Sonoma Clean Power

ELECTRIC VEHICLE BUYER'S GUIDE

A Consumer's Guidebook to Electric Vehicles

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INTRODUCTION

Buying a new car is one of the most significant purchases that households make. As consumers start to narrow their choices for the right car, electric vehicles are increasingly making the list. Today, more than 15 auto makers offer more than 50 different electric vehicle models. This document is designed to help prospective electric vehicle buyers sort through these options by introducing the key aspects of buying an electric vehicle, while addressing some of the common concerns with electric vehicles. This guide is organized as follows:

1. **Electric Vehicle Experience**
   Explore key features of driving an electric vehicle, most notably what to expect from their performance and their range. There are numerous models with a variety of features that meet the day-to-day needs of a typical driver. Learn about electric vehicle types and options and which vehicle has the potential to work best for your lifestyle.

2. **Buying an Electric Vehicle**
   This section helps prospective buyers run through a basic checklist of things to consider before buying or leasing an electric vehicle, including upfront costs, maintenance costs, and incentive opportunities.

3. **Charging an Electric Vehicle**
   Electric vehicles change the way drivers fuel their cars. This section introduces charging options, including charging at home, installing charging infrastructure at home (where appropriate), making sense of electricity rates, and charging away from home.

4. **Sustainability:**
   Electric vehicles offer substantial environmental benefits–including zero tailpipe emissions (when using electricity) for cleaner air, reduced greenhouse gas emissions, potential integration with renewable energy, and energy independence.

1 THE ELECTRIC VEHICLE EXPERIENCE

Electric vehicles can easily be integrated into your existing lifestyle, even though they represent a change from using a conventional vehicle. One of the attractive aspects of owning an electric vehicle is the simplicity of charging your vehicle at home. While consumer options for driving and charging an electric vehicle have improved significantly over the last five years, with a growing diversity of vehicle offerings from auto makers and more charging infrastructure deployed, there are still some limitations that some consumers might face. The following subsections introduce how you can charge an electric vehicle and the electric vehicle offerings available to consumers today.

VEHICLE TECHNOLOGY AND OPTIONS

The diversity of vehicle offerings available today reflects the automotive industry's response to the broad range of consumer interests.

It is important to note, however, that electric vehicle models are still limited. For instance, electric vehicles most commonly fall into two configurations: five-passenger sedans or hatchback vehicles.

Electric vehicles are typically characterized as Battery Electric Vehicles also known as BEVs (all electric, no gasoline engine) or Plug-In Hybrid Electric Vehicles also known as PHEVs (an electric vehicle with a gasoline engine backup).

Battery electric vehicles run solely on electricity; the high-capacity rechargeable battery packs propel the wheels using one or more electric motors. The vehicles are sometimes referred to as pure EVs or all electric vehicles. Regardless of the naming convention, these vehicles only use a battery and tend to have large batteries that require longer charging times. The vehicles typically have a driving range of 60–100 miles, with some models offering a range as high as 240 miles.

Plug-in hybrid electric vehicles have both a high-capacity battery that powers an electric motor and an internal combustion engine fueled by gasoline. The vehicle is different from hybrids that consumers are used to: The vehicle can plug in to an external source of power (e.g., an outlet). Plug-in hybrids typically have a driving range that is comparable to a conventional vehicle (in the hundreds of miles). That range is a combination of miles traveled using electricity and miles traveled using gasoline.

The range of miles traveled using electricity in plug-in hybrids ranges from 10 miles to as much as 72 miles. When the battery pack is fully discharged, the gasoline engine powers the wheels.

VEHICLE MANUFACTURER	PLUG-IN HYBRIDS	BATTERY EVS
Audi	✓	✗
BMW	✓	✓
Cadillac	✓	✗
Chevrolet	✓	✗
Chrysler	✓	✗
Fiat	✗	✓
Ford	✓	✓
Honda	✓	✓
Hyundai	✓	✗
Kia	✓	✓
Mercedes-Benz	✓	✗
Mitsubishi	✓	✗
Nissan	✗	✓
Porsche	✓	✗
Smart	✗	✓
Tesla	✗	✓
Volkswagen	✗	✓
Volvo	✓	✗

The table on page 3 highlights the vehicle manufacturers that offer plug-in hybrids and battery electric vehicles for sale as of July 2018. The vehicle offerings change rapidly, with automobile makers announcing plans frequently. Interested drivers are encouraged to check out FuelEconomy.gov and the Alternative Fuels Data Center for the newest electric vehicle offerings.

CHARGING YOUR VEHICLE

When consumers think about electric vehicles, they often think about how they are going to charge the vehicle. Charging at home is typically the most convenient and cheapest way for drivers to charge their electric vehicles–in fact, about 80% of electric vehicle charging today is done at homes. Residents can typically access attractive electricity rates from PG&E and Sonoma Clean Power, thereby reducing the cost of charging an electric vehicle.

Charging your electric vehicle at home eliminates the inconvenience of having to re-fuel an internal combustion engine vehicle at a gas station—you simply fuel your vehicle at your home, at your convenience. While most of charging may be happening at homes with access to a garage—this is an easy situation for electric vehicle charging; it is important to note that electric vehicle owners live in a variety of situations, renters and owners living in apartments and homes. For those who do not have access to a home charging station, public and workplace chargers play an important role.

Apart from where to charge an electric vehicle, some consumers are worried about special plugs or required equipment. Electric vehicles sold in the US are required to use standardized charging equipment (referred to as the SAE J1772 standard). This basically normalizes the electrical connections between electric vehicles and the grid, taking the guesswork out of charging: consumers can simply plug-in their vehicle and walk away.

Most vehicles today come with equipment that can be plugged into a standard 120 volt (V) outlet to charge the vehicle. When drivers plug into a standard outlet, they should be sure that it is on a dedicated circuit (with a capacity of 15–20 amps). For faster charging, drivers can think about installing level 2 charging at home.

The amount of time that it takes to charge an electric vehicle after it has been fully depleted depends on two factors:

1. the size of the battery in your car (as measured by kWh capacity), and
2. the rate at which you can deliver electricity to the battery.

Many electric vehicles available today can be fully charged overnight (4–8 hours) using the standard 120 V outlet found in all homes. The bigger the battery on the vehicle, however, the more time you will need to charge, unless you go to a higher level of charging. The next section introduces the electric vehicles available today and more specifics about how long they take to charge.

When drivers are not charging at home, they can increasingly find charging opportunities away from home, perhaps via workplace charging or at other locations such as parking lots at retail centers. Consumers should check directly with their employer regarding electric vehicle charging opportunities, which is frequently handled via human resources and/or facilities management staff. Finding other away-from-home charging opportunities is made easy by on-board applications, smart phones apps for finding charging locations, and other technology that drivers can access easily.

Charging away from home can introduce a new experience: paying a fee. Some public charging stations can require a fee for drivers to use. Fee structures vary considerably across the industry—consumers are encouraged to familiarize themselves with various cost structures, and learn how to compare the cost of charging at home against charging away-from-home. Some introductory considerations are discussed later in this document.

On average, Sonoma County residents have some of the fastest commute times in the Bay Area; but the average Sonoma County commuter still spends 25 minutes on the journey from home to work. Electric vehicles have the potential to reduce the amount of time drivers spend in traffic. Some electric vehicles are eligible for Clean Air Vehicle Decals, which allow drivers to access HOV lanes, like those in place along stretches of the US Highway 101.

Charging your electric vehicle at home eliminates the inconvenience of having to re-fuel an internal combustion engine vehicle at a gas station

ELECTRIC VEHICLES HAVE THE POTENTIAL TO REDUCE THE AMOUNT OF TIME DRIVERS SPEND IN TRAFFIC

PERFORMANCE

Consumers generally have positive reports regarding electric vehicle handling and acceleration. Electric motors respond instantaneously to the driver's foot (providing what is called instantaneous torque at low speeds), which typically leads to good acceleration. Electric vehicles are able to get a combination of excellent fuel efficiency and strong performance, responding to some consumer reservations from past experiences with slower hybrid performance.

ELECTRIC VEHICLES AND RANGE

The average one-way commute distance in Sonoma County is about 17 miles. If a vehicle is only being used for commuting, then the majority of the electric vehicle models currently available will satisfy the average commuter's driving habits. But, most drivers take more trips than just to-and-from work.

Consumers should consider their day-to-day driving activity and other driving habits before buying an electric vehicle. For instance, consider that the average Californian drives about 12,000–14,000 miles per year. The type of miles that we drive as individuals vary considerably though. And the type of electric vehicle that works for each individual will depend on the mix of driving, such as the daily commute, trips to the store, recreational outings, and long distance trips (e.g., trips longer than 100 miles). Drivers should consider their driving habits and needs, and different ranges available for electric vehicles.

Electricity is a ubiquitous fuel that can be accessed in most locations to which drivers travel–at home, at work, and on the go during trips around Sonoma and Mendocino counties and the rest of the State. The public charging infrastructure network that electric vehicles require to tap into the grid is in its nascent stages but growing rapidly.

When traveling locally or throughout other parts of the State, drivers of battery electric vehicles will need to understand vehicle range limitations and ensure that they have either sufficient range to complete the trip or that there is (preferably) fast charging equipment along the route. While the public charging infrastructure network required to support electric vehicle trips is in its nascent stages, there are many tools available to electric vehicle planning trips, with clear indication of charging infrastructure, network operators, fee structures, and other relevant information.

2 BUYING AN ELECTRIC VEHICLE

The number one issue for most consumers purchasing a vehicle is price. Even with federal and state purchase incentives, electric vehicles may be priced higher than conventional vehicles or hybrid vehicles. However, electric vehicles help drivers save money by using a cheaper fuel, with a more predictable price. The prospective buyer of an electric vehicle should consider the following:

- Think about driving habits. Drivers should consider how far and how frequently they drive, and think about whether they might benefit from access to the HOV lane.
- Explore different vehicle types. Prospective buyers should do their research regarding plug-in hybrids and battery electric vehicles, understanding vehicle range, the charging requirements, and understand the potential benefits and trade-offs of various electric vehicles.
- Understand purchasing options. The electric vehicle market today is about 50/50 when it comes to buying vs leasing the vehicles. Many auto makers have been offering attractive lease packages for electric vehicles. While leasing vehicles is more popular today than it has been for more than 10 years, the broader car market is about 75/25 when it comes to buying vs leasing.
- Identify incentives. Prospective buyers should ensure that they know about federal and state purchase incentives for electric vehicles, as well as other incentives ranging from utility rates to insurance discounts. Prospective buyers are encouraged to visit California's DriveClean website to find the most updated information about incentives.

While the market is expanding and improving rapidly, many buyers might not find an electric vehicle solution that suits them. For prospective buyers of electric vehicles, this guidebook encourages a look at total cost of ownership – which includes consideration of vehicle pricing, interest on financing (where appropriate), fuel pricing, insurance, sales tax, average maintenance costs, and depreciation.

UPFRONT COSTS

The upfront cost of purchasing an electric vehicle varies based on multiple factors such as manufacturer incentives, dealer incentives, and consumer financing.

PURCHASING VS LEASING

Many manufacturers are currently offering attractive options for both purchasing and leasing electric vehicles. Prospective buyers are encouraged to research current deals offered by the manufacturers of the vehicles in which they are currently most interested. These deals are typically advertised online. Ultimately, the decision to purchase or lease a vehicle comes down to consumer preference and consumer finances.

INCENTIVE PROGRAMS

There are many incentives available for electric vehicles, including:

- Federal income tax credit: The federal tax credit is valued at up to $7,500 and is linked to the capacity of the battery in the vehicle. Battery electric vehicles, for instance, generally qualify for the full $7,500 incentive whereas plug-in hybrids generally qualify for less. Check with your tax professional about details and eligibility.
- California rebate program: The state's rebate program provides $1,500 and $2,500 towards the purchase or lease of a new PEV, depending on the vehicle type. High income earners (single filers making more than $150,000 and joint filers making more than $300,000) are ineligible to for the program. Furthermore, the rebate is increased by $2,000 for households with income less than 300% of the federal poverty level (which is linked to the household size, see table below).

HOUSEHOLD SIZE	300% FEDERAL POVERTY LIMIT
1	$36,420
2	$49,380
3	$62,340
4	$75,300
5	$88,260
6	$101,220
7	$114,180
8	$127,140

- Go Green! Program: The Northern Sonoma County Air Pollution Control District is offering incentives up to $1,000 for a new electric vehicle and $1,000 for low-income residents. This program is only open to residents of the district.

These incentives are in addition to the vehicle purchasing process, and it is important to note that in order to receive these incentives some paperwork may be needed from the buyer.

MAINTENANCE REQUIREMENTS

Electric vehicle drivers can generally save money via lower maintenance costs. Electric vehicles have fewer moving parts, and therefore typically have lower maintenance costs. There is also less wear-and-tear on brakes due to regenerative braking.

FOR BATTERY ELECTRIC VEHICLES

Battery electric vehicles require the following routine maintenance procedures:

- Tire rotation. This typically occurs every 7,500 miles.

- Brake check. Due to regenerative braking, most drivers will likely require a single visit to check the brakes on a battery electric vehicle in the first 100,000 miles driven (compared to 2–4 visits for a conventional internal combustion engine).
- Battery coolant. Most battery systems use a thermal management system. In some cases, this might be checked, but this is rare.

Note that the following maintenance procedures typical for internal combustion engines are not required for battery electric vehicles:

- Oil change
- Automatic transmission fluid
- Spark plugs and wires
- Muffler
- Timing belts

Estimates from Oak Ridge National Laboratory and the California Energy Commission indicate that the maintenance on conventional vehicles is about $700–800 annually, while battery electric vehicles are about $300–360 annually[1].

[1] Assumes a cost of 5.8 and 2.6 ¢/mile for conventional vehicles and battery electric vehicles, respectively.

FOR PLUG-IN HYBRID ELECTRIC VEHICLES

Plug-in hybrid electric vehicles will have similar maintenance requirements as conventional vehicles, because they have both a battery and an internal combustion engine. These maintenance checks include:

- Tire rotation. This typically occurs every 7,500 miles.
- Brake check. Due to regenerative braking, most drivers will likely require a single visit to check the brakes on a plug-in hybrid electric vehicle in the first 100,000 miles driven (compared to 2–4 visits for a conventional internal combustion engine).
- Battery coolant. Most battery systems use a thermal management system. In some cases, this might be checked, but this is rare.

Routine maintenance procedures, such as oil changes, transmission fluid replacement, replacement of spark plugs and wires, muffler checks, and timing belt replacements are all required for plug-in hybrid electric vehicles.

However, the frequency and likelihood of needing these procedures done is linked to the number of miles the vehicle travels using the battery versus the engine. In most cases, drivers should anticipate fewer trips to the auto mechanic to address these issues than when driving a conventional vehicle.

Estimates from Oak Ridge National Laboratory and the California Energy Commission indicate that the maintenance on conventional vehicles is about $700–800 annually, while plug-in hybrid electric vehicles are about $500–600 annually.[2]

BATTERY LIFE AND REPLACEMENT

The battery in electric vehicles will slowly degrade over time. Most analysts, for instance, believe that today's lithium-ion batteries will suffice for automotive applications for at least 100,000 miles, with a potential loss of up to 20% of range over that period. The rate of degradation, however, is linked to factors such as frequency of charging, terrain, and climate.

Performance of electric vehicles may be impacted by weather but due to the mild climate of our community it is unlikely that the weather in Sonoma and Mendocino counties will have a significant negative impact on electric vehicle operating performance over the vehicle lifetime. The average low and high temperatures in Sonoma County are 38°F (for January and December) and 90°F (in July). The daily average temperature over the span of a year is around 60°F.

In extremely cold or hot climates, electric vehicle performance is negatively impacted largely due to impacts on battery performance. For instance, the Idaho National Laboratory (INL) reports that variations in weather can affect the range of electric vehicles by more than 25%. They looked at the performance of Nissan LEAFs and Chevrolet Volts driven across the United States. INL found that Nissan LEAFs driven in Chicago in the winter had 26% lower ranges (60 miles compared to 81) than those driven in Seattle in the fall. Similarly, they found that plug-in hybrid electric Chevrolet Volts driven in Chicago in the winter had 29% lower ranges (30 miles compared to 42) than those driven in Chicago in the spring.

When the vehicle system is cold it becomes less efficient from increases in internal friction as an engine or battery gets colder.

RANGE EXTENDER VEHICLES & MAINTENANCE

We use the terms battery electric vehicles and plug-in hybrid electric vehicle throughout this document. Consumers may come across the term "range extender" or REx. This is a kind of hybridized powertrain. Range extenders typically have an engine powered by gasoline that is used to drive an electric generator, which supplies the vehicle's motor with electricity. In other words, the gasoline powered engine never drives the car, rather it delivers electricity to the battery and motor which drive the car. RExs are likely to have maintenance costs more like a battery electric vehicle than a plug-in hybrid electric vehicle.

[2] Assumes a cost of 5.8 and 4.3 ¢/mile for conventional vehicles and plug-in hybrid electric vehicles, respectively.

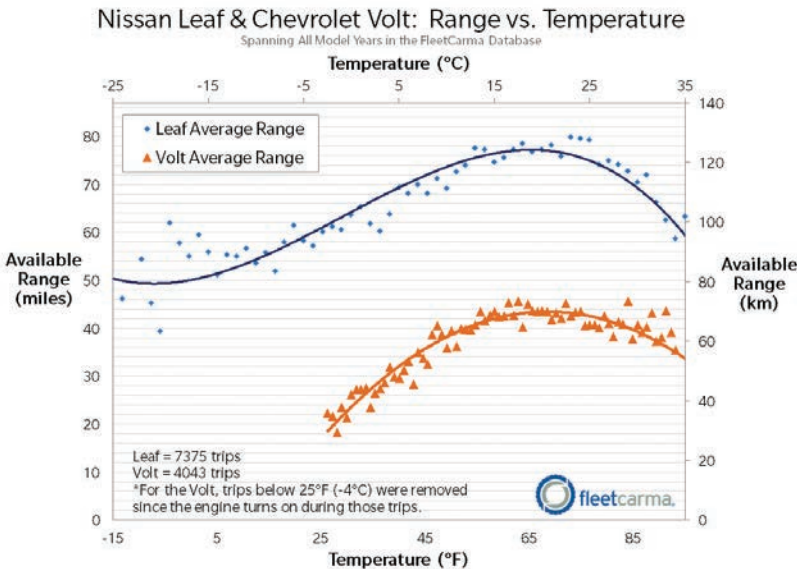
ELECTRIC VEHICLES HAVE LOWER MAITENANCE COSTS

Range is impacted in cold weather because of auxiliary power consumption, such as cabin heaters and fans and component heaters (i.e., battery heaters). Conventional vehicles use waste heat to help warm the cabin, but because all-electric vehicles do not generate sufficient waste heat, an electric heater must be used. Cabin heating therefore reduces the battery charge and potential range of an electric vehicle.

Based on findings of the AAA Automotive Research Center on a limited number of sample vehicles, electric vehicle battery range was reduced by nearly 60% at 20°F, largely due to the vehicles auxiliary loads.[3] FleetCarma published data on more than 7,000 Nissan LEAF trips, noting just a 21% drop from the ideal range of 76 miles at temperatures of 25°F.

Range is also impacted in hot weather because of auxiliary power consumption as drivers increase energy demand to cool the passenger cabin using A/C units.

Based on findings of the aforementioned study from AAA Automotive Research Center, electric vehicle battery range on a limited number of sample vehicles was reduced by about 35% at 95°F, also largely



due to the vehicles auxiliary loads.[4] FleetCarma has published other data indicating that the impact on vehicle range in hot temperatures is not as significant. For more than 7,000 Nissan LEAF trips that they tracked, the average range was about 56 miles, just a 26% drop from the ideal range of 76 miles.

WARRANTY

Electric vehicles have warranties similar to conventional vehicles, and include the battery. Today, most electric vehicle models offer a warranty of 8 years and 100,000 miles. These warranties typically allow for some limited loss of battery capacity during the warranty. Note, however, that plug-in hybrid electric vehicles in California must offer a 10-year, 150,000-mile warranty on the battery to qualify under the

[3] AAA Automotive Research Center, 2014, http://newsroom.aaa.com/2014/03/extreme-temperatures-affect-electric-vehicle-driving-range-aaa-says/.

[4] Ibid.

state's Zero Emission Vehicle Program and to be eligible for the California Clean Vehicle Rebate Project incentives.

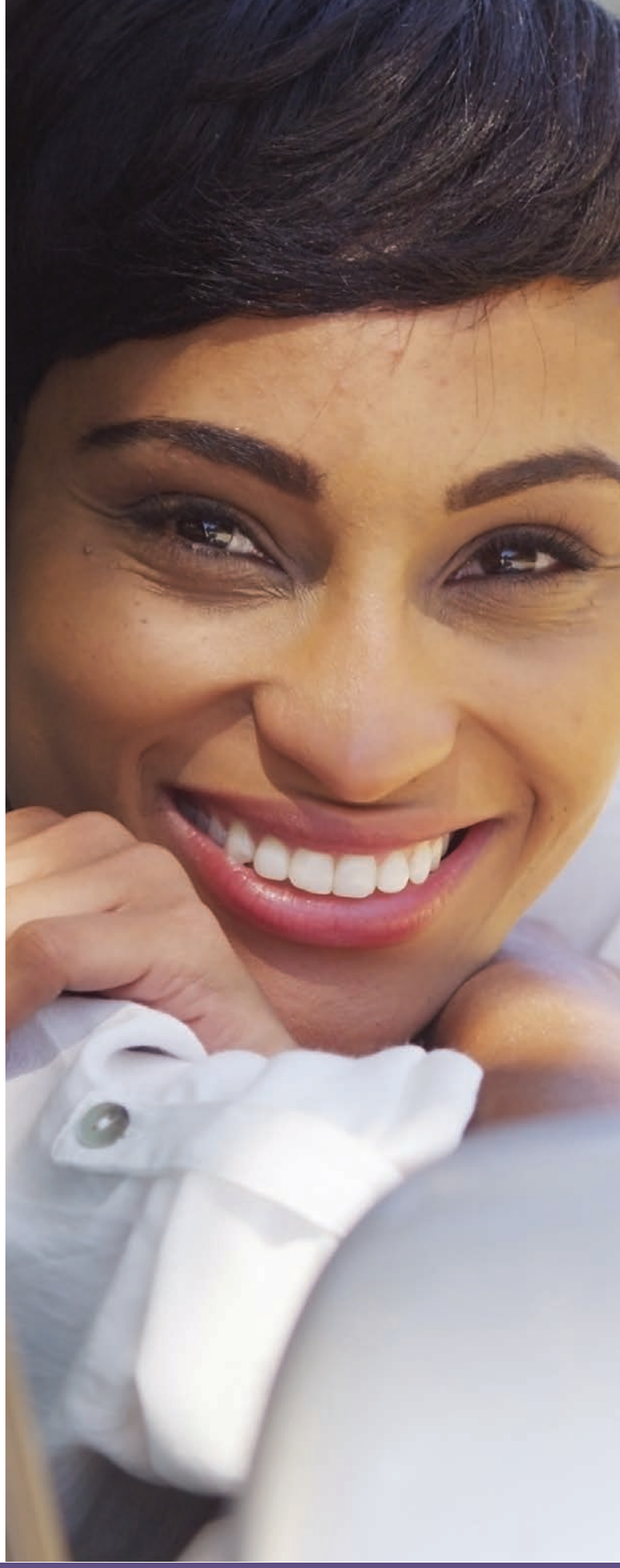
The replacement of battery packs should be done in accordance with recommendations from the automobile manufacturer. If the battery pack is replaced while the vehicle is still under warranty, then the cost should be borne by the auto manufacturer. There is very limited data available regarding firm pricing for the replacement of battery packs in electric vehicles, in large part because of the nascent market for electric vehicles.

- Nissan provides a replacement for the LEAF's 24 kWh pack at a cost of $6,499, with a $1,000 reduction when returning the old battery pack. Nissan estimates that the installation kit will cost an additional $225 and about three hours to install.
- Chevrolet does not provide a firm cost for the replacement of the battery pack on a Chevrolet Volt. However, as of August 2016, Chevrolet has indicated they have not replaced a single battery pack on the Volt due to general capacity degradation.

OTHER INCENTIVES

Apart from purchase incentives, consumers should be aware that there are other incentives available.

HOV lane access: Electric vehicles qualify for Clean Air Vehicle Stickers, which provide an exemption for single occupancy vehicles to travel in high occupancy vehicle (HOV) lanes. Battery electric vehicles and plug-in hybrids qualify for red decals. Decals are set to expire on Jan 1, 2022. Note that the US Highway 101 is the only road in Sonoma County which has HOV lanes.



3 | CHARGING

Electric vehicles can be charged at different levels. The most common levels used today are Level 1, Level 2, and DC fast charging.

Level 1: These chargers use standard outlets at 120 volts, with a three-prong electrical outlet at 15–20 Amps. Level 1 charging requires no new electrical service for a building operating on an existing circuit. Level 1 is best suited for long dwell time such as overnight charging, since a longer time is required to recharge the vehicle. The typical Level 1 charging enables about 4.5 miles of range per hour.

Level 2: These chargers are used specifically for electric vehicle charging and are rated at less than or equal to 240 V and less than or equal to 80 A. Depending on the charge controller on-board the vehicle, 3.3 kW or 6.6 kW, the vehicle can accept about 10–20 miles of range per hour. With a 40 A, 240 V service power can be delivered at about 7.5 kW which shortens charging time considerably for electric vehicles.

Level 2 charging equipment requires additional grounding, personal protection system features, a no-load make/break interlock connection, and a safety breakaway for the cable and connector. Consult an electrician. If 240 V service is not already installed at the charging site, a new service drop will be required from the utility.

DC Fast Charging: These chargers provide power much faster than their AC counterparts (Level 1 and Level 2 charging, described above). They are less common than Level 2 chargers, and are not suitable for residential applications. DC fast chargers are more expensive to build and operate due to the equipment and electrical upgrades necessary to operate them. Not all electric vehicle models are currently equipped with compatible hardware

MOST ELECTRIC VEHICLES COME WITH TOOLS THAT CAN HELP DRIVERS MINIMIZE THEIR ELECTRICITY COSTS

for DC fast charging. Some electric vehicle models may require a package upgrade to enable DC fast charging.

The table below helps prospective buyers understand and compare how much range the battery gains with each hour of charging at different charging levels (Level 1, Level 2, and DC fast charging).

CHARGING LEVEL	POWER DELIVERED	MILES/HOUR OF CHARGE
Level 1	1.4 kW	~5 miles
Level 2	7.5 kW	~25 miles
DC fast	50–120 kW	140–340 miles

CHARGING AT HOME

Electric vehicle owners should consider the level of charging that is appropriate for them. Level 1 and Level 2 charging at home is reviewed in more detail below.

LEVEL 1 CHARGING

Level 1 charging may meet most of a driver's needs. Prospective buyers should think about their driving habits, home layout and parking situation, utility rates, and other relevant factors when deciding between Level 1 and Level 2 charging.

Most plug-in hybrid drivers, for instance, use existing Level 1 charging (i.e., an outlet), and many battery electric vehicle drivers do as well. Most vehicles come with a cord set for Level 1 charging, which uses the standard 120V, 15- or 20-amp, grounded wall outlet (the same outlet used to charge a cell phone). An electrician can install a grounded outlet close to where the electric vehicle would park at a minimal cost, if necessary.

The slow charge of a Level 1 system may be impractical for vehicles with larger batteries, so Level 2 charging may help.

LEVEL 2 CHARGING

Electric vehicle owners that need faster charging, due to a larger battery and driving habits, may opt for Level 2 charging at home. If an electric vehicle owner opts to install Level 2 charging at home, it is strongly recommended that they follow these steps:

- **Consult an electrician.** Consumers should have their home assessed by an electrician to determine whether the electrical panel has capacity for a Level 2 charger. This assessment can help consumers determine if a panel upgrade is required. Similarly, consumers may want to consider a dedicated 240 V circuit.

- **Determine your charging level.** As noted elsewhere in this document, consumers should identify the best rate for them given their driving habits and anticipated electric vehicle charging needs as well as their overall household energy use.
- **Contact utility.** Electric vehicle drivers need to contact PG&E regarding changing their rate. Drivers may be asked to provide their Vehicle Identification Number (VIN).
- **Arrange for electrical work.** The final step is to have a licensed electrician make any service upgrades, add new electrical panels, and install the charging equipment. The electrician can help the consumer understand aspects such as:
  - Electric infrastructure considerations: The electrician will help conduct an electrical load assessment, evaluate the panel capacity, and obtain permits.
  - Preferred location for charging station: The location for charging inlets, where cars are plugged in, can vary between electric vehicle models. As such, the location of charging stations at residences is dictated by the vehicle type purchased.
- Consumers can reach Sonoma Clean Power at (855) 202-2139 and PG&E at 1 (877) 743-7782.

Note that installing Level 2 charging infrastructure at your home can be expensive if any electrical infrastructure upgrades to your home are needed. These costs can be as high as $5,000 if major electrical work is needed. An electrician will be able to provide you with a quote. The Sonoma County Energy Independence
Program has a list of participating electricians online at sonomacountyenergy.org.

If you wish to install a second meter (not required), which also requires a dedicated electrical panel, then PG&E indicates that the additional cost ranges from $2,000–$8,000.

If you live in a condo or an apartment complex, charging your vehicle "at home" can be a significant barrier. However, many employers offer charging at work and utilities are working to make charging at multifamily complexes more accessible.

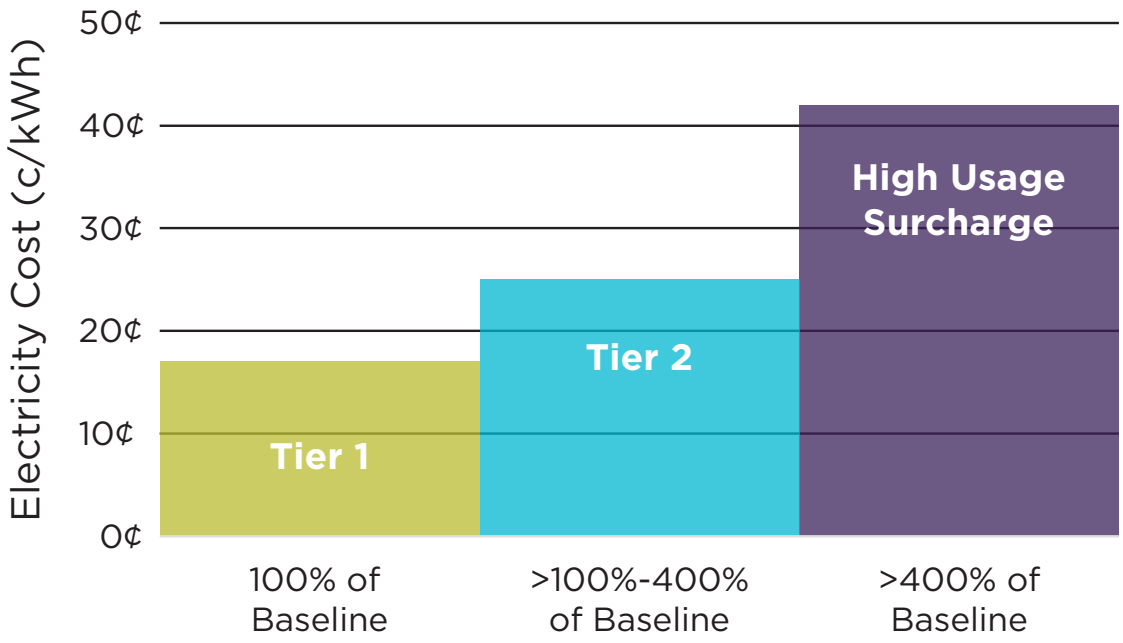
There are incentives available to consumers seeking to deploy infrastructure.

- **PACE financing:** Property Assessed Clean Energy (PACE) financing allows property owners to borrow funds and repay those funds over a defined period through a special assessment on the property. Electric vehicle drivers that own their residence can purchase and install charging equipment through these programs. Some PACE financing programs require that charging equipment installation be bundled with other energy efficiency upgrades.
- **Go Green!:** The Northern Sonoma County Air Pollution Control District is offering incentives up to $500 for a new home charger and installation. This program is only open to residents of the district.

EV ELECTRICITY RATES

Sonoma Clean Power and PG&E both have similar rate structures for electric vehicles (although the pricing differs). The options are as follows:

E-1: This is a tiered rate, and is the most common rate that residential customers are using.



Under E-1, it does not matter when the electric vehicle is charged because this is what is referred to as a flat-rate, meaning the price does not vary throughout the day.

If an electric vehicle is being charged from equipment on the same meter as the rest of the house, the additional electricity consumption is likely to push the consumer into a higher tier.

Consider the figure above, with illustrative average rates for tiers. Charging an electric vehicle frequently at home would likely increase the amount of electricity consumed and push a customer from a lower tier (e.g., Tier 1) to a higher tier (e.g., Tier 2 or High Usage Surchange).

This may increase the cost of general electricity use at a driver's home and depending on the average monthly gas expense, may reduce the benefit of driving an electric vehicle.

EV-A/B: This is a time-of-use (TOU) rate where the price you pay for electricity varries throughout the day. Under EV-A/B rates, the time of day in which you charge your vehicle matters.

EV-A: This rate is for customers with only a single meter for the entire house and their vehicle. All the electricity consumed through this rate will be subject to the time-of-use prices, meaning household electricity usage during the highest priced periods (Peak) will be charged the higher prices regardless of whether a car is charging or not.

Note that for customers under EV-A, all usage in the home, regardless of whether a car is charging or not, will be charged according to the time-of-use schedule as well.

EV-B: This is a time-of-use rate for customers that wish to install a second meter dedicated only to the electric vehicle. Under this rate, the electric vehicle is being charged on one meter subject to the EV rate time-of-use rates while the house can be on another meter at a different rate, like E-1.

The figure below helps illustrate time-of-use rates. The off-peak periods (in yellow) provide the lowest cost for charging electric vehicles (when charging should occur), whereas the partial-peak (blue) and peak (purple) periods have a higher cost of charging. The peak and partial-peak periods should be avoided to maximize savings for an electric vehicle.

Electricity rates can be confusing, even with all the information online and in this guidebook. Prospective electric vehicle buyers are encouraged to familiarize themselves with their current electricity usage and explore how an electric vehicle might impact their utility bill using tools such as PG&E's Plug-in Electric Vehicle Calculator or by contacting your electricity provider Sonoma Clean Power at (855) 202-2139 and PG&E at 1 (877) 743-7782.

Generally, adding an electric vehicle to a consumer's monthly electricity usage in a tiered rate schedule, regardless of whether it is a plug-in hybrid electric vehicle or a battery electric vehicle, will likely yield higher electricity costs.

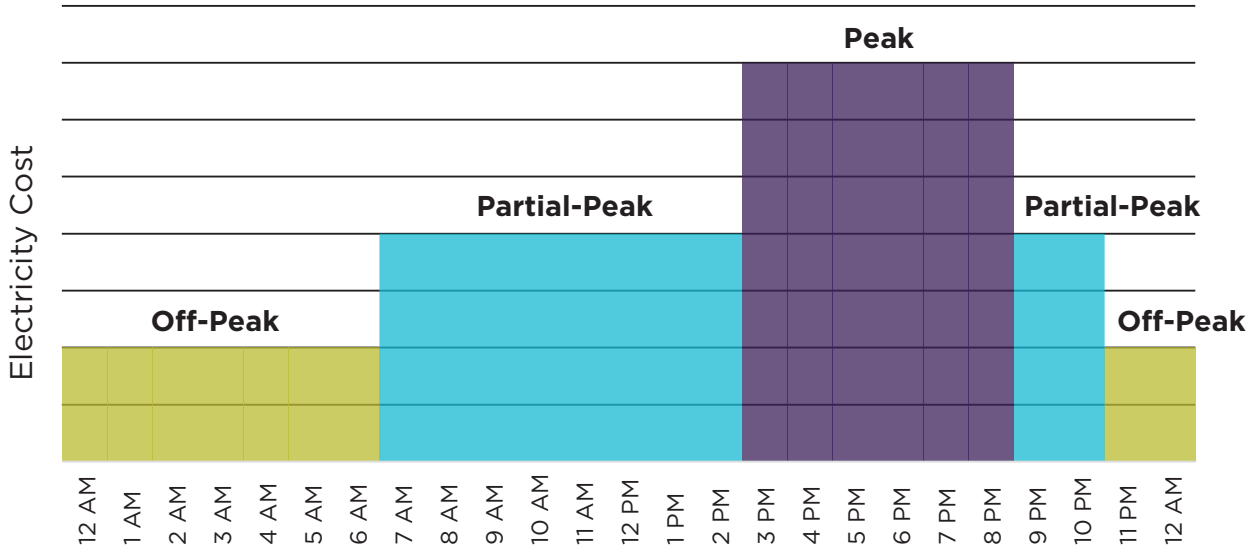
If consumers can switch to a time-of-use rate, and charge an electric vehicle at off-peak times (e.g., at night), they are more likely to realize the cost savings of using electricity as a transportation fuel compared to gasoline.

MANAGED CHARGING

Most electric vehicles come with tools that can help drivers minimize their electricity costs by programming the vehicle to charge at selected times of day. For instance, some vehicles include options to manage charging using controls on the vehicle, while others vehicle manufacturers provide smart phone applications to manage charging. Similarly, depending on the type of charging consumers install at home, the charging equipment may have programmable features to help manage charging.

CHARGING AWAY FROM HOME

There are two broad categories for consideration of charging away from home: charging at work or public charging (sometimes called opportunity charging). In both cases, the charging infrastructure network is new and expanding.



While there are plans to deploy charging infrastructure to satisfy the needs of electric vehicle drivers across the state and throughout service territor, there is still considerable work to be done and investments to be made. Electric vehicle drivers are encouraged to familiarize themselves with various charging networks, charging station locators, and other tools that can help find charging stations, plan trips, and save money.

CHARGING AT WORK

While most drivers will likely charge their electric vehicles at home, accessing charging at work can help drivers increase their range using electricity–which yields economic and environmental benefits, while potentially contributing to a company's employee retention policy. Workplace charging is also very important for electric vehicle drivers who cannot charge at home.

Employers are increasingly seeking to accommodate employees who drive electric vehicles, with some offering charging stations on-site. Prospective electric vehicle buyers should inquire with their employers to determine if there are any charging stations available for employee use.

Most employers that provide charging stations today do not charge for access. Employers might also include some charging etiquette guidelines, such as how long to charge. Some employers have more sophisticated systems in which employees can reserve the charging station for blocks of time depending on what the driver thinks they might need for a given day, as determined by driving habits.

ACTIVE NETWORK PROVIDERS

CARCHARGING/BLINK
CHARGEPOINT
EVGO
GREENLOTS
SEMACONNECT
TESLA

PUBLIC CHARGING

Electric vehicle drivers can also find charging when out and about in our commmunity. Many electric vehicles have built-in navigation and maps to help drivers find charging infrastructure. Many electric vehicle drivers also use smartphone and mobile apps (e.g., PlugShare, EV ChargeHub, Next Charge EV, PlugSurfing, ChargePoint mobile app, Blink mobile app, etc.) that help find charging infrastructure, and allow users to update other drivers about the status of the equipment (e.g., is it operational, is it occupied, what level of charging it provides, etc.). There are also many charging network providers active in our community.

NETWORK PROVIDERS

When drivers are seeking opportunities to charge in public, they will likely come across network providers–these are the entities that manage or maintain the charging equipment, often in coordination with a site host, owned and operated by individual entities.

DEPARTMENT OF ENERGY'S WORKPLACE CHARGING CHALLENGE

If consumers are interested in getting their employer to look into workplace charging more seriously, refer to the Department of Energy's (DOE) Workplace Charging Challenge for more information and useful resources. To increase the convenience and affordability of driving electric, the Workplace Charging Challenge encourages employers to provide charging access for employees. The DOE provides access to outreach tools and materials to help employers engage employees on the benefits of driving electric and help promote workplace charging in their community.

Although network providers are working on normalizing access to public charging infrastructure, drivers will likely need access cards to various network providers. Network providers typically establish some sort of fee for charging, sometimes in partnership with site hosts.

Regardless of the structure, drivers should become familiar with the various network providers, especially if those that are most active along frequent travel corridors.

ACCESS CARDS

Electric vehicle drivers that charge away from home frequently deal with having multiple access cards, one for each of the multiple charging networks. While this may be an inconvenience for drivers, progress is being made towards interoperability aiming to "simplify electric vehicle charging by enabling drivers to use any participating charging network account for convenient access to charging stations across multiple charging networks."[5]

[5] ROEV Association—a trade association of major charging network providers

FEES FOR CHARGING

The issue of assessing a fee for electric vehicle charging is typically worked out by potential site hosts and infrastructure network providers alike. Because the upfront cost of deploying charging infrastructure can be high, network providers and/or potential site hosts may be hesitant to make the investment without some mechanism to recoup the costs. The following are the most common fee structures for an electric vehicle charging in the market today:

- **Fixed fee:** When charged a fixed fee, the driver faces a predetermined cost each time the electric vehicle is connected. The duration of the charge or the electricity delivered to the vehicle is irrelevant.
- **Fixed rate:** A fixed rate is typically linked to the amount of electricity that is consumed (in units of kWh), so the driver pays only for the electricity consumed during the charging session. The network provider or the charging site host can determine the fixed rate, so there is likely considerable variation in the market place.
- **Monthly subscription:** Some network providers offer a monthly subscription option, whereby the driver pays a monthly fee and receives unlimited access to the provider's charging stations.

FEE	DURATION	NOTES	COST	SESSION COST	ESTIMATED COST
Fixed fee	2 hours	3.3 kW on-board charger	$2.00/hour	$4.00	$0.60/kWh
Fixed fee	2 hours	6.6 kW on-board charger	$2.00/hour	$4.00	$0.30/kWh
Fixed rate	2 hours	3.3 kW on-board charger	$0.40/kWh	$2.60	$0.40/kWh
Fixed rate	2 hours	6.6 kW on-board charger	$0.60/kWh	$7.80	$0.60/kWh

Regardless of the fee structure, drivers should seek to:

a) understand hardware limitations of the charging equipment and the vehicle, and

a) familiarize themselves with electricity rates and the economics of charging when seeking out away from home charging.

For illustrative purposes, we consider the same charging session under multiple scenarios for a fixed fee and fixed rate charge, as shown in the table on page 21.

The illustrative scenarios account for the two most common types of on-board charging hardware, rated at 3.3 kW and 6.6 kW.

Note that some vehicles have on-board hardware which limits charging. In other words, even if a Level 2 charging station can deliver power at up to 7.5 kW, the vehicle will limit the power to less than that to protect the onboard battery or other internal components. Prospective buyers and drivers should review the capabilities of electric vehicles to understand what the hardware limitations might be for their vehicle.

4 | SUSTAINABILITY

REDUCED EMISSIONS

Electric vehicles can promote local, regional, and global sustainability through reduced emissions, integrating with renewable electricity, and energy independence.

Electric vehicles help reduce pollution locally and regionally as electric vehicles have zero tailpipe emissions when using electricity as a transportation fuel. This helps improve and maintain air quality locally and regionally.

On-road transportation accounts for over half of the greenhouse gas emissions in our community. As such, electric vehicles can help contribute towards mitigating the impacts of global climate change because electricity has much lower greenhouse gas emissions than gasoline.

In Sonoma and Mendocino counties, those greenhouse gas emissions are even lower thanks to Sonoma Clean Power. SCP offers two electricity products:

- CleanStart, the default product that has a higher renewable energy and carbon-free energy content, with lower greenhouse gas emissions than the incumbent utility, and
- EverGreen, the premium service with 100% renewable, locally generated electricity for a premium of 2.5¢/kWh.

Driving an electric vehicle powered by EverGreen cuts emissions by about 95%. For more information on Sonoma Clean Power, visit sonomaclean-power.org or call 1 (855) 202-2139.

Electricity in California emits about 70% less greenhouse gases than gasoline on a lifecycle basis. This accounts for the greenhouse gas emissions from all fuel-related activities, such as oil extraction, refining, and combusting the fuel in an engine, as well as extracting natural gas, delivering it to a generation plant, and combusting it for electricity generation.

INTEGRATING RENEWABLE ENERGY

As more electric vehicles are deployed, they can become part of a greater effort to make electricity cleaner and enable more renewable energy. This can be done in two ways.

Enabling renewable energy deployment: If electric vehicle charging is encouraged at times coincident with renewable generation, then electric vehicles can help enable more deployment of renewable energy. When renewable energy production from solar PV or wind resources is high, electric vehicles can be charged, thereby acting as storage for renewables, thus helping enable for renewables on the grid. This can be done through new rate structures or other utility incentives.

Vehicle-Grid technology: In the near future, using more advanced vehicle-to-grid (V2G) communications, electric vehicles with a surplus of energy stored in the battery could act as sources of power and provide electricity back to the grid. Electric vehicles that are plugged into the grid, can also help stabilize the grid through methods such as peak shaving and more advanced load leveling. Although there are not sufficient electric vehicles on the road today, these types of grid benefits can only help improve the value proposition of electric vehicle ownership in the future.

ENERGY INDEPENDENCE

California generally imports from other countries about 50% of the oil that is refined in-state—from places like Saudi Arabia, Iraq, Ecuador, and Canada. In other words, California consumers send a significant amount of money outside of the state and country to continue using gasoline. Electric vehicles charged with EverGreen electricity from Sonoma Clean Power are powered from locally generated renewable electricity, keeping money local. This can have a significant long-term benefit to the state and local economy.

BATTERIES

When lithium-ion batteries reach the end of their useful automotive life, they can be reused in other applications. Automobile manufacturers are partnering with technology providers to sell mass market energy storage systems using old batteries to store renewable energy production, or use them at their own facilities for energy-cost saving purposes. The batteries can also be used to supply back-up power as needed.

The primary challenge associated with recycling batteries from electric vehicles today is the diverse range of battery chemistries that are used. Since electric vehicles using lithium-ion batteries have only been in use for about 5–6 years, there is insufficient demand for recycling to support large scale recycling plants.

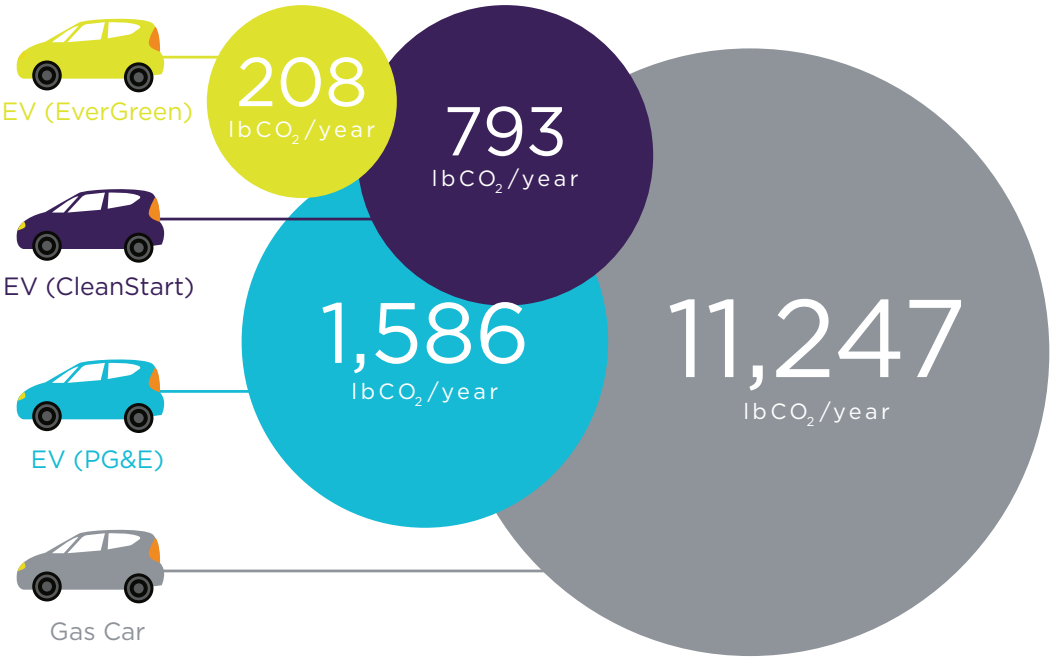
ELECTRIC VEHICLES CHARGED WITH EVERGREEN ELECTRICITY FROM SONOMA CLEAN POWER ARE POWERED FROM LOCALLY GENERATED RENEWABLE ELECTRICITY

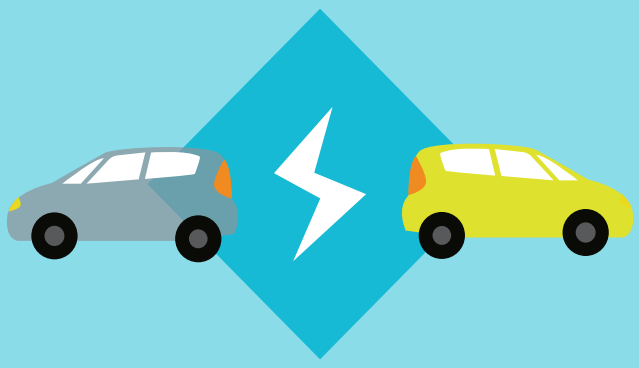
AS MORE ELECTRIC VEHICLES ARE DEPLOYED, THEY CAN BECOME PART OF A GREATER EFFORT TO MAKE ELECTRICITY CLEANER AND ENABLE MORE RENEWABLE ENERGY

ANNUAL CO_2 EMISSIONS
FROM AVERAGE SONOMA COUNTY VEHICLES

Sonoma Clean Power

GAS VS. ELECTRIC VEHICLE USING DIFFERENT POWER OPTIONS





THE AVERAGE ELECTRIC VEHICLE EFFICIENCY IS

28.5 KWH/100 MILES

GAS CARS PRODUCE

MORE CO_2 EMISSONS PER YEAR

than EV (EverGreen)

- The average light duty vehicle in Sonoma County is projected to travel 12,795 miles in 2016 according to the Emission Factors (EMFAC) 2014 model maintained by the California Air Resource Board. The same model estimates that these light duty vehicles averaged 22.02 miles per gallon in 2016.
- The gasoline transport fuel emission factor used is 8.78 kg CO2/gal from Table 13.1 of the 2016 Climate Registry Default Emission Factors April 2016.
- The average electric vehicle efficiency used is 28.5 kWh/100 miles.
- The 2014 PG&E Electricity Emission Factor (434.92 lb CO2/MWh) is third party verified through The Climate Registry. PG&E's 2015 emission factor was not available at the time of printing.
- The 2015 Sonoma Clean Power Electricity Emission Factors for CleanStart (217.57 lb CO2/MWh) and EverGreen (57 lb CO2/MWh) are third party verified through The Climate Registry.

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