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NADA MANAGEMENT SERIES

SL46

A DEALER GUIDE TO

Electric Vehicles



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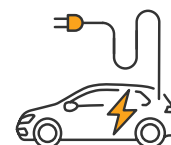
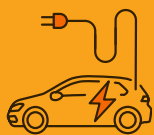


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A DEALER GUIDE TO

Electric Vehicles

I. EVs: The Opportunity

Introduction

Though electric vehicles (EVs) have been attempted in the U.S. for almost two centuries, they have never gained a firm foothold—but that's changing, and fast. Spurred by fuel economy regulations and a goal of zero emissions, encouraged by financial incentives, and empowered by technological advances, OEMs are betting billions on EVs, which they're building in a wide array of models in all vehicle classes. Nearly 60 battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV) models are [available in the U.S. right now](#), with dozens more in the pipeline or on the drawing board. Some OEMs aim to phase out production of internal combustion engine (ICE)-powered vehicles entirely, while some states say they'll ban the sale of ICE vehicles in the next decade.

Though consumers have been slow to adopt EVs in the past, [study](#) after [study](#) demonstrates rapidly increasing interest. Indeed, U.S. sales of BEVs and PHEVs together increased 45% in the first quarter of 2021 from the same period in 2020—and sales of HEVs (hybrid electric vehicles) nearly doubled. As of May 2021, IHS Markit forecast BEVs will jump to [25% to 30% of the U.S. new-car market in 2030](#), and [45% to 50% by 2035](#).

That's a huge opportunity for franchised dealers. Dealers can provide customers with the firsthand experience of EVs that is crucial to considering a purchase or lease.

In both its 2021 “U.S. Electric Vehicle Consideration (EVC) Study” and its “U.S. Electric Vehicle Experience (EVX) Ownership Study,” J.D. Power found that familiarity breeds intent: Respondents who had experienced EV ownership would consider another EV purchase.

Indeed, many studies find that more than half of EV owners would buy an EV the next time around.

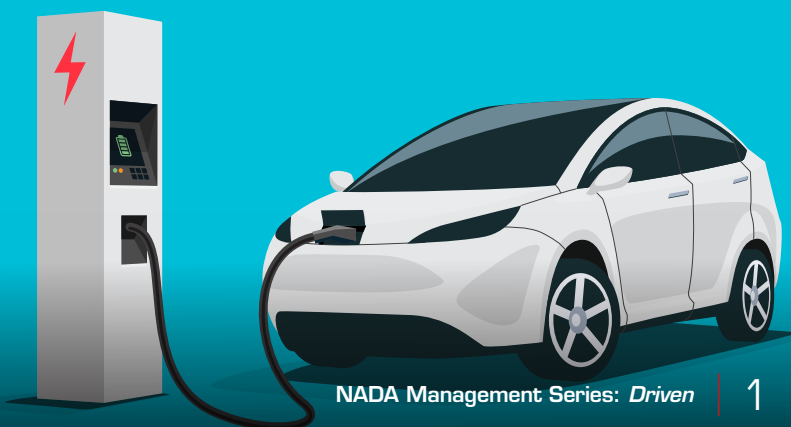
Drivers love EVs' performance: the instant acceleration, the smooth handling, the quiet ride.

In the EVC Study, even those who had only *ridden* in a BEV said they were likely to consider an EV for their next vehicle.

But half of survey respondents had never been in a BEV.

Additionally, many respondents who indicated they would not consider a BEV said they *would* consider a PHEV or a HEV. Many said they couldn't consider BEVs because they simply didn't know enough about them.

This means more opportunities for you. Dealers can get customers into an EV—whether it's a BEV, a PHEV or a HEV—and let them examine it and take it out for a drive. Dealers can teach customers about the vehicle. Dealers, whom customers trust and rely on, can provide the information customers need to be able to trust EVs.



What This Guide Will Cover

When NADA published *A Dealer Guide to Marketing Electric Vehicles, Version 1.0* in 2016, EVs were a niche vehicle. There weren't many models available, and they were considerably more expensive than ICE vehicles. There were performance and charging concerns, and confusing incentives and charger installation rules.

Not all those issues have been resolved, but costs have come down considerably and range has vastly improved. And now, from government to climate activists to OEMs, there is a strong push for EVs, which are being produced in every vehicle class, from subcompacts to SUVs to pickups.

This guide offers solid general information about the PHEVs and BEVs that will be arriving at your dealership in ever greater numbers. It builds upon NADA's 2016 publication, which we recommend dealers re-read, and attempts to anticipate some of your questions, and your customers'. It is, however, meant to be an overview. For specifics about your makes and models, look to detailed information and training from your OEM(s).

We hope the guide can help you help your customers to embrace EVs.

First, let's clarify some terms.

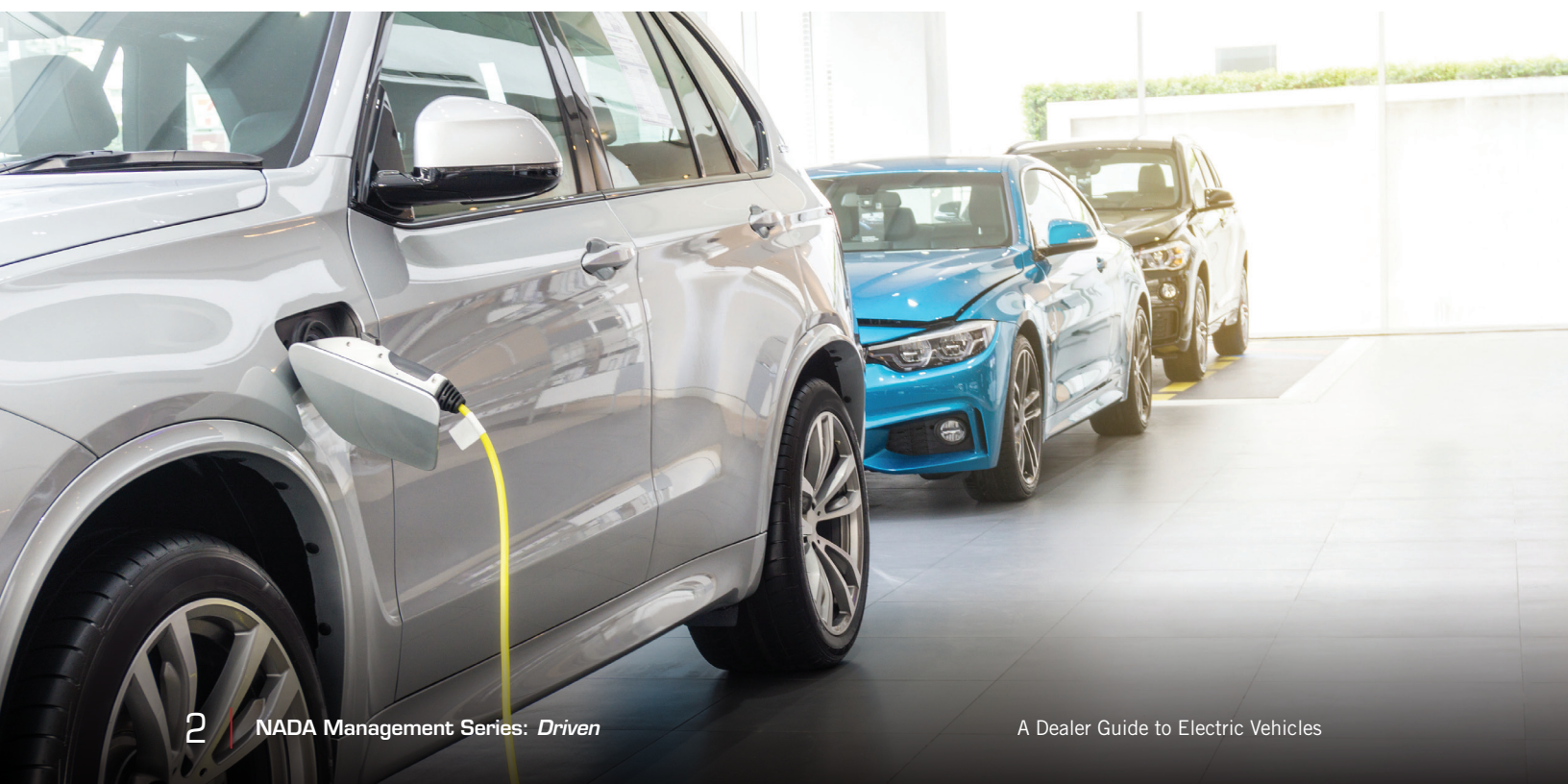
Definitions

Battery Electric Vehicles (BEVs) run exclusively on electrical power stored in onboard batteries. A BEV is charged by plugging into an off-board electric power source. Additionally, BEVs are charged when braking, using what's called "regenerative braking" (see below). BEVs are zero emission vehicles; they produce no tailpipe emissions.

Charging infrastructure refers to the three levels of charging power that EVs typically use as well as the availability of the power supply in an area. See the section on "Charging," below.

Electric Vehicle Supply Equipment (EVSE) refers to the equipment required for the safe transfer of energy between the electric utility and the EV. It includes charging stands or stations, charging cords, attachment plugs, and vehicle connectors and protection. EVSE enables communication between the car and the charger, so that the correct charge is used in the correct amount for the car.

Hybrid Electric Vehicles (HEVs) have a small battery and a small ICE. They can run on electricity or gasoline (or diesel), or a combination, but cannot be plugged into an off-board electric power source. The battery is recharged during braking. HEV sales began in the late 1990s and are quite familiar to many customers.



Plug-in hybrid electric vehicles (PHEVs) have both a battery and an ICE, like a HEV, but the battery is typically larger, and the vehicles can charge by plugging into an off-board electric power source, using the ICE, or through regenerative braking. Some PHEVs use battery power first and then run on the ICE or as a HEV when the battery is depleted. The ICE may also power the vehicle during rapid acceleration, at high speeds, or when significant heating or air conditioning is required. PHEVs have zero tailpipe emissions when in electric-only mode. The use of both electricity and fossil fuel enables decreased emissions and increased fuel economy while eliminating “range anxiety.”

“Range anxiety” refers to concerns about running out of power, particularly on longer trips.

Range, or driving range, is the total distance a vehicle can travel on a full battery charge (or a single tank of gas or diesel). The maximum range for an EV depends on the charge level and the amount of time spent charging the vehicle.

Regenerative braking allows HEVs, PHEVs and BEVs to capture some of the energy normally lost during braking, storing that captured energy in the battery.

II. EVs: The Issues

The following sections discuss some of the issues that are key to mass adoption of EVs as well as dealers’ role in addressing those issues with customers.

Affordability

The perception that EVs are “rich people’s cars” of interest primarily to older white males is changing. Though adopters still tend to be fairly well-off, Cox Automotive Mobility found that nearly half of those considering an EV purchase now are female, about 60% are Millennials, and 44% are non-white.

Further, OEMs are not focusing solely on luxury vehicles. Many EVs currently in production are intended for the mass market and priced accordingly. Indeed, the price of new EVs is going down as battery technology improves. Most new EVs currently cost more upfront than comparable ICE vehicles, but the gap is decreasing steadily. With rebates and other subsidies, EVs can even cost less than comparable ICE vehicles.

In addition, the total cost of ownership (TCO) can be less for an EV than for an ICE vehicle depending on how much and for how long they are driven. Since electricity and gas prices vary widely by region, the most reliable way to compare costs is to use the tool provided by the Department of Energy (DOE) at the Alternative Fuels Data Center (AFDC), which zeroes in on [energy prices by state](#), and compares vehicles in part based on [how they are used](#). TCO calculations typically include fuel costs as well as base price, federal and local incentives, maintenance, depreciation, financing and insurance.

As miles and time accumulate, EV operating costs decrease, partly because electricity generally costs less than gasoline. Electric drivetrains, furthermore, are more efficient than internal combustion engines. Electric drivetrains convert about 60% of electric energy to power at the wheels, while conventional gasoline vehicles only convert about 20% of gasoline energy to power at the wheels. EVs typically offset their higher upfront purchase costs through lower lifetime operating costs.

According to a [study](#) by the DOE’s National Renewable Energy Laboratory (NREL) and Idaho National Laboratory, the electricity required to run a BEV over its 15-year lifespan could cost **\$14,500 less than fueling an ICE**. The researchers assessed costs state-by-state, considering a multitude of electricity tariffs and real-world charging equipment and installation costs. They used the 2020 national average of 15 cents per kilowatt-hour to charge an EV and assumed that 81% of charging was done at home, 14% at the workplace or public station, and 5% with a DC fast charger (DCFC). The study found state-by-state fuel savings ranging from an average **\$4,571 to \$12,048 over 15 years or more**.

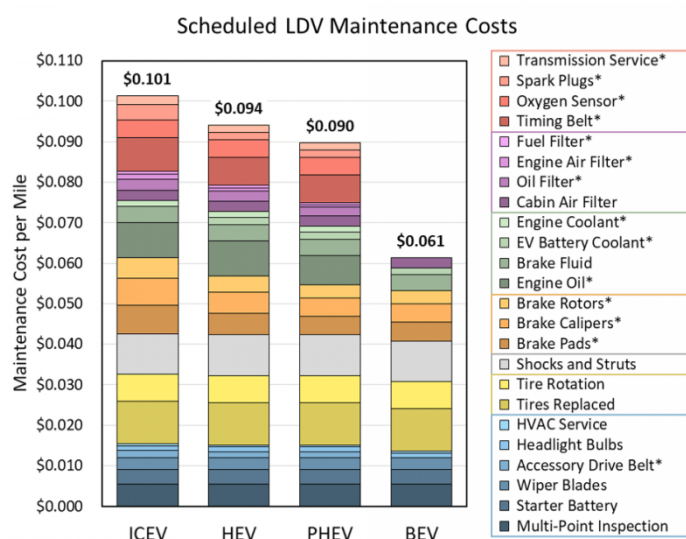


Calculating the fuel cost of an EV involves knowing the cost per kilowatt-hour (kWh) and how much electricity is used to travel 100 miles. If electricity costs 13 cents per kWh and the vehicle uses 33 kWh to go 100 miles, on average, the cost per mile is about 4 cents. Fully charging this EV, assuming a 200-mile range, will cost about \$9.

The DOE says it costs about half as much to drive an electric vehicle versus an ICE and its [eGallon tool](#) allows state-by-state comparisons. To find fuel economy ratings and annual fuel cost comparisons among currently available vehicle models, visit [FuelEconomy.gov](#).

Fuel savings aren't the only cost benefit.

Routine scheduled maintenance costs are lower. According to the DOE's Office of Energy Efficiency & Renewable Energy, the [estimated scheduled maintenance cost for a BEV](#) is 6.1 cents per mile, in contrast to an ICE vehicle's 10.1 cents per mile. The maintenance costs for HEVs and PHEVs are less than ICE vehicle maintenance costs, too, though the savings are not as great as those for fully electric vehicles. EVs have fewer moving parts, they need fewer fluids topped up, and they're easier on brakes.



Department of Energy, Office of Energy Efficiency & Renewable Energy

*Service interval varies by powertrain

LDV= light-duty vehicle

It's important to point out that batteries, which represent the bulk of an EV's upfront cost, are usually covered by warranty for at least eight years or 100,000 miles, and most automakers offer battery degradation coverage as well.

Regarding resale value, and therefore the pricing of used EVs: EVs have tended to lose their value more quickly than ICE vehicles, a factor that traces back to consumers' and banks' anxiety about the battery and EVs' brief depreciation history. Newer EVs that can travel more than 200 miles on a charge hold their value as well as their gas-powered counterparts. Like ICE vehicles, EVs depreciate at different rates, depending on many factors, including vehicle class, features and OEM. As battery health and range improves, it is expected that residual value patterns for EVs and ICE vehicles will look more similar.

Dealers' Role

Know your customers, and communicate with them

You and your salespeople should become familiar with all the costs of the EVs you sell or will soon sell. Understand the specifics of available discounts and rebates offered by the federal and local governments and your local utilities. Have a general idea of utility rates in your market area, especially where time-of-use (TOU) rate plans reduce electricity cost when demand is lowest. Be prepared to explain the TCO, including how costs are affected by driving habits (such as aggressive acceleration and braking, discussed below in "Range") and charging patterns (such as frequent fast charging, discussed below in "Charging"). Know how each customer plans to use his or her vehicle most of the time. Does a customer plan to drive long distances regularly, or will the EV be used for a shorter commute?

Keep up with improvements in battery technology, which are key to costs like battery life, depreciation, and resale value. Customers will look to you for information.

You'll also need to be prepared to answer questions about at-home charging and the cost and process of installing Level 2 chargers at customers' homes. That is a separate, one-time cost (see "Charging," below).

Show your customers where to find more information, such as the plethora of calculators offered by the DOE. Lead them to the [AFDC website](#), for example, and the [Fuel Economy website](#) for vehicle fuel cost comparisons. The AFDC maintains a [searchable database](#) of federal and state laws and incentives for alternative fuels and vehicles.

Your fleet customers are prime candidates for EVs. Fleets that put many miles per year on their EVs will recoup higher upfront costs faster.

Be transparent: EVs are new to most new- and used-vehicle shoppers. Arm them with the knowledge they need to make an EV purchase from you.

Charging

You may have installed some Level 2 or even Level 3 chargers at your dealership—for inventory, the service department and your customers. But customers also need access to chargers along their driving routes. Most of us are accustomed to charging phones

and laptops, but charging vehicles is a new concept requiring a new set of habits. EV drivers can't stop at the corner gas station, fill up in minutes at a predictable, usually low cost, and simply drive off. EVs present a major change. The change involves charger availability, time to charge, and cost.

And according to the March 2021 “[CarGurus Electric Vehicle Sentiment Survey](#),” the availability of charging stations in respondents' areas was the Number One issue for EV adoption—over cost savings or incentives, extended warranties, resale value, or the environment.

According to the AFDC, which offers a charging station [locator](#), at this writing there are more than 100,000 public charging outlets at about 43,000 public charging stations in the U.S. More stations are being built every day as charging companies, utilities and governments rush to dispel range anxiety, and make EV use easier for people without access to home or workplace charging, including those who live in apartments, condos, and townhomes.

So how does one charge an EV, how long does it take, and what does it cost every time you “fill up”?

Electric Vehicle Supply Equipment is classified in three levels according to the maximum amount of power provided to the battery. The higher the voltage, the faster the charging time. Time to charge can take less than a half-hour to more than 20 hours depend-

ing on the type of EVSE, as well as the type of battery, how depleted it is, and its energy capacity. BEVs typically have more battery capacity than PHEVs, so they take longer to charge. (But, as described above, PHEVs can run like HEVs or ICEs.)

Level 1 delivers 110/120-volt alternating current (AC) electricity to the vehicle, which the vehicle's own equipment (its onboard charging system, or OBC) converts to the direct current (DC) needed to charge the batteries. EVs generally come with a portable Level 1 cord set.

Level 1 works well for charging anywhere, including at home or work, and can be done inside or outside using standard three-prong outlets and a standard J1772 coupler that plugs into the vehicle. Level 1 takes 8-12 hours* to charge an EV fully, although larger batteries may take longer. This slowest charging speed adds about 3.5 to 6.5 miles of driving range per hour of charging time, and can work well for PHEVs, which have a 20- to 50+-mile all-electric range, and/or drivers who drive an average of 30- to 40-miles/day.

Level 2 uses 240-volt (residential) or 208-volt (commercial) AC, which the vehicle converts to DC. Level 2 has to have a dedicated circuit of 20 to 100 amps. Level 2 equipment is compatible with all EVs and is commonly used for public and workplace charging as well as residential charging (see below); more than 80% of public outlets in the U.S. were Level 2 as of 2020.

* All figures for charging times and costs are approximate. Times will vary according to battery size, OEM, level of depletion, etc.

LEVEL 1 CHARGING



J1772 CONNECTOR

Level 2, which also uses a J1772 port, can charge a typical EV battery overnight, or in as little as four hours, though its charging rate may be limited by the vehicle's OBC, which monitors the rate to protect the battery. Level 2 charging delivers about 10 to 35 miles of range per hour.

Though portable Level 2 charging equipment is available, it is a common permanent installation choice for those who want to charge at home. Most houses already have 240-volt service for such appliances as clothes dryers and electric ranges. Installing Level 2 equipment typically requires hiring an electrician, who will usually run a 240-volt circuit to the garage to install a wall-mounted system. Installation might involve utility upgrades if a home has insufficient electric capacity. Many PHEVs only charge at Level 1 or Level 2, because of their smaller batteries.

It can be practical to own Level 2 charging equipment, particularly in localities where electricity rates are discounted for EV charging during certain times of the day or night. Many EVs can be programmed to start charging at a specific time to take advantage of lower rates.

The costs of installing a Level 2 charger vary but count on an hourly charge for the electrician, the price of the charging station, and a permit. Installing a new circuit is additional. There may be federal, state, local, utility, and/or OEM incentives or financing to help with these expenses. According to **J.D. Power**, installing a Level 2 charger can easily run \$1,000 to \$2,000. Some dealers or OEMs partner with select retailers or charging station manufacturers; some customers may be able to add the cost of the charging station into their vehicle financing.



Level 3, or DC Fast Charging (DCFC), utilizes 400 to 900 volts to supply DC current directly to the vehicle and charges an EV to 80% in about 20 minutes to an hour. That's around 90 to 200 miles of range in 30 minutes depending on the amount of power the EV battery can handle and the capability of the particular DCFC. To protect the batteries, BEVs are designed to accept the most power when they're the most depleted; the amount gradually decreases as the battery reaches 80%. Most OEMs advise charging only to

LEVEL 2 CHARGING



J1772 CONNECTOR

LEVEL 3 CHARGING



CHAdeMO



CCS



TESLA

80%. Most, but not all, BEVs can charge at Level 3. There are three types of DC fast-charging systems, depending on the type of charge port on the vehicle: SAE Combined Charging System (CCS), CHAdeMO (CHArge de Move), and Tesla. The CCS connector (which is also known as J1772 combo) is particularly useful because a driver can use the same charge port when charging with Level 1, 2, or DC fast equipment. Most DCFCs can charge via both CCS and CHAdeMO connectors.

Level 3 is used mostly for long trips and is most available along heavy traffic corridors. Some roadside assistance companies have portable fast chargers for emergency use. Home DCFC chargers cost about \$50,000 to install and are therefore prohibitive for most individual residences, but DCFC charging is currently offered at more than 18,000 chargers in 5,000 stations countrywide.

You can find public Level 2 and Level 3 charging stations, along with the specific connectors that your models use, throughout the United States and Canada [here](#), [here](#), and [here](#). Tell your customers that the AFDC locator is also available as an iPhone and Android app.

Regular use of DCFC may speed battery degradation because of heat issues. Some OEMs have advised against using fast charging every day.

As for costs, fees to charge the same EV battery pack can vary widely depending on the rate charged by the EVSE owner (in part based on time of day) and the speed of charging. Charging costs can range all the way from free to considerably more than the cost per mile to fuel an ICE vehicle.

Wireless Charging: Inductive charging equipment uses an electromagnetic field to transfer electricity to a BEV wirelessly. This technology has been developed and introduced commercially but is not widely available. Currently available wireless charging stations operate at power levels comparable to AC Level 2, though this technology has been used internationally at higher power levels in mass transit applications.

New Technologies are making public charging easier. [Shift Magazine](#) explains that public charging has often required membership in various charging networks, each of which had their own access cards or logins. Increasingly, EV models from various OEMs are or will be compatible with multiple charging networks using “Plug and Charge” technology, which

also accepts credit cards and authorizes payments. On the horizon is the possibility that EVs will be able to recharge while speeding along on the highway; researchers are exploring the “rolling recharge” option. Another possibility is battery swapping, in which a driver pulls up to a special station where his or her battery is exchanged for a fresh, fully charged battery. Currently very successful in China, battery swapping hasn't yet taken hold in the U.S.

Dealers' Role

Again, know your customers, know your EVs, and be able to show customers the charge ports and connectors on those EVs. Use a locator app to show them the location of charging stations nearest their home or workplace. If possible, let customers experience what it's like to charge a vehicle. There's nothing like hands-on experience.

With knowledge of a customer's planned use of the vehicle, explain the charging levels and the time to charge. It's important but not very difficult to plan driving trips to approximate the range needed for a particular trip and map out charging station locations if more range is needed to reach a destination. OEMs and EV charging networks offer powerful tools and apps for phones and in-vehicle consoles to help. If a charging station is not located along a particular route, it may be there soon; until then, reroute or take a detour.

You may want to read up on the portable mobile chargers that some companies are rolling out to roadside assistance companies for emergency or anytime, anywhere charging. Though these units are expensive, you and some of your EV customers may be interested in purchasing one for individual use. One company sees portable chargers as an [elegant solution for apartment dwellers](#), who might order a charge the same way they order pizza delivery.

Make sure to discuss both the possibility of running out of charge and the vicissitudes of range (see “Range,” below). And be sure to explain how excessive fast charging may harm the battery.

Have plenty of educational material that customers can take with them. Again, know the utility rates in your area, and any available incentives, and have internet links ready for more information.

Finally, take your cue from the customer, who may have learned quite a bit about EVs and charging before coming to your store.



If an EV battery has a very low SOC (State of Charge), typically the vehicle reduces available power and alerts the driver to find a charging station or pull over and call for help. Some EVs provide a buffer of several miles once that alert appears; others do not. Know the capabilities of the vehicles you sell, including any EVs in used inventory.

Range

We have estimated above that charging an EV for “x” amount of time delivers “y” amount of driving range.

That’s true, as far as it goes. Estimated range as listed on a new-vehicle Monroney sticker or on [FuelEconomy.gov](https://www.fueleconomy.gov) is best understood as a guideline. EVs, just like ICE vehicles, operate differently depending on terrain, load, speed, driver behavior, and outside temperature.

Extreme weather, particularly the cold, decreases range. *Car and Driver* notes the sweet spot for outside temperature as about 75 degrees and cites findings from AAA that range decreased by an average 41% when the temperature went from 75 degrees to 20. At 95 degrees, range decreased 17%. *Car and Driver* also offers a “[Range Finder](#),” which uses information such as the farthest a driver plans to drive in a day, whether it’s city or suburban driving, whether the driver’s willing to take charging breaks, and climate type to help determine how much range a driver actually needs.

The extra heating or air conditioning needed to keep vehicle passengers comfortable uses energy from the battery—which also needs to be heated or cooled—thereby reducing range.

High speed is another factor that draws more energy from the battery, which results in decreased range. DOE advises that EVs lose 14% less energy if speed is reduced by 10 miles per hour. Range is best extended by driving under 60 miles per hour; efficiency usually decreases rapidly at higher speeds. It’s often wiser to take a route that allows for slower, steady driving than opt for the highway. It’s also energy-efficient to avoid driving in heavy traffic where possible, or over rough terrain and steep hills.

Aggressive acceleration and deceleration can also lower an EV’s range. Even though it can be exhilarating to gun an EV because of the instant torque, basically it takes far more energy from the battery to accelerate to a higher speed from a standing start—or to decelerate from a higher speed—than from a lower speed. In addition, driving at a high speed increases the resistance of the air the vehicle is moving through, again forcing the battery to work harder and decreasing range.

Drivers should also avoid hard braking and instead anticipate stops and brake gently—when necessary to brake at all. The ideal is to lift your foot off the accelerator to slow the car to a stop, allowing the regenerative braking system to recover energy from the vehicle’s forward motion and store it as electricity. Hard braking causes the vehicle to use its conventional friction brakes, which don’t recover energy. Use regenerative braking to control speed.

Hauling heavy loads reduces range, whether you’re packing the vehicle with gear for skiing or water sports, or pulling a trailer. *Car and Driver* puts it this way: “EVs are aerodynamically slippery, and attaching a trailer to one is like strapping a parachute and ankle weights on a marathon runner.”

“EVs are aerodynamically slippery, and attaching a trailer to one is like strapping a parachute and ankle weights on a marathon runner.”

—*Car and Driver*



Range anxiety, particularly for a first-time EV purchaser, is real but it can be overcome. One EV driver described range anxiety thus: “...I can honestly say that range anxiety is very quickly replaced by range awareness.... Range anxiety is where one is constantly worried about whether the car will reach its final destination, or the next charging stop, before running out of battery power. This is just due to inexperience. Range awareness, on the other hand, is where you know precisely how far your car will go on any percentage of the full charge, so that although you are very aware of the range issue, you are always confident about reaching your planned destinations.”



Dealers' Role

Customers look to you for advice; make sure you understand what minimizes and maximizes driving range, so that you can help your customers become “range aware.” Though consumers say they want EVs that have a range of over 350 miles, most people drive fewer than 100 miles a day. At this writing, the median range of EVs is more than 250 miles, with a maximum of 400 miles. (In comparison, the median range for ICE vehicles is 415 miles, with a max of around 700 miles.) It has been found that many owners are satisfied with 250 miles, and that range anxiety lessens with experience. And there are ways to maximize miles per charge and keep range anxiety at bay.

In the peak summer and winter months, for example, or in a particularly hot or cold climate, tell your customers to plan ahead. Pre-cool or pre-heat the cabin while the vehicle is plugged in to reduce the need for heat or AC on the road; doing that will extend a BEV's or PHEV's range. Air conditioning, heating, and entertainment systems affect range for all vehicles, but they affect EVs more.

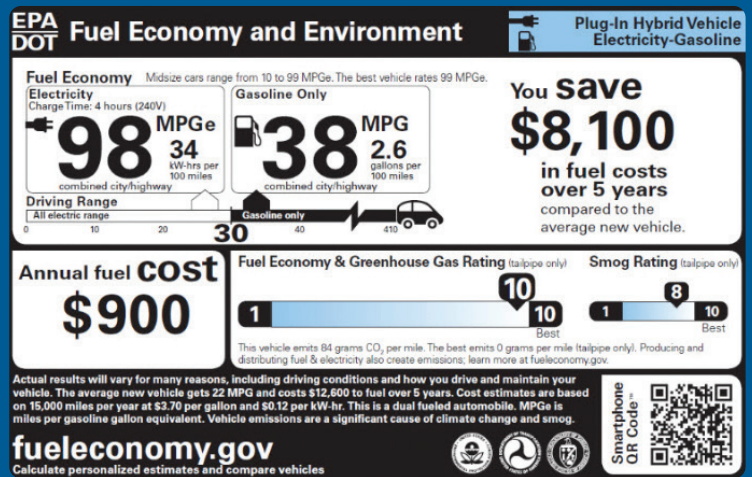
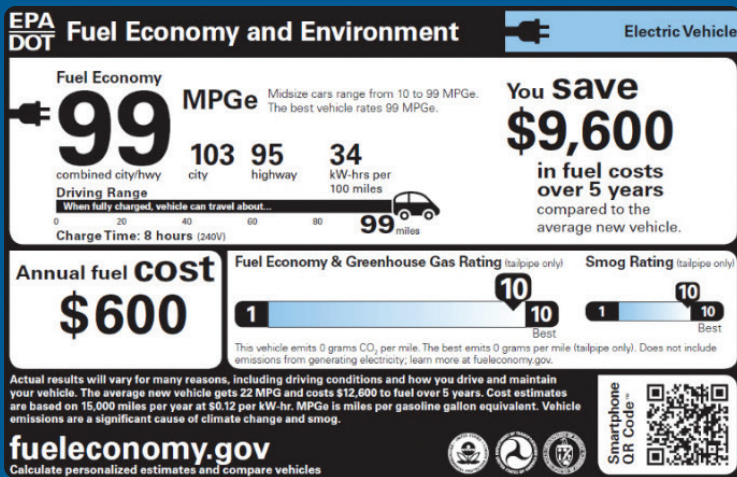
Additional tips for maximizing range in hot weather include:

- Keep the AC on low and open the window.
- Maintain a consistent speed to minimize accelerating and braking, and avoid high speeds.
- Use energy-saving settings whenever possible.
- Limit weight in the car. The more items you're carrying, and the heavier they are, the less efficient the battery will be.
- Park in a garage or in the shade.

- Charge at night. Batteries don't like the hot sun.
- Keep the vehicle plugged in when you're home.
- The more accessories you use, the more power you lose. Minimize panel and touchscreen use—even the radio. If you do use the radio, keep the volume down if you want full range.
- To keep the battery at peak efficiency, don't overcharge. Particularly in extreme temperatures, keep the charge below 85%, ideally within 60% to 70%.

Similar tips apply to maximizing range in cold weather:

- Set your overnight charge to finish as close as possible to when you will need to drive.
- Keep the battery warm by plugging in as much as you can, making sure the battery is at least 20% charged.
- Keep the heater set at a low level.
- Keep your speed below 65 miles per hour if you are driving on highways.
- Make sure tires are properly inflated. It's critical to maintain correct tire pressure for optimal energy efficiency. Consider winter tires.
- Consider an EV with a heat pump.
- Park indoors when possible. If you must park outdoors, park in the sun to warm the battery as well as the interior.
- Defrosters can decrease battery capacity. Turn defrosters off when front and rear windows are clear.
- Use regenerative braking, which returns energy to the battery; friction braking wastes energy.
- Keep the vehicle clear of ice and snow; there's no engine to melt snow on the hood.



Make sure your customers know about your vehicles' economy mode, if applicable, and how to activate it. They should understand that this feature maximizes fuel economy but may limit other aspects of the vehicle's performance—acceleration rate, for example—to save fuel.

Driving with under-inflated tires uses more energy, as does hauling trailers, or adding weight with cargo in the trunk or on the roof. Even adding such accessories as roof racks increases energy consumption at higher speeds.

Keeping the battery charged helps PHEVs use as much electricity and as little gasoline as possible, saving both fuel and money. For BEVs, it helps maximize driving range.

Frequent fast charging uses more energy; use DCFC sparingly to maximize range.

Finally, advise customers to consult the owner's manual specific to their vehicles. EVs can vary significantly, particularly in the way they manage energy use.

Batteries

The battery is the heart of an EV. It's also the most concerning thing about EVs, from the consumer point of view. Will the battery hold its charge? Will it last for as long as the consumer has the vehicle? Consumers want some assurance, and that takes education. Here are the basics:

Most EVs use lithium-ion batteries, which have a high energy density and resist losing charge when at idle. As batteries age, however, less of their stored energy is accessible, and performance inevitably degrades. The three primary avenues for degradation are temperature, the number of charge and discharge cycles, and time. "Calendar degradation," or parking a vehicle for long periods at or near the battery's full capacity or close to empty, reduces battery performance. So can frequent use of the maximum available charge and frequent fast charging, especially in cold weather, and exposure to heat.

According to the Union of Concerned Scientists, the battery system in current EV passenger vehicles in the U.S. is **likely to lose 12% to 50% of its range** over the vehicle's average lifetime, with higher capacity systems losing the least. A new EV with a 250-mile range can be expected to have 150 to 200 miles of range after 12 years. As battery technologies improve, range degradation will lessen.

An EV's battery capacity is expressed in kWhs. The higher the kWh rating, the more range the battery has. A battery's estimated range, as rated by the EPA, is listed on the Monroney label of every new vehicle sold in the U.S. The sticker displays the vehicle's official "MPGe" ratings for city, highway, and combined city/highway driving. MPGe, or miles-per-gallon equivalent, is a way for ICE-accustomed consumers to understand range in an EV. MPGe equates 33.705 kWhs to a gallon of gasoline. As noted above, however, actual range can vary quite a lot depending on individual driving habits, weather extremes, load, and frequent fast-charging.

Also on the Monroney label are the number of kWhs needed to drive 100 miles, with comparisons to similar vehicles; the projected annual cost to run the EV; an estimate of how much less you'll spend on energy over five years; the average number of miles the vehicle can run on a charge; and how long it takes to fully replenish a discharged battery using a Level 2 charger.

Data on range, energy consumption, and greenhouse gas (GHG) emissions for individual models is also on the EPA/DOE [Fuel Economy website](http://fuelconomy.gov).

All EVs have an on-board battery management system (BMS) that keeps the vehicle from charging or discharging at the very maximum or minimum of the battery's capacity. EVs are intentionally designed not to charge to 100% or discharge to zero. The BMS regularly monitors everything that's happening in the battery—its temperature, voltage, current, even coolant flow—to ascertain that the battery pack is operating safely.

The BMS can monitor individual battery cells; if a cell fails, the BMS stops its use. The BMS ensures that the battery receives the correct voltage when charging, and constantly checks temperature. It is essentially a brain, monitoring not only the battery, but also the internal charging controllers, motors, and external chargers to make sure it's safe to draw power.

Today, an EV's battery pack represents 35% to 40% of the vehicle's cost. In the future, battery costs (and weight) are expected to decrease while, at the same time, energy density and range should increase.

Dealers' Role

Dealers can help shore up consumer confidence in EVs by focusing customer education on the battery, charging, and range. The three are, of course, interconnected. The battery also affects EV safety (see below) and affordability.

As noted above, most EV batteries have warranty coverage of at least eight years or 100,000 miles. Most OEMs also provide degradation coverage to at least 60%. As confidence in the battery grows, so will your sales.

Teach your customers about the battery, and how they can make it last longer by using the tips we've noted throughout this guide—e.g., avoiding extreme temperatures, managing charging, and minimizing fast charging.

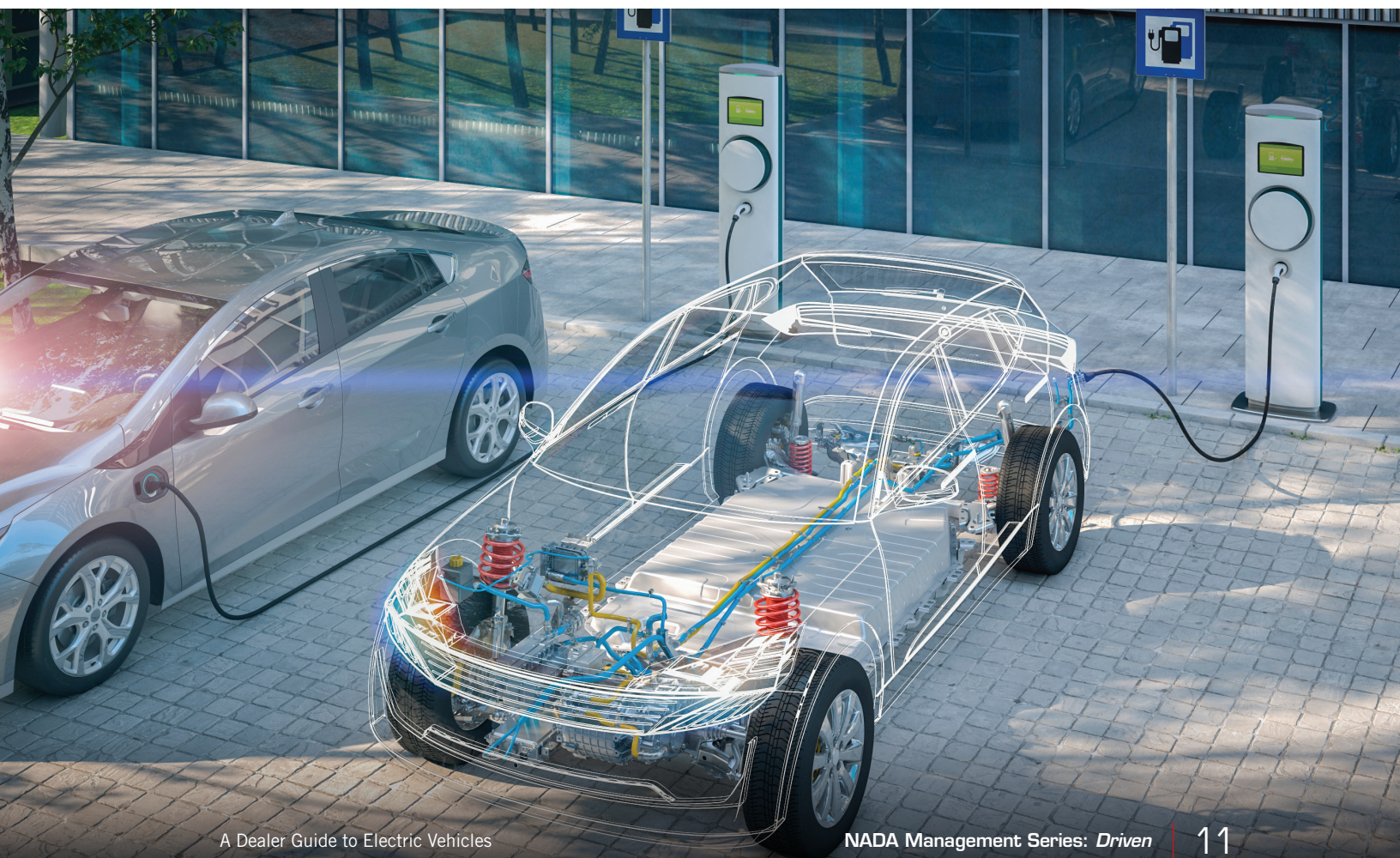
As well, don't park or store an EV with a maximum charge for an extended time. That situation makes the battery work hard to maintain the charge. You also don't want to park or store an EV with an empty battery.

To maximize performance, some OEMs recommend daily charging to less than 80% and storing the vehicle with a charge level between 20% and 70%.

As mentioned earlier, plug the vehicle in whenever it's really hot or cold outside. Plugging in allows the charging system to properly monitor the battery and to cool or heat it as necessary.

Important: Always encourage customers to read their owner's manuals—not all EVs are alike.

Finally, reassure customers that the battery in the new EV they just purchased could outlast the vehicle itself if they pay attention to battery health.



Safety

The consensus among experts is that EVs are just as safe as ICE vehicles.

Safety standards for EVs are the same as for ICE vehicles except for additional precautions concerning EVs' high-voltage electrical systems. An EV-specific standard sets requirements for limiting chemical spillage, securing batteries during a crash, and isolating the chassis from the high-voltage system to prevent electric shock. EV manufacturers design their vehicles with safety features that deactivate the high-voltage electric system in the event of an accident. In addition, since EVs are heavier than ICE vehicles, they may better withstand a crash. EVs also tend to have a lower center of gravity than ICE vehicles, making them less likely to become involved in a rollover accident.

Since 2011, the Insurance Institute for Highway Safety (IIHS) has performed EV crash tests, which are basically the same as crash tests for ICE vehicles except for an electrical isolation test, which ascertains that power to the battery has been disconnected after a crash to prevent shock and fires. The test also looks for thermal runaway. The crash tests, IIHS said, "have never resulted in a fire or a spike in battery temperature that would indicate the potential for a thermal runaway event." After testing certain 2021 EVs, IIHS said "evidence is growing that electric vehicles are at least as safe as conventional ones," and awarded the models its "top safety pick" designation.

IIHS also noted that driver and passenger injury claims were 40% lower than for identical ICE models from 2011 to 2019.

IIHS President David Harkey said, "We can now say with confidence that making the U.S. fleet more environmentally friendly doesn't require any compromises in terms of safety."



"We can now say with confidence that making the U.S. fleet more environmentally friendly doesn't require any compromises in terms of safety."

—David Harkey, IIHS President

The National Highway Transportation Safety Administration (NHTSA) has established a Battery Safety Initiative for Electric Vehicles to collect data, coordinate research, and develop safety standards for EV batteries. NHTSA will study crash and non-crash incidents related to battery safety; research battery diagnostics, prognostics, and intervention; and explore cybersecurity issues.

New EVs tend to be equipped with the latest Advanced Driver Assistance Systems (ADAS). One safety concern specific to EVs, however, is that they are so quiet that pedestrians may not hear them approaching. As *Car and Driver* puts it, "It will take a shifting mindset for traditional car enthusiasts to learn to love EVs. When you've spent your years understanding engine purrs and roars as indicators of something very right (or wrong), chucking a quiet EV into a few corners can be jarring...."

To address this issue, NHTSA requires EVs to emit sounds at low speeds. In any case, drivers should use extra caution when driving EVs around pedestrians.



"It will take a shifting mindset for traditional car enthusiasts to learn to love EVs. When you've spent your years understanding engine purrs and roars as indicators of something very right (or wrong), chucking a quiet EV into a few corners can be jarring."

—*Car and Driver*

Dealers' Role

Dealers need to be able to reassure customers, particularly after well-publicized incidents may have magnified fears. Use this guide and information from [IIHS](#), [AFDC](#), the [National Fire Protection Association](#) (NFPA) and other organizations listed in the bibliography to emphasize EV safety systems.

When EV battery fires do occur, whether due to a crash or otherwise, specially trained emergency responders and very large amounts of water are required to extinguish them, because the batteries are larger and in harder to reach locations.



Dealers need to take care when storing and transporting new and used batteries outside of a vehicle. Cox Automotive Mobility lists these storage considerations:

- Use effective and appropriate climate control—heat and humidity destroy batteries.
- Have all appropriate fire protection, including hoses, sprinklers, and fire extinguishers.
- Consider installing sand pits to control a potential thermal runaway event.
- Use battery cyclers to analyze battery capacity and efficiency and ensure batteries are set to the correct charge for the activity.

If a battery is removed because it might be compromised due to a crash or a battery recall, it should be isolated in a dedicated space designed to control failures. Systematic safety controls for failure containment, battery transport and storage should be adhered to at all times. NFPA, which provides EV-specific first responder training recommended by the National Transportation Safety Board (NTSB), offers a wealth of information, including instructive videos, on its website. NFPA also maintains a collection of [free emergency response guides](#) from more than 35 alternative fuel vehicle manufacturers.

Assure customers of your dealership's commitment to their safety. Explain your EV technicians' specialized training and tools, and show them your well-equipped service department (see "Service," next column). Explain technicians' rigorous training in safety practices with respect to EVs in for service or for crash repair. Your customers can be confident that your dealership can take care of their EVs.

Service

As noted in the "Affordability" section above, EVs have lower routine maintenance costs. After all, BEVs have fewer mechanical components that require regular service. They don't need tune-ups, transmission servicing, spark plugs, and drive belts. But they still need regular servicing of brake fluid, coolant, windshield washer fluid, tires and brakes (although regenerative braking can save on brake wear and tear).

But routine maintenance is only part of the story.

According to analytics firm We Predict, which studies actual and predictive automotive service repair frequency and cost, first-year service cost per vehicle, including both labor and parts, can be higher for EVs than for ICE vehicles even with EVs' lower maintenance outlay. Although service costs decrease after the first year, We Predict said they are still higher than for ICE vehicles.

Average labor hours and labor rate also may be higher for EVs. Technicians often need more time to diagnose problems with EVs, in which there's a lot of back and forth with the OEM, test driving, and detailed reporting. We Predict's data showed that technicians need 1.5 times as much time to fix problems, and their average labor rate is 1.3 times higher.

As for EV parts, half of the top ten serviced parts are related to the high-voltage system, with the battery charger/cable and the battery itself taking the top two positions. The other three include the battery contact, high-voltage wiring, and the battery control unit. Just about all the remaining parts needing service are electronic.

Though EVs are projected to improve over the years, some will need less service and repair, some more—just as with ICE vehicles. We Predict projects that EVs will be in “perpetual launch mode” for the next five to seven years as dealers and dealership technicians, as well as OEMs and suppliers, progress along the learning curve that EVs present.

Cox Automotive Research finds that franchised dealers will retain the majority of service opportunities as the transition to EVs continues.

Dealers' Role

Properly managed dealership service departments will be as busy and profitable as ever.

EV owners will likely go to EV-certified dealers to have EVs serviced, especially under warranty. They won't trust their high-tech vehicles to independent shops that aren't EV-ready. Here's where the relationship you have built with your customers, and with your OEM(s), is all-important.

Show EV purchasers your well-equipped service departments. Tell them about how you send technicians for OEM training on high-voltage work, charging, lift safety, battery diagnostics, battery storage, discharging and charging, and safety equipment and that they are ASE light-duty hybrid/electric vehicle (Level 3) certified. Show off your EV-model-specific equipment and tools.

If possible, bring your customer into the shop to meet an EV-certified technician and/or service manager. According to a survey of more than 16,000 consumers conducted for *Fixed Ops Journal*, consumers want to meet the service manager or director when they purchase a vehicle.

That said, be transparent with your customers.

Emphasize the lower scheduled maintenance cost and frequency. And that they don't have to come to the dealership every few thousand miles for regular lube, oil and filter changes, or to fix the myriad mechanical parts on a gas vehicle. That's a big plus for most drivers.

When they do need repairs, though, it may be more expensive because the labor is highly specialized, and the parts are costly. You have invested thousands in special equipment and tools to service EVs. Most important is your investment in technician training.

Dealers may want to investigate other service opportunities. Some experts have suggested that tire and wheel services can be a healthy profit center as tires are reengineered for EVs.

EVs put more stress on tires because they're so much heavier than gas vehicles. EV tires need to power the wheels to deliver instant torque, and they need to have lower rolling resistance and a greater grip on the road. Plus they need to be lighter and extremely strong. And because EVs run silently, tires need to reduce road noise.

As EV owners come to understand how important their tires are, they won't come to the dealership just to check tire pressure and treads or to have their tires rotated according to manufacturer guidelines. If you offer tire sales, customers might purchase the latest tires recommended for their vehicles and have your technicians do the mounting, balancing and alignment.

It's not a hard sell.

EVs are new to most drivers. They want to take special care with them. Your dealership can provide that care.

EV service is a golden opportunity to retain customers. Prove your dealership's value with a customer's new-fangled, expensive motor vehicle, and you might just make that customer your customer for life.

Environment

Over their lifetime, EVs typically are better for the environment than ICE vehicles. BEVs do not produce tailpipe emissions. To the extent that they use clean electricity for motive power, PHEVs and HEVs are also better for the environment.

Transportation—cars and trucks, air travel, marine transportation, and rail—[contributes 29% of this country's GHG emissions](#), according to the EPA. Burning fossil fuels like gasoline and diesel releases carbon dioxide, the primary GHG emitted into the atmosphere through human activities. And GHGs arguably contribute to climate change.

The EPA and the Department of Transportation set ever more stringent standards for GHG emissions and fuel economy to help reduce carbon pollution. State, local, and regional programs are working to implement clean

car standards. Making and selling EVs is one way to help meet those standards.

Mining the raw materials for EV batteries, however, generates GHG emissions, as does producing the electricity that EVs run on.

But power plants are steadily getting cleaner and, according to the [Union of Concerned Scientists](#), even considering those emissions, driving an EV today in most of the U.S. produces fewer emissions than driving a gas vehicle getting 50 miles per gallon.

Dealers' Role

Many customers are already familiar with the environmental benefits of EVs. Though the relative importance of “greenness” in customers’ or prospective customers’ choice of an EV can vary, the green factor is very important to certain customers. Thus, dealers need to understand the benefits of clean cars and explain them, if needed. Use Monroney label and OEM information to detail the environmental advantages of the new EV models you sell.

III. Marketing and Selling EVs

Dealers have been spending hundreds of thousands of dollars to get ready for EVs—including chargers, higher voltage outlets, special tools and lifts, solar panels, and training. With time, those investments will pay dividends.

A recent national [Cars.com survey](#) showed that two-thirds of Americans may be interested in purchasing an EV, their appetites whetted by announcements of massive governmental investments in EV infrastructure. Though barriers remain—chiefly affordability, range, and a lack of charging stations—trends revealed include:

- Urban buyers are much more likely to buy EVs.
- As gas prices increase, so does interest in EVs.
- Environmental benefits, tech features, and vehicle style lead the reasons for purchase.

The survey also found that the overwhelming proportion of those who had already purchased an EV would purchase another for their next vehicle. The [J.D. Power studies](#) cited above had similar findings, and noted that “among heavy-use drivers, the prospect of eliminating gasoline expense seems to neutralize range anxiety.”

The [CarGurus survey](#) mentioned earlier also found enthusiasm for EVs, with more than half of car owners expecting to own an EV in the next 10 years, especially if more charging stations and replacement parts become available. Current EV owners use their vehicles for daily driving, so they must have access to cost-effective charging nearby. Respondents said that long-term fuel and maintenance savings outweigh the higher purchase price. The overwhelming majority of buyers said they’re open to several brands of EVs and, while the majority look to purchase new vehicles, they are willing to consider preowned as well.

CarGuru’s survey respondents said they were most likely to consider SUVs and crossovers, while Cox Automotive identified full-size EV pickup trucks as “a catalyst for EV growth,” counting two in five pickup truck customers interested in electric pickups. The [Cox Automotive Consumer Snapshot: Electric Pickup Trucks](#) found that ICE pickup truck shoppers prioritize horsepower whereas EV pickup shoppers care more about technology.

The interest is there. And the vehicles are arriving. What can you do to position your dealership for success in the EV era?

Marketing

Here are some suggestions:

- Have EVs charged and ready for test drives. You will recall the J.D. Power finding that firsthand experience is key to considering purchase.
- If possible have a selection of EVs to show customers.
- Display EVs prominently on your lot. Make them visible alongside your ICE vehicles.
- Better yet, display EVs in an interesting way. One dealer displays EVs under a solar canopy with charging stations.
- Consider acquiring a few CPO or used EVs.
- Have brochures and web links about regional utilities and charging information at hand. Show customers you have the resources and understand what they need.
- Make your website a resource for customers. Don’t just picture inventory; have links to incentives, local renewable energy sources and chargers, and mobile apps. Allow searches by fuel type. If you sell BEVs, PHEVs, and HEVs, illustrate basic differences. Make concepts such as charging and range relatable: For example, use a map app to illustrate the location

and level of chargers near the dealership. Or use an infographic to show how many miles of range takes you from the dealership to the mall, the baseball stadium, the multiplex.

- Take advantage of opportunities to showcase your EVs at auto shows and local events where you can provide test drives.



Research shows that people who attend auto shows are considering buying within a year. And nothing beats an auto show as a low-pressure, experiential environment for comparing the latest models from multiple OEMs. Particularly important now, the auto show is a place to educate consumers on EV technology and get them comfortable behind the wheel with test drives and ride-and-drives. Attendees can sit in the front and back, check out the instrument panel and the technology features. They can compare competing models, learn about charging, ask as many questions as they want. The product specialists at the various booths are knowledgeable about EV technology, cost savings, charging, performance, etc., and most booths also have computer kiosks where consumers can get in-depth information. Some shows may even invite you to send a booth representative.

Your most important marketing tool is your highly trained and motivated staff.

As discussed above (see “Service”), repairing an EV is a specialized and labor-intensive enterprise. EV-certified service technicians are trained on the high-voltage work that EVs need. Further, they know how to service the abundance of advanced electronics in new EVs, including ADAS and entertainment packages. Your technicians are certified to perform the warranty work owners wouldn’t trust to any other shop.

Your salespeople, too, need to understand EVs. Send them for training or train them in the dealership to talk to shoppers about EVs: These vehicles are new, they are different, and if a customer is not in the market for an EV today, he or she may be in the market tomorrow.

It’s a good idea to train at least one of your salespeople to be an EV specialist. EV specialists—they might be EV enthusiasts—need to know the particulars about the EVs *you* sell as well as EVs in general. They should know everything about charging *your* EVs—including

the charging system and outlet types they need, compatible public chargers and locations in your market area, the basics of installing home charging equipment, and where to find more information. EV specialists should also know details about federal, state and utility incentives.

And an EV specialist can help consumers choose the right EV.

Selling

Though many of the considerations that govern vehicle choice are the same for EVs as for ICE vehicles—price, capacity, and style, for instance—getting your customer into the right EV requires asking the right questions. Many consumers will come to the dealership having already figured out what vehicle is best for them, but many more will need help understanding whether a HEV, PHEV, or BEV might work best for them.

The EV specialist, with a firm understanding of the differences among these three electric options, should help customers grasp the concept of range. Ask how far they drive in a typical day, and how often they take longer trips. Do they have access to charging at home or at work? Do they regularly haul lots of kids and gear—hockey sticks, soccer balls, camping supplies, skis?

Battery packs are constantly changing so you need to keep up with the latest range estimates for your models. In general, currently available BEVs work well for the average commuter who drives 40 miles or less in a day. Regenerative braking is great for city commuters because every time you lift your foot off the accelerator, the battery recaptures energy. For longer trips, a BEV owner needs to plan charging breaks.

A PHEV might be best for longer commutes, combining useful electric range with an ICE that can pitch in to complete commutes and handle longer trips. Indeed, a PHEV doesn’t have to be plugged in and can operate in hybrid mode as long as there is fuel in the tank. Also, many PHEVs, but not all, are eligible for the full federal tax credit now available to BEVs. (Again, EV specialists should be familiar with [federal and state laws and incentives](#), and with the local [Clean Cities Coalition](#) or [State Energy Office](#).)

HEVs can be a good option, particularly for customers who are reluctant to invest in a PHEV or a BEV. A

HEV can be a bridge to a plug-in vehicle. In addition, companies continue to develop technologies to make HEV internal combustion engines more efficient and thus reduce emissions.

Because of their larger batteries, and therefore longer electric range, BEVs typically cost more than PHEVs, which cost more than HEVs.

When addressing price, EV specialists should take care to stress available incentives, special OEM financing or lease terms, and the total cost of ownership (see “Affordability,” above), which might include lower insurance premiums. EVs may be eligible for [HOV or HOT lane access](#) regardless of the number of passengers. If your dealership offers free or reduced charging for customers or has partnered with charging station retailers to offer package prices, make sure the customer knows. And for new EVs, be sure to use the Monroney label to explain fuel economy benefits.

But once the basics are explained and questions asked and answered, the imperative is to get the customer behind the wheel.

The Test Drive

Drivers who own or have driven BEVs report that they are fun to drive, with instant torque and smooth handling. The battery pack is typically in the center of the vehicle, beneath the floorboard, which lowers the center of gravity and provides excellent weight distribution and stability to improve cornering and minimize rollover risk.

Arrange a test drive that allows the customer to experience the EV's performance and comfort. Perhaps your dealership has its own test track. If not, map out a route that shows off the vehicle. The ability to provide test drives is one of the key advantages your dealership has.

IV. The Dealership Advantage

With the advent of EVs, franchised dealers are more important than ever. EVs represent a sea change, and dealers have the basic organizational and physical structure—the infrastructure, if you will—to handle every aspect of sales and service.

Mike Stanton, NADA president and CEO, enumerated those aspects: “Things like consumer education about the product, help with comparing models, working with a customer’s budget constraints, financing assistance, helping with trade-ins, allowing test drives, and—yes—even good-old-fashioned tire kicking. And this is all in addition to the new challenges specific to EVs, such as the complexities of charging...and other variables that don’t exist in the ICE market.”

Consumers know to comparison shop dealerships for the best prices; intra-brand competition keeps prices down. They know dealers can help them with financing, registrations, parts, and maintenance. They know dealerships protect them by servicing recalls and warranty repairs. They know dealerships have the highly trained people who can assist them over the life cycle of vehicle ownership. They see dealerships as resources for education about their vehicles.

To quote James Appleton, president of the New Jersey Coalition of Automotive Retailers, “... franchised new-vehicle dealers are—and always have been—the most efficient and reliable go-to-market strategy for new and innovative automotive products and services.”

Dealers hold the key to widespread adoption of EVs.



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