Electric Vehicles: How Much Do You Know?

A FACT-BASED GUIDE FOR CONSUMERS

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SMART ENERGY
CONSUMER COLLABORATIVE

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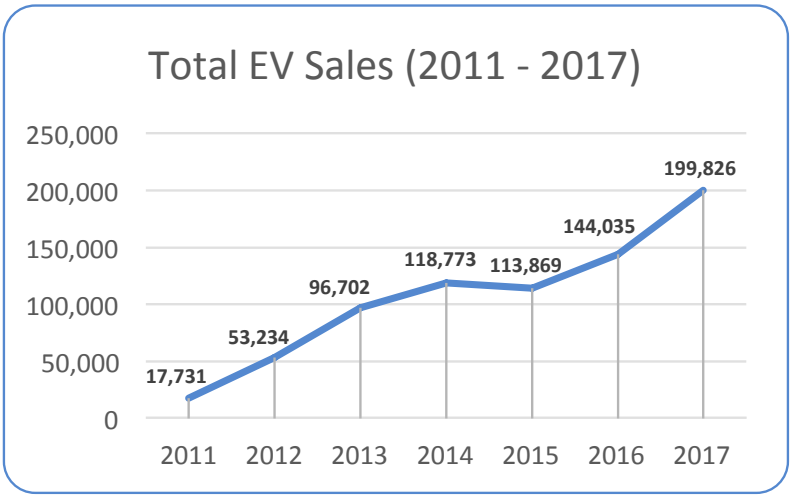
Figure 1: New York's Easter Parade, 1900 (IMAGE: UNIVERSAL HISTORY ARCHIVE/UIG/GETTY IMAGES)

According to industry statistics, consumers purchased almost 200,000 electric vehicles (EVs)[1] in the United States in 2017 — the most ever by roughly 55,000 vehicles. Yet, as a percentage, this figure still only represents about one percent of total light vehicle sales in the U.S.

Considering this modest proportion of EV sales relative to the total car market, you might be tempted to say, "Who cares?" Yet, given the rapid pace of technological change, it's worth taking a closer look at EVs and their potential for changing the way Americans get around.



[1] U.S. Department of Energy Alternative Fuels Data Center U.S. Plug-in Electric Vehicle Sales & InsideEVs Monthly

Figure 2: New York's Easter Parade, 1912 (IMAGE: PHOTOQUEST/GETTY IMAGES)

Consider an example that Tony Seba, an energy expert and lecturer at Stanford University, likes to tell his audiences about what happened at the Easter Parade in New York City in the early 1900s. After examining photos from the National Archives, he observed that in 1900, with one exception, every vehicle was a horse-drawn carriage; however, there was one "horseless carriage" — one of the earliest automobiles.

Fast forward 12 years, and during the same Easter Parade, the scene was reversed: There were Ford Model Ts everywhere, with only one horse-drawn carriage. Obviously, technological change can happen very quickly (think smartphones), and many experts think that EVs will be one of the next examples.

So how much do you know about electric vehicles?

Why EVs?

EVs are three times more energy efficient than gasoline-powered vehicles. A typical gasoline-powered vehicle with an internal combustion engine (ICE), the predominant type of power system in use today, converts only about 21 percent of the energy contained in gasoline to actually move the vehicle – the rest is wasted. For an EV, more than 60 percent of the electrical energy stored in the battery is used to turn the wheels and move the vehicle. In dollar terms, this means that a typical EV can travel about 43 miles on $1 worth of electricity, or about one-quarter the fuel cost of a typical 2016 gasoline-powered car. One study[2] estimated that EV owners could save a median of $770 per year on fuel costs and in some cases more than $1,000.

EVs are also cheaper to maintain than gasoline-powered cars because they have fewer moving parts to break down than vehicles with an ICE, which also means they are more reliable. EVs, for example, don't have carburetors, spark plugs, starters/alternators, oil pumps and filters, etc. And EVs don't require oil changes like gasoline-powered cars.

Furthermore, electric vehicles accelerate much faster than a gasoline-powered car due to the instant torque produced by the electric motors. Just search "Tesla acceleration" or "EV acceleration" in YouTube, and you'll find many videos showing just how fast an EV can accelerate.

Aren't EVs a lot more expensive to purchase than a gasoline-powered car?

Although cheaper to own and operate, EVs can cost more up front to purchase than equivalent gasoline-powered cars. For example, a 2018 Nissan LEAF retails for $29,990 compared to a $23,645 2018 Toyota Camry. However, the federal government and many states are offering incentives to encourage consumers to purchase an EV. The federal government, for example, offers consumers a tax credit of up to $7,500 for purchasing a new EV, which significantly helps lower the purchase cost. These tax credits, however, will phase-out as EV model sales hit 200,000 cars sold, which will begin happening in 2019 for the most popular EVs like the Tesla Model S. The tax credit will reduce to $3,750 for six months and then $1,875 for another six months before disappearing completely.

Many states all over the country from Florida to Washington are offering consumers rebates or other benefits for switching to an EV. For example, 20 states currently allow HOV lane access to EV drivers – even if they're driving solo. Other states offer perks like providing free access to toll roads and parking spaces or even discounts on yearly registration.

The cost of the EV battery is the primary reason for the higher purchase cost, but design and manufacturing innovations are driving battery costs down rapidly. In fact, EV battery costs have declined more than 70 percent over the past six years, and analysts are predicting that EVs may reach cost parity with gasoline-powered cars by 2025 – and possibly as soon as 2020. Tony Seba, the energy expert mentioned above, says that EVs are on track to be the "rational, economic choice" because EVs will have the performance of a Porsche but at the cost of a Buick.

[2] Union of Concerned Scientists' Going From Pump to Plug (2017

How many models of electric vehicles are currently around today?

Tesla is, of course, the most recognizable brand of EVs on the road today. In fact, the Tesla Model S is the best-selling EV in the United States and, along with the Nissan LEAF and the Chevy Volt, accounted for over 50 percent of EV sales in 2015 and 2016. However, this is quickly changing as more and more new EV models are introduced.

The majority of global car manufacturers have announced that they will be adding EVs into their vehicle line-ups in the coming years – if they haven't already. Volvo announced, for example, that all of their vehicles will have an electric motor option by 2019, and they're planning for 50 percent of their vehicle sales to be "fully electric" by 2025.

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Other manufacturers like Mitsubishi, Land Rover, Hyundai, Jaguar and Kia will be introducing EV models in either 2018 or 2019. And Porsche plans to release its first EV sports car in 2019 called the Mission E. Furthermore, Volkswagen is planning to release an all-electric version of its iconic Type 2 Microbus by 2022.

Where can I find information about purchasing an EV?

Electric utilities, who increasingly are focused on providing customers with more energy choices and related services, see supporting EVs as a major priority, and many of them are providing information and tools for consumers who are looking at EVs. For example, Southern Company, a major utility in the Southeast, sponsors a website called rEVolution to help its customers compare and test drive different models and makes of EVs.

National Grid and Con Edison in NY provide their customers with vehicle choice engines, featuring a zero to 100 efficiency score and personalized total cost of ownership estimates that allow them to compare any vehicle model to an EV, thus helping more car shoppers discover the benefits of EVs.

Further, a nonprofit organization called Forth based in Portland, Oregon — with support from various utilities, auto and equipment manufacturers and municipal organization — has developed the Go Forth Electric Showcase, which provides consumers with an opportunity to test drive a number of different EV models, including the Chevy Bolt, Nissan LEAF, Honda Clarity Electric and the Ford C-MAX Energi in a no-pressure, hassle-free environment away from dealer showrooms.

Don't EVs need to be plugged in often to recharge their batteries?

Range anxiety is a fear that your car will run out of battery power in the middle of nowhere and is often cited in surveys as the number one reason consumers reference for not wanting to purchase an EV. Although a legitimate concern, range anxiety is fading rapidly. On the one hand, most Americans really don't drive that far very often. One academic study concluded that the daily mileage total for urban-based cars was just 36.5 miles, while rural-based cars drove an average of 48.6 miles per day. These are distances that are easily accommodated by pretty much all EVs on the road today.

However, car manufacturers are also rapidly improving the range of EV batteries. In model year 2011, for example, there were just three different models of all-electric vehicles whose full-charge range spanned 63 to 94 miles. By model year 2017 the number of EV models had increased to 15 and their ranges had increased to a full-charge range of over 300 miles. And from 2011 to 2017, the median range for an all-electric vehicle increased by 41 miles — from 73 to 114 miles.

Furthermore, in 2017 there were at least five car models with full-charge ranges of over 120 miles. The 2017 Chevy Bolt, for example, features an impressive 238-mile range while priced at under $40,000. Experts believe that over the next two to four years, the median EV battery range is likely to increase to over 200 miles.

What about charging options? Isn't finding a charging station still a problem?

Along with range anxiety, many consumers are concerned about the availability of charging stations for EVs. The reality is that most EV owners charge their EVs at home overnight, often taking advantage of special electricity rates. In addition to people's homes, there are thousands of public charging stations in the U.S., and the number is growing rapidly every year.

According to the U.S. Department of Energy's Alternative Fueling Station Locator, there are currently over 18,200 charging stations in the U.S. with over 51,000 outlets. Not surprisingly, California leads the nation with about 4,500 stations currently and over 16,000 outlets; but every state, including Alaska, has at least a handful of charging stations. During the five-year period ending in 2016, the number of charging outlets nationwide had more than tripled.

There are a number of resources to help EV owners find places to charge their cars. In addition to the federal government's Alternative Fueling Station Locator website mentioned above, there are a number of companies like Blink, ChargePoint and EVGo that install and maintain a network of charging stations. Using iPhone and Android apps, these companies make it easy to find a charging station, plug in, and start charging your EV. The apps will even help you monitor the progress of your charging session and will inform you when charging has completed. Another free app called PlugShare enables EV owners to find charging stations, regardless of who installed and maintains the charging station. Using their app, you can quickly find a charging station near you. PlugShare claims they are the largest community of EV drivers in the world, and in addition to helping drivers find charging stations, they provide access to a community of drivers seeking to get the most out of their EVs.

Electric utilities, as part of their support for EVs, are making investments in charging solutions on behalf of their customers. California utilities, not surprisingly, are leading the way with a plan to invest nearly $768 million to support the state's goal of having five million EVs on the road by 2030. Pacific Gas & Electric (PG&E), along with Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) have all announced ambitious investment plans to promote and support customers driving EVs. Particularly noteworthy is SDG&E's plans to install 5,500 charging stations at multi-family properties to provide charging solutions for customers living in apartments and townhouses.

Although California is a clear leader, they are not the only state whose utilities are making significant investments in grid infrastructure to support the growth of EVs. New York, for example, has a goal of installing 10,000 charging stations by 2021. And ComEd, an electric utility based in Chicago, announced in 2015 that it would invest up to $100 million to install 5,000 charging stations over a five-year period to provide more charging options in municipal parking lots, workplaces, multi-family residences and economically disadvantaged areas.

In addition to their investments in publicly available charging solutions for their customers, utilities are developing online marketplaces for their customers to help them shop for and purchase a wide array of energy efficient products such as LEDs, smart thermostats and appliances. And some utilities, such as Con Edison in New York City and SCE in Southern California, are using their marketplaces to help consumers find, compare and purchase EV chargers for their homes or businesses. Con Edison also integrates a solar concierge service that helps their customers invest in rooftop and community solar to power their EVs with clean energy.

Won't my electricity bill go up?

Charging an EV at home will use more electricity, but it may not raise your bill very much, if at all. Most utilities and electricity providers offer customers special low-cost rate plans for EV drivers. Typically, these rate plans are referred to as time-of-use (TOU) plans, because the electricity rate (i.e., the cost per unit of electricity called a kilowatt-hour [kWh]) varies depending on the time of day and sometimes the day of the week based on the overall demand for electricity.

The cost of electricity during the middle of the night, or midday depending on utility needs, can drop to just a few cents per kWh depending on where you live, and most EVs can be easily programmed to wait until a specific time (e.g., midnight) to start charging. So if you switch to a TOU rate plan and charge your EV overnight, you might find that your electric bill actually goes down rather than up. And keep in mind (as discussed above) that using electricity to power a vehicle rather than gasoline is almost always cheaper. So, even if your electric bill does go up some, your overall transportation costs most likely will go down.

Some utilities are developing additional programs to meet the needs of their EV-driving customers. Austin Energy in Texas, for example, launched a program called Plug-In Everywhere, which offers customers access to unlimited EV charging at over 600 charging ports for just $4.17 per month. And Austin Energy, Georgia Power, San Diego Gas & Electric, Maui Electric and other utilities are developing programs for businesses, retail centers and apartment complexes to help them install EV charging solutions for their employees, customers and residents.

Furthermore, some utilities are beginning to develop programs where EVs are used as a "smart grid" resource, helping to balance the supply and demand on the power grid and rewarding EV drivers for participating. Using advanced technologies and groups of consumers that agree to participate, these programs enable consumers to automatically charge their EVs when the electricity supply is high, and prices are low.

The most futuristic programs are exploring the reverse situation as well. Namely, when the electricity supply is low, and prices are high, the electric grid could tap the energy stored in EV batteries to help balance the grid, thus reducing the need to build expensive generating stations. In return, EV owners would be compensated for helping to provide this critical "grid service."

The Austin Energy program called Plug-In Everywhere, offers customers access to unlimited EV charging at over 600 charging ports for just $4.17 per month.

Is driving an EV really better for the environment?

Yes, it is. In general, a vehicle's emissions can be divided into two broad categories: air pollutants that contribute to smog, haze and health problems, and greenhouse gases (GHGs), such as carbon dioxide and methane that contribute to global warming. Researchers at the U.S. Department of Energy did some calculations to estimate the total annual "well-to-wheel" emissions driving the same number of miles produced by a gasoline-powered car and an EV including all the emissions associated with extracting, processing, distributing and using the energy to run a gasoline-powered car (i.e., gasoline) and an EV (i.e., electricity).

They determined that, on average, 11,435 pounds of emissions annually are associated with operating a gasoline-powered car and 4,455 pounds of emissions are associated with operating an EV, or about 2.5 times fewer emissions.

In some states, the differences are even more stark because of differences in how electricity is generated. In Vermont, for example, 89 percent of the electricity comes from either nuclear- or hydro-powered generating stations which don't produce GHGs. So, for a state like Vermont, the annual emissions for an EV are almost zero, whereas the emissions from a gasoline-powered car matches the national average value of 11,435 pounds.

In contrast, for a state like West Virginia, for which 96 percent of the state's electricity is produced by coal-powered generating stations, the annual emissions associated with an EV is 9,451 pounds. This is more than twice the U.S. average for EVs, but it is still about 17 percent less than the emissions from a gasoline-powered car. So, even in West Virginia, driving an EV instead of a gasoline-powered car, would reduce GHGs and other pollutants emitted to the environment by almost 20 percent.

Nationwide, coal is used to generate about 30 percent of electricity, but that figure is falling as more renewable generating resources like wind and solar continue to scale up and more natural gasoline-powered generating stations replace coal-powered stations. So driving an EV today is already better for the environment than driving a gasoline-powered car (not to mention cheaper too), and the environmental benefits will continue to improve as more electricity is generated from renewable and pollution-free resources such wind, solar, hydro and nuclear. And, EV drivers can be carbon free, despite the carbon footprint of the grid electricity available to them, by taking advantage of rooftop solar and community solar options, with or without energy storage, or enrolling in green power plans.

Electric vehicles: The wave of the future

The transportation sector accounts for 29 percent of primary energy use in the U.S., of which 80 percent is associated with vehicles powered predominantly by gasoline or diesel. As we've shown, these gasoline- and diesel-powered vehicles are major sources of pollution and GHGs. EVs are perhaps the most promising technology for reducing emissions and transforming the transportation sector away from emitting harmful pollutants. Just as the innovations that fueled the transformative rise of the Ford Model T and away from the horse-drawn carriages, recent developments in battery technologies and manufacturing, along with state and federal incentives, are helping transform EVs from being a niche vehicle, used by relatively few people, to being the "rational, economic choice" for many.

EVs are more efficient and cheaper to maintain and operate than gasoline-powered vehicles, and they are also very powerful while high performing. Virtually every major manufacturer is planning for a future where EVs are the norm and not the exception. Perhaps the time is right for you, too, to consider joining the wave of the future

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