ELECTRIC CAR CHEAT SHEET

INTRODUCTION

Electric cars are quite practical. They cost about half as much to run as a gasoline car. They need very little maintenance. Even brakes last longer.

All electric cars are peppy, because electric motors produce the most torque at slow speed. Many electric cars accelerate faster than gasoline cars. Even when you're accelerating quickly, electric cars remain quiet.

The variety of electric cars is increasing. There are 7-seater electric cars, electric cars that can tow trailers, AWD electric cars designed to be taken off road, and electric pickup trucks with specialized features like outlets to operate power equipment.

For a given size, electric cars have more room and storage than similarly-sized gasoline cars, because the power train, including the gasoline engine, transmission, and gas tank, take up more room than the electric motors and batteries, which tend to be mounted low. Electric cars are heavier than gas cars, because the batteries weigh a lot.

Electric cars are amazingly efficient. Each 100 miles of stated range is equivalent to about a gallon of gasoline. So, if a car's range is 250 miles, that's the energy storage equivalent of only 2.5 gallons of gasoline. The cost per mile is about half of a gasoline car, i.e. it costs about $20 for the electricity to fill up from near empty.

LOCAL USE

Any electric car makes an ideal second car to be used within the range of the car. Electric cars can be used intermittently or frequently. Their mileage is not hurt by short trips. If you can charge at home, it'll be filled up when you start the day. You generally won't have to recharge during the day. So, if you have a car with a 250 mile range, you can plan to use the car within about 80 miles of your home without worrying about charging.

TRIP USE

It's not practical to take long trips in electric cars that don't support Fast DC charging. Charging times taking many hours are just too long.

If your car does support Fast DC charging, you can take your car on trips, as long as you know where the Fast DC chargers are along the way.

Because of their Supercharger network, Teslas are by far the most practical electric car to take on trips. (See the Fast DC and Tesla sections below.) Generic Fast DC chargers are rare enough that it can be a problem finding one for other cars. This situation will improve in upcoming years. One of the improvements is that more Tesla Superchargers will support non-Teslas.

HYBRID CARS

If just having an around-town electric car is not practical for you, and if electric cars that support DC charging are too expensive, a hybrid electric vehicle can be a good alternative, especially a plug-in hybrid vehicle.

Regular Hybrids

Hybrid cars charge a traction battery, when you decelerate, and save that energy to power an electric motor to provide acceleration. Hybrids also use battery power to run the car's accessories. The gasoline engine doesn't need to run when you're stopped. The car will start the gasoline engine when it needs to. It all happens automatically without intervention. Hybrids are often ~50% more efficient than gasoline-only cars.

Plug-in Hybrids

Plug-in hybrids are halfway between regular hybrids and full-electric cars. They plug into charge, just like an electric car. However, the battery is much smaller – usually enough for about 20-30 miles. When the battery runs low, the car starts the gasoline engine. Note that the engine may also need to start for things like defrosting the windshield. It all happens automatically without intervention.

When you're taking trips around town, the engine may not need to start. Plug-in hybrids often have a control to delay starting the engine, so that you can get to your destination only on battery power. Plug-in hybrids can be charged at a public Level 2 charger (See below.), but they work best, if you can charge at home or work.

When the traction battery runs low, a plug-in hybrid reverts to operating as a normal hybrid. Total range for the car is the distance that can be driven on the traction battery, plus the distance that can be driven

on gasoline. Plug-in hybrids can be twice as efficient as gasoline-only cars. Ford, Toyota, and others have plug-in hybrids.

FULL-ELECTRIC CARS

There is some difference in the efficiency of electric car models, but it's not really significant. You should buy the longest range electric car that you can afford. Longer range means more flexibility in how you can use the car.

During the summer, the effective range of an electric car is about 70-80% of the stated range. That's because in day-to-day use, you may only want to charge to 80-90% capacity in order to extend battery life. (Charging to 100% for long trips is fine.) Also, you'll want to aim to leave 10-20% in the battery, when you arrive at your destination, so that you don't risk running out.

During the winter, range will be reduced, because of the energy required to heat the cabin. (Electric cars don't create much waste heat.) The colder it gets, the bigger the effect on range. (Air conditioning doesn't have much of an effect on battery life -- only heating.) So, during the winter, the effective range of an electric car can sometimes be only 60% of the stated range. (More and more electric cars have heat pump, instead of only resistance heating. Heat pumps greatly improve winter range.)

Also, you don't have to worry about running out of fuel in a traffic jam any more than a gasoline car. Electric cars last about as long as gasoline cars, when in stop-and-go traffic in the winter. A fully charged electric car can heat the cabin for a couple of days. Of course, if you are nearly empty in either kind of car, it can be a problem.

Typically, batteries don't lose charge when they are cold, but they may recharge slowly until the battery warms. The types of charging are outlined below.

LEVEL 1 CHARGERS

Most cars come with a Level 1 charger. Level 1 chargers are those with the normal plug that supports 115V/12A. They charge very slowly, adding only about 4-5 miles each hour.

If you have access to a normal plug where you park at home, you'll be able to add about 50 miles overnight. If on average you drive less than 50 miles a day, Level 1 may be all you need for local use. (You might need to be careful on the coldest days of winter, when there might not be enough energy available in a Level 1 charger to warm the battery for charging.)

If you have access to an outlet that supports 115V/16A, you can charge just a little faster. You'll need both a charger and an outlet with a NEMA 5-20 plug. A NEMA 5-20 plug looks like a normal NEMA 5-15 plug, except that one of the prongs is horizontal rather than vertical. A charger with a NEMA 5-20 plug will add 5-6 miles each hour. It's not much of an increase from a normal NEMA 5-15, but it makes a difference over time. If an outlet where you park is connected to a 20A circuit breaker, but doesn't have a NEMA 5-20, you can ask an electrician to install one.

You can always supplement Level 1 charging at home, with Level 2 or Fast DC charging while you're out. However, if you average more than 50 miles per day, it's most convenient to have a Level 2 charger at home.

LEVEL 2 CHARGERS

Level 2 chargers are 230V, between 20 and 50 amps. (Some cars may not able to accept a charge at the higher end of the amperage range. A bigger charger is fine -- the car will just max out at its limit.) The amount of range gain is roughly a few miles less than the number of amps. each hour. For example, a 40A charger will add about 35 miles each hour. Charging from nearly empty to full typically takes about 7 hours. Level 2 chargers connect to your car with the same round connector as Level 1.

Most of the chargers that you'll find in parking lots, etc. are Level 2 chargers. They are called Destination Chargers, because they don't charge fast enough to use mid-trip. They are good when you're going to be someplace for hours -- like work.

A few public chargers are open, but most are part of a network, like ChargePoint. To use them, you just wave a card or your phone in front of the charger and plug in your car. Your credit card will be charged. Some places charge by time, others by kilowatt-hours. Rates vary, but it'll cost less than the equivalent about of gasoline.

If you want to have a Level 2 charger at home, you'll need a 230V outlet where you park. Plus, you'll need the Level 2 charger itself. They look like the Level 1 charger that comes with the car, but connects to a 230V outlet. Level 2 chargers work on all electric cars. (With Teslas, you'll need to use the adapter that came with the car.)

Typically, the 230V outlet where you park at home will be a NEMA 14-50 (same as an electric range) or a NEMA 14-30 (same as an electric dryer). (There are other styles of plugs, but they are less common.) Level 2 chargers come in models from 20 to 50 amps. Some chargers even have adjustable current draw.

Except for off-peak rates (See below.), it's better just to get a 230v outlet installed in your garage rather than a built-in charger. An outlet will allow you to change chargers in the future without calling an electrician. If your home electrical panel capacity is tight, a 20-30A charger is fine – 30A is the optimal size. Your car will still charge overnight, while drawing less current to compete with other electrical uses at home. A 40-50A charger is only necessary if charge time is very important.

If you have a NEMA 14-30 plug, you can use a 15-30A charger. If you have a NEMA 14-50 plug, you can use a 15-50A. Make sure that the plug on the charger matches the outlet in your garage, or wherever you park. Running the wiring for a 230V outlet will require hundreds to thousands of dollars, depending on if your panel or electric service needs to be upgraded. The Level 2 charger itself costs several hundred dollars. If you have a NEMA 14-50 outlet and a NEMA 14-30 plug on your charger or visa versa, you can get an inexpensive adapter to convert one to another. Of course, if you have a NEMA 14-30 outlet, you must not connect a charger that draws more than 30A.

Your electric utility may offer incentives for installing a Level 2 charger in your home. Also, your electric utility may offer a recurring rebate, if you allow them to pause your charging during periods of peak electric demand. Often, this requires a branded charger, like a ChargePoint.

Finally, if you have to expand your panel or electric service from the street, consider what you need for the future. Since changing electric service or panel is so expensive, you don't want to do it more than once. The following is very rough, but it can serve as a guideline: you will need 200amp service for one Level 2 plugs plus a mini-spilt for HVAC; you will need 320/400amp service for two Level 2 plugs plus a whole-house heat-pump for HVAC.

Shared Charging at Home

Network chargers are ideal in shared parking situations, like apartment or condo complexes. https://www.chargepoint.com/solutions/apartments is an example. In those circumstances, the charging fees can pay for the electricity, plus the installation of the charger.

Off-peak Charging

If you live in a state that doesn't have off-peak electric rates for your home, network chargers at home may allow you to take advantage of cheaper electricity rates overnight. Network chargers, like Chargepoint, can coordinate with your power company for lower billing of off-peak charging. ChargePoint chargers have slightly different electrical requirements that will likely require an electrician to install.

FAST DC CHARGERS

Level 3 chargers are more commonly known as Fast DC chargers. They are the closest analog to a gas station for electric cars. If you have access to a Fast DC charger local to home, you can actually get along without home charging.

Fast DC chargers supply DC rather than AC current at hundreds of volts and hundreds of amps, resulting in hundreds of miles added each hour. Typically, a car will charge from nearly empty to nearly in half an hour or so. It's hard to be exact, because it varies depending on charger, temperature, level of charge, etc. You might want not to charge the last 10% at a fast charger, because topping off the battery can take a long time.

Not all cars can use Fast DC chargers. The Fast DC charger connector looks like the round Level 1/2 car connector with the addition of 2 extra prongs on the bottom. If you're buying a car that offers fast charging as an option, definitely get it. All Teslas support Fast DC charging and Tesla Superchargers are Fast DC chargers. In the future Tesla will be supporting other types of cars at its Superchargers.

Fast DC charging is a requirement for long trips. Tesla Superchargers are common. However, fast DC chargers for other cars can be difficult to find, but slowly more are being added. For example, the Massachusetts DOE has a program to add more, and one will be installed in Acton, Massachusetts at Veterans Field at the corner of Main Street and Great Road.

Often, Fast DC chargers are located around shops or restaurants. So, you can get a sandwich or cup of coffee while you're charging. Even if you are only going to be in the rest room for 5 minutes, it can be worth it to plug in to get an extra 50 miles of range.

TESLAS

Teslas are the most practical of electric cars. They are roomy, the most efficient, and have extensive software features. You can order one on-line, and it will be shipped to a pick-up location near you. However, lead times are some months certain models.

There are a few notable differences with Teslas. In North America, Teslas have their own car connector style for charging. Tesla has a $50 adapter from a Level 1 or Level 2 charger to a Tesla connector to allow use of ChargePoint and other network chargers. One of these adapters also comes with the car.

Tesla Superchargers are a type of Fast DC charger. The Supercharger network is extensive. There is a Supercharger at least every 100 miles along most of the US Interstate highway system -- even in Wyoming. There are many more Superchargers near urban areas. The car automatically plans long trips that include Supercharger stops, and the car knows how many chargers are unoccupied at a particular site. The Supercharger network makes Teslas by far the most practical electric car for long trips.

You don't need to wave a card or anything to use a Supercharger. The Supercharger will recognize the car, and charge the credit card associated with the car.

Teslas don't need to use a generic Fast DC charger very often, because of the extensive Supercharger network. However, if you want to be able to use them, you'll need a $250 adapter. It's probably only worth it, if you have a generic Fast DC charger near to where you live or work.