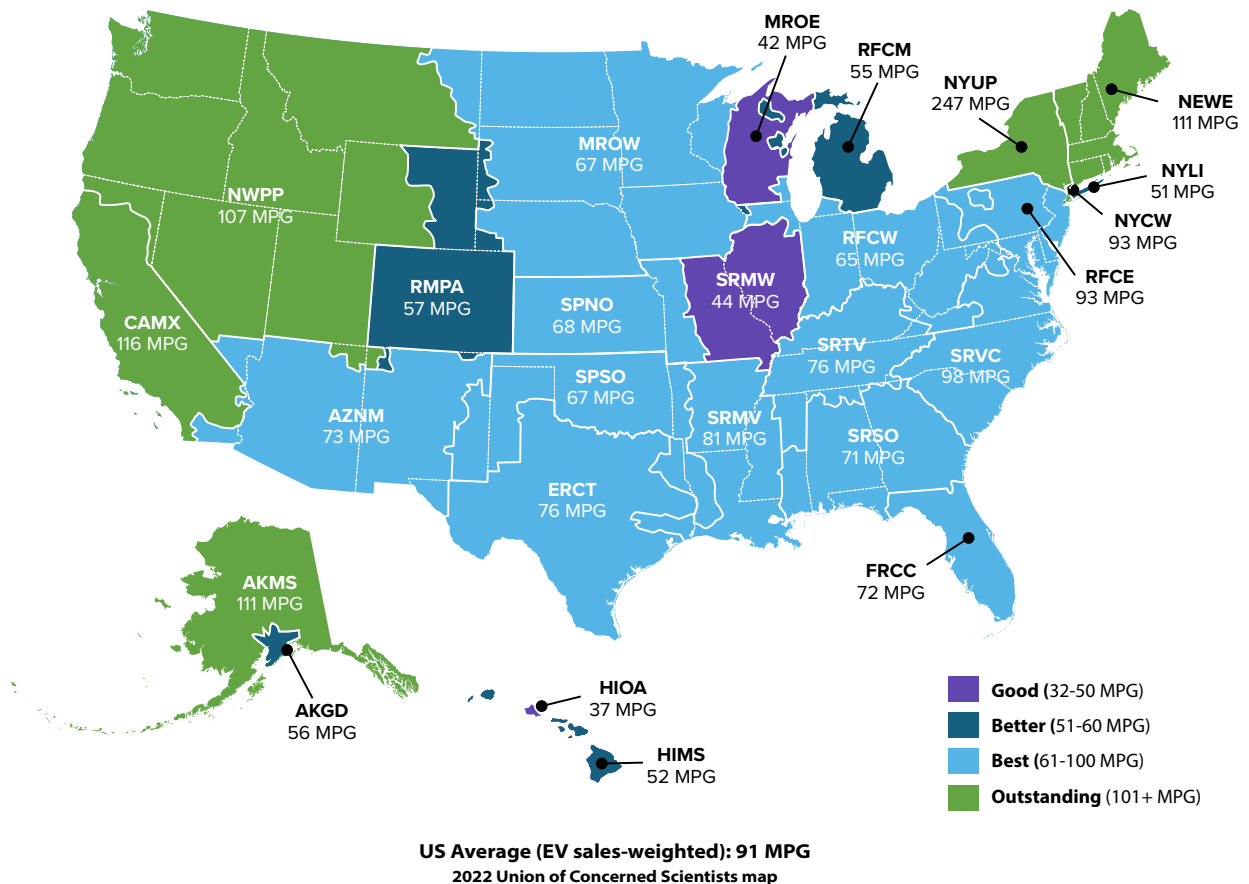


When choosing electric, you save money on fuel and maintenance, drive a higher performance car and make a difference for the environment.

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.



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 electricity 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



In the US, on average, an electric car is equivalent to a conventional gasoline car that gets 91 miles per gallon.

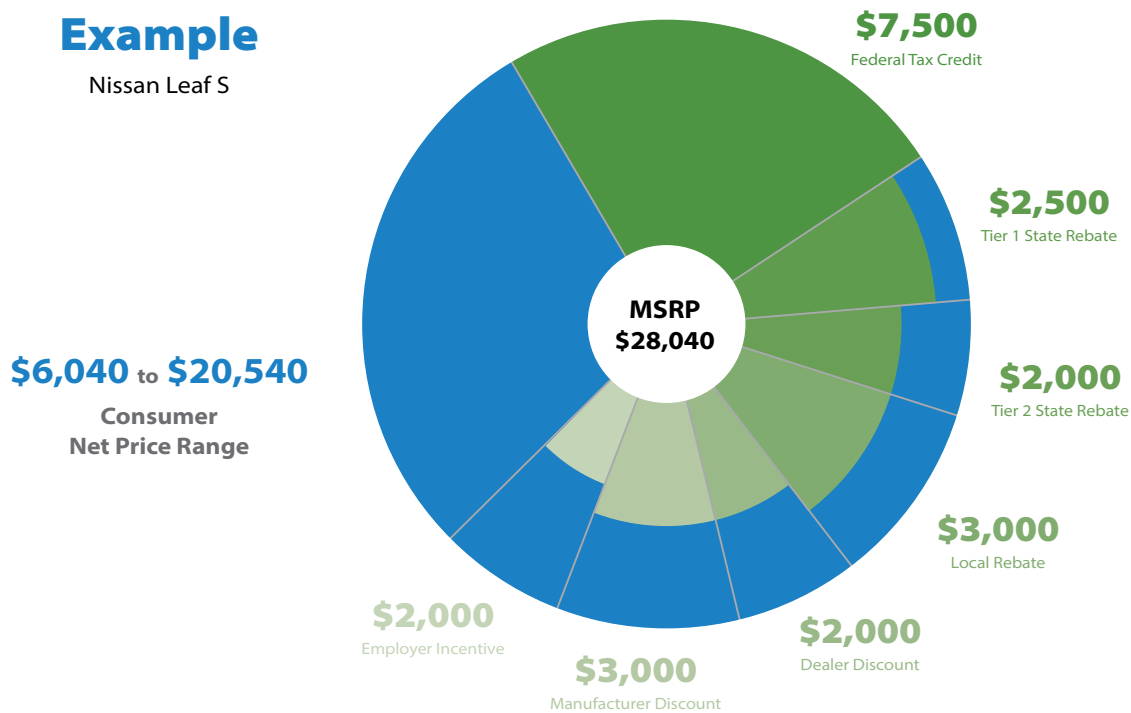
Zero Emission Vehicle Incentives

Plug-In Electric Vehicle Incentives: Discounts, Tax Credits & Rebates

After-purchase rebates are available at the Federal level and in many state and local jurisdictions.

Example

Nissan Leaf S



Federal Tax Credit

Starting in 2023, the federal EV incentive applies 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 (MSRP).

Employer Incentive

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



The federal EV incentive is an income tax credit of up to \$7,500. It applies to EVs and PHEVs that are assembled in the U.S. and meet set MSRP caps.

Charging Basics

Home and Public Charging Options

EV
Basics

BY CHRISTOPHER ALAN

EV Charging Options

Over 130,000 public charging stations are available nationwide to extend the range of EVs, but realistically, unless you drive more than 80 miles a day, your home is your fuel stop. Charge overnight, and your car is ready to go in the morning.

Although it's possible to charge EVs with the standard 120v cord that comes with the car, it takes longer than you sleep. At 120v, it will take longer than the time-of-use off-peak discount some utilities offer. The Kia Niro and Hyundai Kona, for example, take about 20 hours to charge from empty to full at 120v.

Most EV drivers purchase 240v charge stations, usually referred to as "Level 2" chargers, which can charge the Kia Niro or Hyundai Kona from empty to full in just 6-7 hours.

Almost all modern Battery Electric Vehicles, with the exception of older EVs and most PHEVs, can also use a DC Fast Charger that can fill the battery to 80% within 15-30 minutes. These are found only at retail and commercial sites that have 480v industrial power supplies.

HOME CHARGING

There are a couple of things that can make the installation of a 240v home charger quicker, cheaper and more functional.

One of the things that will most influence the cost is whether your charger is a dedicated installation requiring an electrician and permit, or if it can be simply plugged into an available 240v outlet, like an unused washing machine or dryer receptacle.

Professional installations, which will run dedicated wiring to your charge port, generally run between \$500 - \$1,700. A electrical code compliance inspection typically ranges from \$10 to \$100. The cost of a permit for a 240v receptacle, used with a plug-style charge station, may be less expensive.

Cord lengths vary from 16-25 ft, be sure to check your requirements before ordering. Most chargers come with a holster that keeps the J1772 plug secure and the cable neat when not in use.

Evo Charge sells an electric vehicle charging station that has a retractable reel which helps keep the cable tidy.

PUBLIC CHARGING

The appearance of orange pins on charge station software like PlugShare, signifying Fast Charge Stations, are the equivalent of being notified of range boost. The radius of travel just got larger. An EV driver can now easily drive from downtown to the edge of the metro area and back again with just a 30-minute stop at one of the fast charge stations, usually located at major malls. Charging sessions that would require a 2-4 hour stop at a Level 2 240v station can be done in 15-30 minutes at a DC Fast Charge station.

In Southern California, a resident of San Bernardino or Riverside county could easily drive to the LA city center and do whatever business or errands are on the agenda. With less time than it takes to eat lunch, they'll be charged and back on the road home. Even a weekend trip from LA to Santa Barbara can be negotiated with just a single stop in Thousand Oaks, Camarillo or Ventura.

When a charge session can be used to accomplish other tasks, the wait is no inconvenience.



There's an App for That

Finding a charge station for an EV is really easy. Go out to your garage, pick up the coupler and plug it in. But for those occasions when you need to charge as you're out and about, there's an app for that.

The market is split between public charging networks and third party apps. Charging networks like ChargePoint have their own apps which report whether a charger is in use, while third party apps such as PlugShare list stations and user reviews.

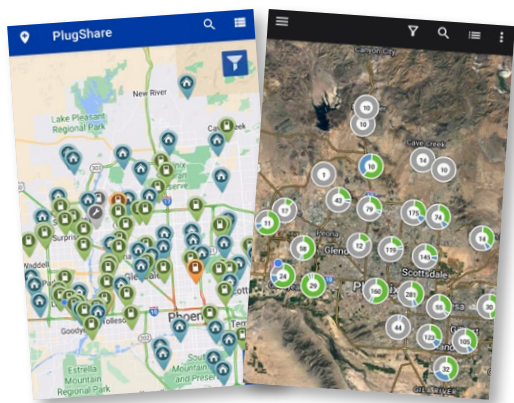
How do the apps stack up against each other?

ChargePoint lists thousands of public charging stations, giving drivers the options of an updated "list view" to see how far a destination is, payment options, and 24x7 telephone support. ChargePoint also offers its "trip mapping" allowing for a user to plan a trip route and flag charging stations along the way. The "charging status" screen lets you remotely keep track of your charging session.

The Electrify America app only displays chargers on the EA network, but shows how many chargers are in use. The EA display includes type of chargers, charging cost per kWh, and the hours of operations for the charging station. When plugged in, the app shows your car's charging status so you are free to walk around, go shopping or get a meal. The app will send you notifications as your charge session nears completion. EA's hardware reliability is spotty, but multiple units at each charge site mean you can usually complete a charge session. EA's telephone support is excellent and can often restart a balky charger.

PlugShare uses crowd-sourced information. It represents the community of EV owners, and includes private residences and businesses that are available to fellow EV drivers who need a quick fill to get back home or to a another charge point. PlugShare's map includes chargers from all of the major charging networks. PlugShare's station info profiles are the best of the mobile apps, displaying a photo of the location of the charge station, a map of the charging station, types of plugs, access, cost, and reviews for each charging station.

Another third party app, Chargeway, does trip planning and groups charger coupler types using color codes and charger speeds using a 1-7 number system.



HOV Sticker Installation

My HOV stickers came with installation instructions and some official paperwork to keep in the glove box. No tips on how to stick them on straight though. You might want to try a method that allows for dry runs and includes visual aids before permanently affixing the stickers to your ride.

First, trim the backing around each sticker. Leave a margin around the curve so that you don't slice into the decal, but try to keep the cuts straight on the straight edges;



you'll need those edges to line things up on the car. Next, figure out where you want to stick the decals and clean the surface of the area where you'll be applying them. Now stick a couple of pieces of painter's tape on the back of the decals, rolled over itself so you can hang it on the car temporarily. It's best to use painter's tape so that it's easy to reposition. You can try lining it up with character lines, trim pieces, or some other feature on the body or bumper. After you've temporarily hung it on your car, stick pieces of painter's tape along the straight edges of the sticker. The tape will serve as a guide when you're ready to permanently affix the sticker.

I got all these steps done, and then it was time to commit. Take the sticker off the car, remove the backing, and carefully line up the corners and edges of the sticker with the pieces of painter's tape, working the sticker's adhesive onto the car from one edge to the other, trying not to form any bubbles.

In summary: Trim the backing to the shape of the decals and test fit them on the car. Try different positions. View your candidate placements from different angles and distances before committing. When you find the perfect position, frame the sticker around its straight edges with painter's tape. Then affix the sticker permanently using the painter's tape on the top and bottom as a guide.

EV Educational Resources

Supporting EV Adoption from
Awareness to Advocacy

Electric Car

INSIDER

EV & EVSE Buyers Guides



Comprehensive, full page profiles of the best EVs and EV chargers.

Electric Car Guest Drive



Test drive the latest electric cars and learn from EV owners at a no-pressure social event.

Discount Pricing Guide



The app that can save you thousands of dollars on EV and EVSE purchases. Customizable for utilities and AQMDs.

Educational Pillars



Large scale interactive exhibits for indoor and outdoor events.

Mobile EVSE Classroom



Turn-key electric vehicle charger exhibit with commercial and residential demo units.

EV Navigator



Online, interactive app to guide prospective EV drivers on the path to ownership and advocacy.

ECI creates electric vehicle educational resources for utilities, AQMDs, automakers and EVSE manufacturers, integrators and installers.