Union of Concerned Scientists

EXECUTIVE SUMMARY

STATE OF CHARGE

Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States

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Updated with 2009 Power Plant Data – June 2012

For electric vehicles (EVs), the future is here. No longer just concept models, EVs are being featured in—and rolling out of—showrooms across the country. For example, the all-electric Nissan LEAF, powered solely by batteries, and the plug-in hybrid Chevy Volt, powered both by batteries and an internal combustion engine, debuted in 2011. Automakers are introducing many new models in 2012, including the Ford Focus Electric, Toyota Prius Plug-in Hybrid, and Mitsubishi "i," with plans for many more EVs over the next several years.

These vehicles will draw some or all of their power from the U.S. electricity grid instead of the gas pump, resulting in significant reductions in the oil consumption, global warming emissions, and fueling costs of driving. However, the global warming emissions of driving an EV depend on how the electricity is generated—given that the sources of power vary among the nation's regional electricity grids—and the cost to fuel these vehicles is dependent on local utilities' electricity rates. To compare the global warming emissions and fuel-cost savings of electric vehicles with traditional gasoline-powered vehicles, consumers need access to more localized information, which has not been readily available—until now.

This report's analysis shows that consumers should feel confident that driving an electric vehicle yields lower global warming emissions than the average new compact gasoline-powered vehicle. **In regions covering 45 percent of the nation's population,** electricity is generated with a larger share of cleaner energy resources—such as renewables and natural gas—meaning that **EVs produce lower global warming emissions than even the most efficient gasoline hybrids.** But in regions where coal still makes up a large percentage of the electricity grid mix, the most efficient gasoline-powered hybrid vehicles will yield lower global warming emissions than an electric vehicle. Even then, however, electric vehicles slash oil consumption in nearly all regions.

Our analysis also concludes that wherever **EV owners** "charge up," they **can save $750 to $1,200 a year compared with operating an average new compact gasoline vehicle** (27 mpg) fueled with gasoline at $3.50 per gallon.[1] At that gasoline price, driving the average gasoline vehicle costs more than $18,000 to refuel over the vehicle's lifetime, but the owner of an EV can expect to pay thousands of dollars less to power his or her vehicle. Thus, while in this early electric vehicle market these products have higher up-front costs, knowing how much one can save by using electricity instead of gasoline is an important factor for consumers considering an EV purchase. In some areas, consumers' **realization of *maximum* savings may entail a switch from their current electricity rate plan** to the most advantageous one offered by their utility.

1 Assuming 11,000 miles of driving per year.

In particular, this report answers the following key questions:

GLOBAL WARMING EMISSIONS

Where you live, does an electric vehicle have lower global warming emissions than a gasoline hybrid?

FUEL-COST SAVINGS

How much does it cost to charge an electric vehicle in 50 major cities around the country? And how can you save the most money?

Global Warming Emissions of Electric Vehicles

Electric vehicles have no tailpipe emissions,[2] but the production of electricity used to charge these vehicles can result in varying levels of global warming emissions as well as the release of other pollutants. When the electricity used to power the vehicle comes from resources such as wind and solar power, EVs can operate nearly emissions-free. This potential is being demonstrated today by some individuals who are pairing rooftop solar electricity systems with their electric vehicle ownership. For most electric vehicle owners, however, their cars will be charged using electricity from their region's electricity grid.

Regional differences in the mix of fuels used to generate electricity, such as coal, natural gas, nuclear, hydro, and wind, result in significant variations in global warming emissions. In other words, not all electricity sources are created equal. For example, for each unit of electricity produced, the global warming emissions of coal-fired power plants are about twice those of natural-gas-fired power plants.[3] Burning oil to produce electricity also is very dirty, but because it accounts for less than 1 percent of total U.S. electricity generation, oil's impact on overall emissions from that sector is limited. Renewable resources such as wind and hydro, on the other hand, emit no global warming gases at all when producing electricity. Thus a region's global warming emissions intensity (global warming emissions per unit of electricity), and therefore the global warming emissions of driving an electric vehicle there, will vary according to the region's mix of power plants.

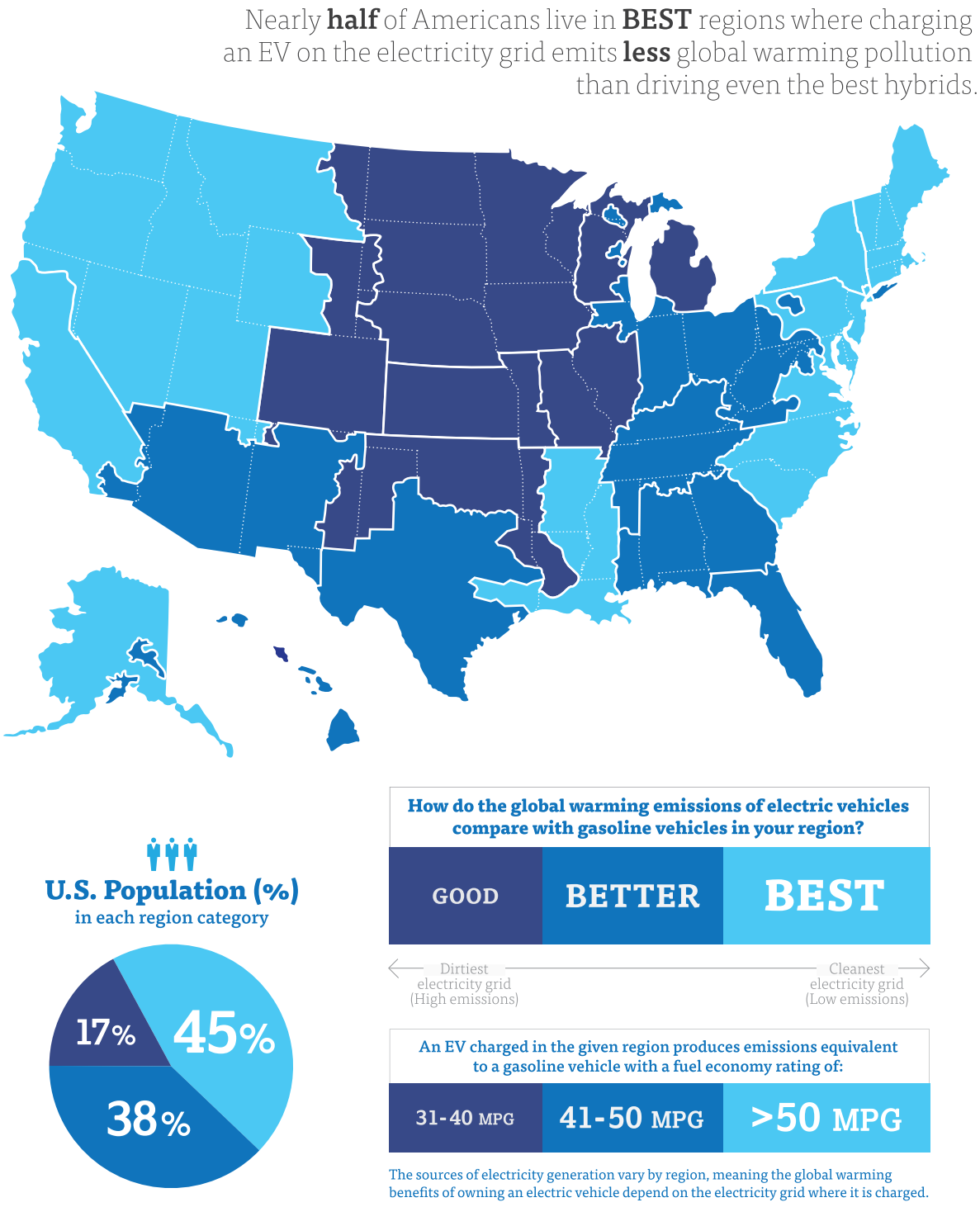
The mix of electricity sources varies not only by region; it is also changing over time as older power plants are retired and the production of clean electricity increases. These changes are due in part to state and federal policies such as air pollution standards, renewable electricity standards, and tax incentives to increase clean electricity production. By 2020, global warming emissions intensity of electricity generation is expected to have improved in some regions by as much as 30 percent over 2010. That means the global warming emissions from driving an electric vehicle purchased today will likely decrease over its lifetime.

However, consumers in the market for an EV want to know how the global warming emissions of plugging in an electric vehicle compare with those of operating a gasoline vehicle today. To provide this information, we determined the global warming emissions that result from electricity consumption in the 26 "grid regions" covering the United States, and we rated each region based on how charging an electric vehicle there compares with driving a gasoline vehicle. Each regional electricity grid represents the group of power plants that together serve as the primary source of electricity for that specific area of the country.[4]

Our ratings, described in Figure ES.1, provide a rule of thumb for consumers in different regions when evaluating the global warming emissions footprint of an EV powered by grid electricity, relative to a gasoline-powered vehicle.

2 For plug-in hybrid electric vehicles, which use both gasoline and electricity, tailpipe emissions are eliminated only when the vehicle is operating exclusively on electricity.
3 The average global warming emissions intensity of coal-fired electricity in the United States is 2.3 times that of natural-gas-fired electricity, based on emissions data from the U.S. EPA's eGRID database (EPA 2012).
4 The regional electricity emissions data used in this analysis are based on the most recent version of the EPA's eGRID database available at the time of publication, which includes power plant emissions from 2009.

Figure ES.1. REGIONAL GLOBAL WARMING EMISSIONS RATINGS FOR ELECTRIC VEHICLES



Notes: Ratings are applicable to midsize electric vehicles of average efficiency. Gasoline mpg comparisons are for combined city/highway EPA fuel economy ratings. Electricity grid boundaries represented on the map are approximations. See Table ES.1 for more detailed regional information. Assumptions: Full fuel-cycle accounting is used both for electric vehicle and gasoline vehicle emissions. Global warming emissions per gallon of gasoline are 11,200 grams/mile while electric emissions vary by regional electricity grid and are based on 2009 power plant data from the EPA's eGRID2012 database (the most recent version available). EV efficiency is 0.34 kWh/mile, equivalent to the efficiency of the Nissan LEAF battery-electric vehicle. Population estimates are from year 2000 data published by the U.S. Census Bureau.

An EV driver could save **6,100 gallons** of gasoline and **nearly $13,000** over the life of the vehicle relative to today's average compact gasoline car, assuming a national average electricity price and $3.50-per-gallon gasoline.

Key findings include (see Figure ES.1):

- **Nearly half (45 percent) of Americans live in BEST regions—where an EV has lower global warming emissions than a 50 mpg gasoline-powered vehicle, topping even the best gasoline hybrids on the market.** Charging an EV in the cleanest electricity regions, which include California, New York (excluding Long Island), the Pacific Northwest, and parts of Alaska, yields global warming emissions equivalent to a gasoline-powered vehicle achieving over 70 mpg.

- **Some 38 percent of Americans live in BETTER regions—where an electric vehicle has the equivalent global warming emissions of a 41 to 50 mpg gasoline vehicle, similar to the best gasoline hybrids available today.** For example, charging an EV in Florida and across most of Texas yields global warming emissions equivalent to a 48 mpg gasoline vehicle; this is the fuel economy level of vehicles such as the Honda Civic Hybrid (44 mpg) and Toyota Prius Hybrid (50 mpg).

- **About 17 percent of Americans live in GOOD regions—where an electric vehicle has the equivalent global warming emissions of a 31 to 40 mpg gasoline vehicle, making some gasoline hybrid vehicles a better choice with respect to global warming emissions.** The Rocky Mountain grid region (covering Colorado and parts of neighboring states) has the highest emissions intensity of any regional grid in the United States, which means an EV will produce global warming emissions equivalent to a gasoline vehicle achieving about 34 mpg. Gasoline-powered cars with fuel economy at this level include the Hyundai Elantra (33 mpg) and the Ford Fiesta (34 mpg).

For detailed emissions estimates by region see Table ES.1 (p. 12).

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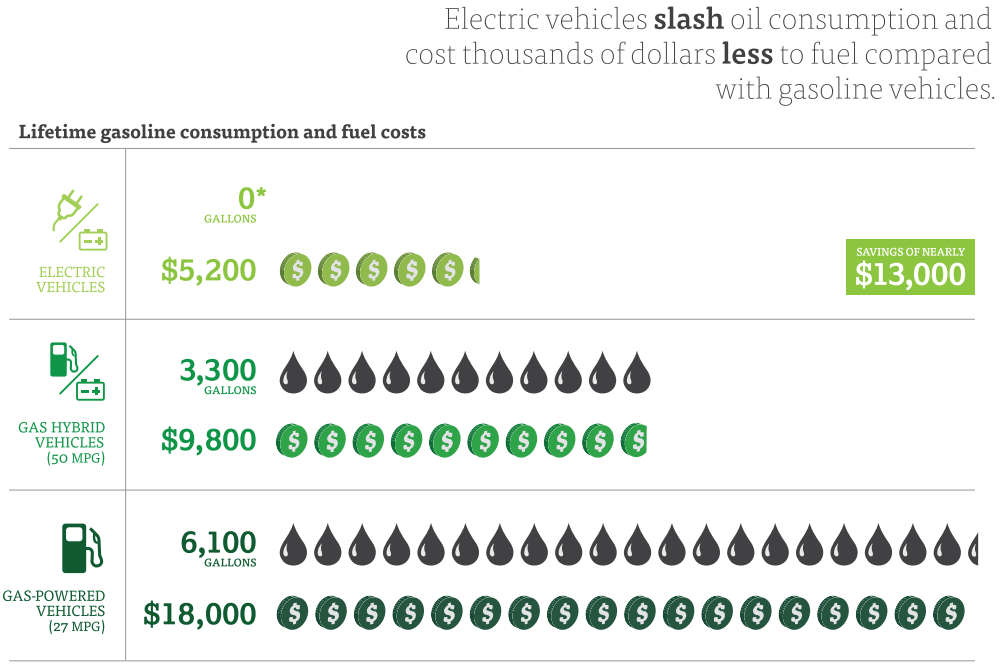
Your Electricity May Vary

The ratings of GOOD, BETTER, and BEST are based on a region's mix of electricity sources and its average emissions intensity (global warming pollution per unit of electricity) over the course of a year. In actuality the electricity grid is a very dynamic system, with the mix of power plants constantly changing—in response to variations in hourly, daily, and seasonal electricity demand as well as to variations in the availability of electricity resources such as wind, solar, or hydro. Individual utilities within regions may also have mixes of electricity sources that differ from the regional average, based on the specific power plants from which they obtain the electricity. However, the annual average regional emissions provide reasonable estimates of what one might expect from EV charging. In the future, reporting of utility-level emissions data could provide more localized emissions estimates.

Figure ES.2. COMPARISON OF LIFETIME VEHICLE FUEL/CHARGING COSTS AND GASOLINE CONSUMPTION



*Electric vehicles consume no gasoline and contribute very little to oil consumption, since less than 1 percent of U.S. electricity is generated with petroleum.
Note: Assumptions include gasoline cost of $3.50 per gallon, a national average electricity price of 11 cents/kWh, a discount rate of 3 percent applied to future savings, cumulative lifetime mileage of 166,000 miles, and annual travel that starts at 15,000 miles per year and declines 4.5 percent per year over 15 years. Electric-drive efficiency is that of the Nissan LEAF (0.34 kWh/mile) and is representative of today's small to midsize EVs. Greater annual mileage or higher electric efficiency would result in increased cost-savings estimates.

Fuel-Cost Savings of Electric Vehicles

Electric vehicles currently offered by manufacturers come with a wide range of price tags, ranging from luxury sports cars with $100,000 sticker prices to more modest four- and five-passenger vehicles, some of which can be purchased for under $30,000 (when factoring in an available $7,500 federal tax credit).[5] While electric vehicles today cost more to purchase than comparable gasoline vehicles and, if faster charging is desired, require some up-front investment in home equipment, EV owners can realize significant fuel-cost savings compared with operating a gasoline vehicle because driving on electricity is cheaper. An EV driver could save 6,100 gallons of gasoline and nearly $13,000 over the life of the vehicle relative to today's average compact gasoline car, assuming a national average electricity price[6] and $3.50-per-gallon gasoline (Figure ES.2). But electricity rates vary among cities and utilities across the country, and many utilities offer optional rate plans that can benefit EV owners. In the 50 most populous cities in the United States, driving on electricity will save money compared with driving the average gasoline vehicle, but taking advantage of utility rate plans that offer lower-cost electricity at night may provide additional savings of hundreds of dollars per year for EV owners.

Our analysis compiled information from utilities serving those 50 cities to determine the cost of charging an EV (Figure ES.3, p. 7) on different rate plans (see box, "EV Charging Options and Electricity Rate Plans," p. 6), and we then evaluated how much owners could save on fuel costs. Most electric vehicles being offered by automakers today are small to midsize cars, so fuel-cost savings from EVs were compared with the average new compact gasoline vehicle, which has an EPA city/highway fuel economy rating of 27 miles per gallon.[7]

Continued on page 8

5 These cars include the four-passenger Mitsubishi "i" and the five-passenger Nissan LEAF.
6 The national average residential electricity price is 11 cents per kilowatt-hour, based on the U.S. Department of Energy's Annual Energy Outlook 2011.
7 Based on new vehicle sales in 2010, the most recent year for which data are available.

EV Charging Options and Electricity Rate Plans

Standard Rates

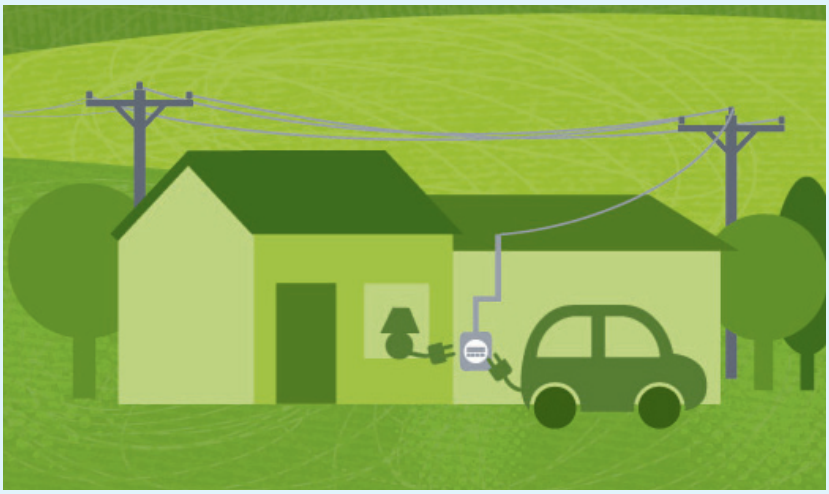
Most residential consumers have one electricity meter and are on a default rate plan, in which the cost of electricity is based on the amount of electricity consumed. Typically, the rate does not vary by time of day.

Time-of-Use (TOU) Rates

TOU rates have electricity prices that change over the course of the day. In order to relieve pressure on the electricity grid, these rates are typically structured to have higher costs during hours of peak electricity demand and to offer very low rates during off-peak times—typically overnight, when EVs are most likely to be charged. Figure ES.3 shows the time-of-use rate offered by the Los Angeles Department of Water and Power to electric vehicle owners; it reflects a typical TOU rate structure. In estimating charging costs on TOU rates, our analysis assumes that the vast majority of vehicle charging is done during off-peak hours, with the remainder of charging being equally distributed throughout the rest of the day.[8] TOU rate plans apply to either the combined electricity consumption of the household and EV charging or, if a separate meter has been installed, just the EV charging. Because the cost to charge an EV can differ under these two setups, TOU rates are separated into two corresponding categories:

Time-of-Use Whole-House (TOU-WH)

A TOU-WH rate means that both the household electricity use and the EV-charging electricity use are subject to time-varying electricity rates. Not only will the cost of vehicle charging change depending on when you plug in, so will the cost of running your dishwasher or air conditioner. For customers using significant amounts of electricity during peak hours (typically during the day), when prices are high, choosing a TOU-EV rate (see below) for charging a car may be a better option. In any case, you should obtain from the utility an estimate of the cost impact of TOU-WH pricing on your home's electricity consumption before making a switch to TOU-WH (cost savings in this report for TOU-WH rates are for electricity consumed by EV charging only and do not include any change in household electricity consumption costs that might occur).



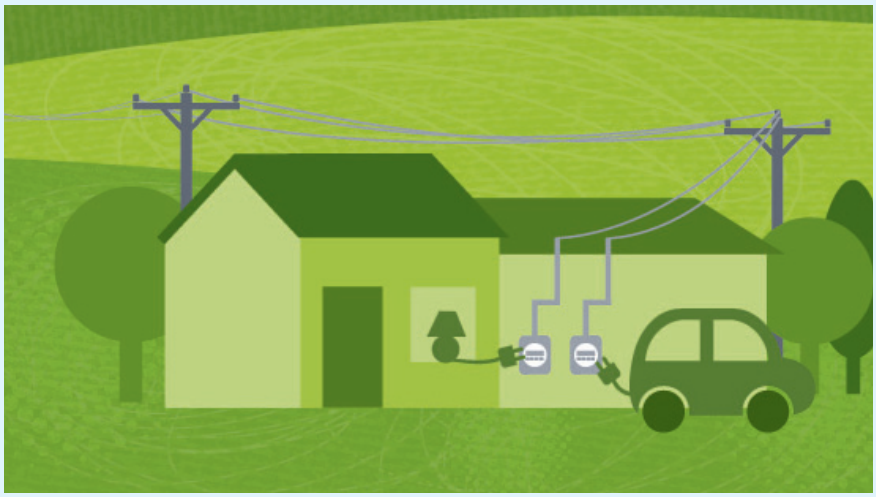
Adapted from © iStockphoto.com/Sigal Suhler Moran

A single electricity meter can be used for both a home's electricity consumption and electric vehicle charging. This configuration is used to access standard electricity rate plans and time-of-use whole-house (TOU-WH) electricity plans.

8 Off-peak charging assumptions range from 76 to 94 percent of total vehicle charging, depending on the TOU rate plan offered by the utility. The lower end of the range applies to rate plans with the shortest length of off-peak hours and the range's upper end applies to rate plans with the longest length of off-peak hours. See the full report for a detailed description of charging assumptions.

Time-of-Use EV-Only (TOU-EV)

Because a TOU-EV rate applies only to the electricity consumed for EV charging, it requires a meter separate from the existing household electricity meter. The additional cost of installing the second meter varies by utility as well as by the amount of electrical work needed in the home. The individual home's situation should be evaluated before switching to such a plan. In the future, alternatives to installing a second utility meter could make TOU-EV rates more accessible and affordable. For example, using meters built into the vehicle or the home's charging equipment could eliminate the need for installing a second utility meter.



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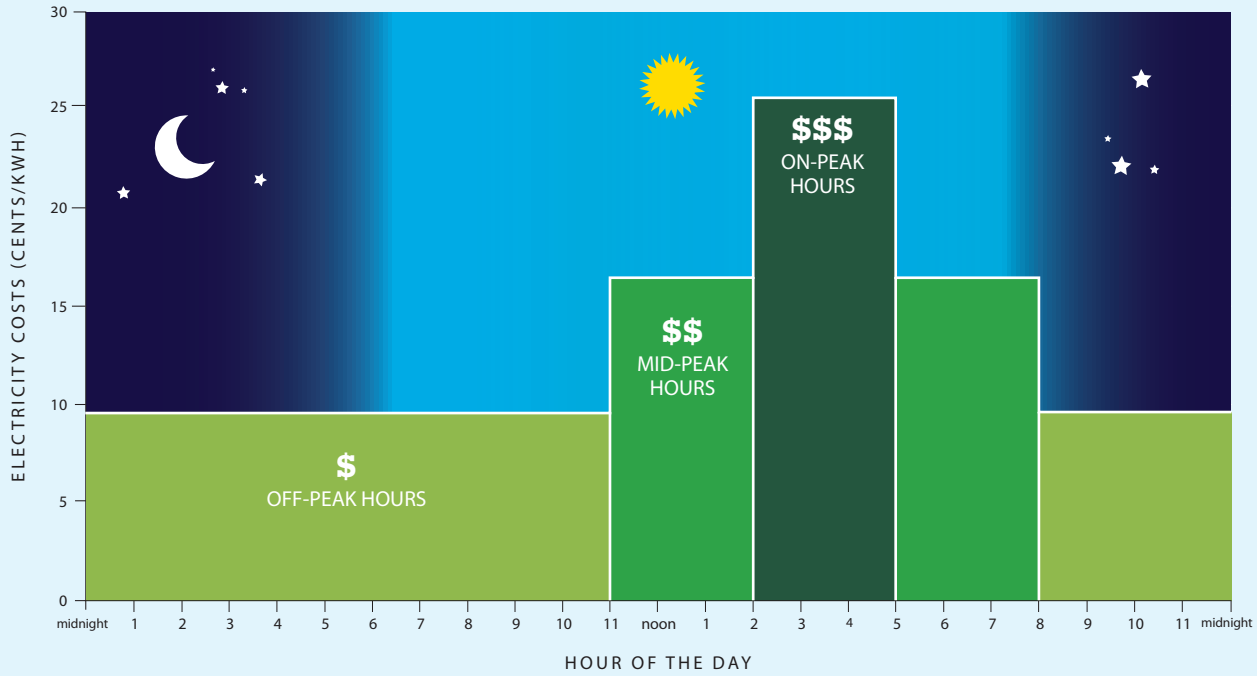
A second electricity meter can be used to separate EV charging from household electricity consumption. This configuration allows access to time-of-use EV-only (TOU-EV) electricity rate plans.

Figure ES.3. LOS ANGELES DEPARTMENT OF WATER AND POWER'S TIME-OF-USE RATE FOR EV CHARGING



Note: Rates are for summertime weekday electricity consumption and include taxes and fees.

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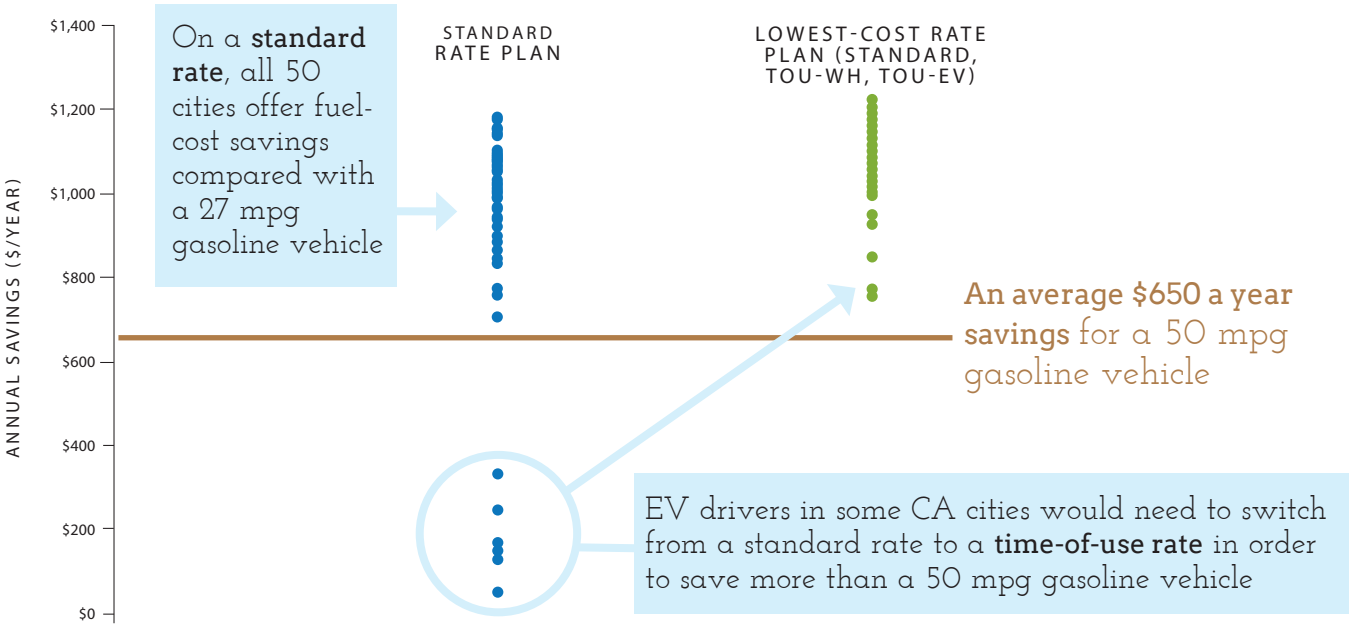
Key findings include (see Figure ES.4):

- **When charging on the lowest-cost electricity plan, EV owners can save $750 to $1,200 per year in fuel costs compared with the cost of operating the average compact gasoline vehicle (27 mpg) at gasoline prices of $3.50 per gallon (Table ES.2, p. 13). This finding represents a reduction in fueling costs of 50 to 85 percent every year.** In the cities with the lowest-cost electricity, such as Oklahoma City and Indianapolis, an EV owner could save more than $1,200 a year. Even in Philadelphia, which offers the most modest savings among the 50 cities evaluated, an EV owner could still save more than $750 per year in fuel costs.

  Even when their electric vehicles are compared with a 50 mpg gasoline-powered vehicle, EV owners can save $100 to $570 per year in fuel costs when using the lowest-cost rate plans. This means a cutting of fuel costs by 10 to 75 percent relative to today's most fuel-efficient gasoline-powered vehicle.

- **Switching from a standard rate plan to a time-of-use (TOU) rate plan and then charging the car primarily when electricity is cheapest can mean hundreds of dollars in additional savings per year, especially in California cities.** Time-of-use rates often offer the best EV charging costs. Thirty-nine out of the 56 utilities serving the 50 cities evaluated offer TOU rates, and all but four were estimated to save money on EV charging compared with the standard rate. In many California cities, EV owners paying TOU rates could realize savings of more than $500 per year compared with staying on standard residential rate plans.

Figure ES.4. FUEL-COST SAVINGS OF ELECTRIC VEHICLES COMPARED WITH A 27 MPG GASOLINE VEHICLE IN 50 U.S. CITIES AT GASOLINE PRICES OF $3.50 PER GALLON



Notes:
(1) Data points represent EV fuel-cost savings on rate plans of 56 utilities serving the 50 most populous cities in the United States. The same utility serving more than one city is shown as separate points. See Table ES.2 for a list of all 50 cities.
(2) We assume 30 miles per day of travel and EV efficiency of 0.34 kWh/mile. Home charging equipment costs are not included. Time-of-use whole-house (TOU-WH) rates do not include estimates of changes in household-electricity consumption costs that may occur as a result of switching from a standard rate plan. Savings on time-of-use rate plans assume 76 to 94 percent of charging occurs during off-peak hours, with greater percentages assumed for rate plans with longer off-peak periods. The remainder of charging is distributed evenly throughout the day. See the full report for further details.

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Switching from a standard rate plan to a **time-of-use (TOU) rate plan** and then charging the car primarily when electricity is cheapest can mean hundreds of dollars in additional savings per year, especially in California cities.

- **In every one of the 50 cities, EV owners will save money on fueling costs compared with the average compact gasoline vehicle—even without changing to the lowest-rate plans.** In 44 of the 50 largest cities (88 percent), the standard electricity rate plan offers savings compared with even the best gasoline hybrid (50 mpg). The only exceptions are some California cities, where a switch to time-of-use plans is necessary to top the best gasoline hybrid (assuming a gas price of $3.50 per gallon).

Table ES.2 (p. 13) shows the cost savings of charging on different electricity rate plans for the 56 utilities serving the 50 cities studied, and it shows the regional global warming emissions rating for those cities as well.

Consumer Advice

Electric vehicles can help enhance our nation's energy and economic security by reducing the consumption of oil and the emissions of global warming pollutants. And while costing more up front than a gasoline vehicle, EVs can save thousands of dollars on refueling costs over their lifetimes compared with those of gasoline vehicles. Purchasing an electric vehicle today can help support an early market for these technologies and send a strong signal to automakers to continue investing in them, while tax incentives from the federal and some state governments can help make EVs more affordable.

Here is some advice, based on the findings of our analysis, for consumers considering the purchase of an electric vehicle.

Reducing the Global Warming Emissions of Electric Vehicles

- **Use our regional ratings to estimate global warming emissions.** To estimate the global warming emissions of an EV in your region, use the regional ratings in this analysis as a rule of thumb. For plug-in hybrid-electric vehicles, which are powered both by electricity and gasoline, these ratings apply to the portion of miles driven on electricity. We assume an EV with an efficiency of 0.34 kWh/mile, but an EV that uses less electricity per mile will have even lower emissions than our ratings imply. And remember that the emissions caused by a vehicle you buy today will likely decrease over its lifetime as the electricity grid (according to projections) becomes cleaner.

- **Consider your options for buying cleaner electricity, especially in GOOD regions.** Consumer demand for renewable electricity sends a strong signal to business people and policy makers and thus can help to stimulate more investments in renewable energy projects. Increasing GOOD regions' fraction of renewable energy sources and decreasing their reliance on coal-powered electricity will

help move them into the BETTER and BEST categories (see box, "Options for Buying Cleaner Electricity").

- **Support clean vehicles and clean energy polices.** Support state, regional, and federal policies, such as renewable electricity standards and tax incentives, that increase the availability of renewable electricity. These policies ensure that your contribution to tackling climate change by investing in an electric vehicle will only grow more significant over time.

Minimizing Electric Vehicle Charging Costs

- **Use our charging costs as an estimate, but contact your utility for more information.** If you live in one the 50 cities we evaluated for charging costs (or live nearby and are served by the same utility),[9] use our estimates for an idea of how much you might expect to save. But be sure to contact your utility for the latest information on rate-plan options for EV charging and to obtain estimates of charging costs and any up-front costs that might be involved.

- **Consider switching to a time-of-use rate plan, especially in California.** TOU plans typically offer cheaper rates in the early-morning hours, so if vehicle charging is primarily overnight, as is likely for many EV owners, a TOU plan can be a good option. If your home's electricity consumption is high during the day (when TOU rates typically are high), consider your options for charging the electric vehicle on a TOU-EV rate. Consumers should ask their utility to estimate any changes in their household electricity costs as a result of switching to a TOU-WH rate and any costs associated with installing a separate meter for a TOU-EV rate.

- **Remember: even on standard rate plans, EV charging is cheaper than fueling the average compact gasoline vehicle.** EV owners should get educated on what options, such as TOU plans, are available from their utility, but also keep in mind that most "plain vanilla" standard rate plans across the country will still deliver significant fuel-cost savings compared with operating the average compact gasoline vehicle.

To learn more about electric vehicle technology, visit our website at *www.ucsusa.org/model-e*.

Clean Cars, Clean Energy—Getting from Here to There

Major automakers' introduction of electricity-powered vehicles may be an early signal of our transition toward a virtually zero-emissions and oil-free transportation future. To make this transition a success, however, the electricity grid needs to evolve alongside our vehicles. As the market for EVs expands, we must phase out the highest-emitting electricity sources, such as coal, and increase the use of cleaner and renewable alternatives. Only by taking both types of actions in parallel—increasing the numbers of electric vehicles while cleaning up our electricity grid—can EVs fulfill their potential.

Making electric vehicles an affordable choice for greater numbers of consumers is also important to ensuring continued progress away from gasoline-powered cars and trucks. Electricity-purchasing options that offer low rates to encourage off-peak charging at certain times of the day can help EV buyers save money while also allowing utilities and electricity grid operators to better manage that grid. Utilities and regulators can help increase consumer access to low vehicle-charging rates in two important ways: by making TOU plans available to more people in more cities, and by making it easier to separate EV charging from home electricity consumption.

Driving on clean electricity promises to play a major role both in ending the United States' oil addiction and in slowing global climate change. But because the transition from oil will take time, investments in clean energy and advanced vehicle technologies must be sustained. The good news is that electric vehicles are off to a running start.

9 Note that local taxes can vary by city, which could have a small effect on cost-savings estimates.

Photo credits: (solar panels) © iStockphoto.com/Elena Elisseeva; (wind turbines) © iStockphoto.com/Sergiy Serdyuk

Options for Buying Cleaner Electricity

Consumers can support renewable energy by generating their own renewable electricity, participating in green power programs offered through their utility, choosing an energy provider that offers cleaner electricity (if they have a choice), or buying renewable energy certificates.

Installing solar panels to generate electricity is an alternative being considered by an increasing number of people for at least some of their home's electrical needs. Among EV owners with existing solar electric systems, increasing the size of these systems may be an option for generating the electricity that would otherwise have to be purchased to charge their vehicle.

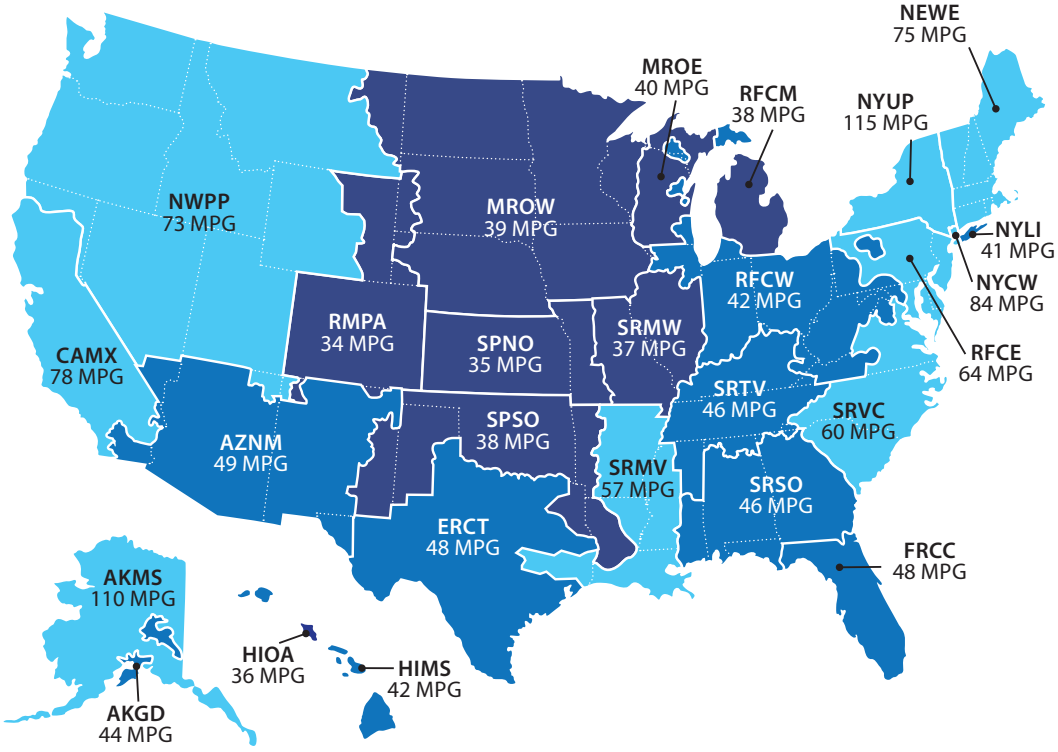
According to the U.S. Department of Energy, more than 860 utilities across the nation are offering some type of green power program. These initiatives allow consumers, by paying a premium for renewable electricity, to support their utility's greater investment in renewables. The types of renewables and program details vary by utility.

In some deregulated utility markets, consumers have the ability to choose their power provider. In those locales, selecting a provider that supplies electricity from renewable sources or that maintains a green power program may be a distinct option.

Purchasing renewable energy certificates (RECs), which are available nationwide, is another option. RECs are directly tied to electricity generated by renewable sources and are sold in a voluntary market. Purchasing RECs can help to increase demand for renewable electricity generation by providing additional revenue for renewable energy projects

When reviewing your options for buying green power, look for the Green-E certification label, which indicates that the products have been independently verified (***www.green-e.org***). To learn more about options for supporting green power, visit the U.S. Department of Energy's website on "The Green Power Network" ***(eere.energy.gov/greenpower***).

Table ES.1. ELECTRIC VEHICLE GLOBAL WARMING POLLUTION RATINGS AND GASOLINE VEHICLE EMISSIONS EQUIVALENTS BY ELECTRICITY GRID REGION. (The mpg value listed for each region is the combined city/highway fuel economy rating of a gasoline vehicle that would have global warming emissions equivalent to an EV.)



NOTES: Cities shown are a sample of those located in the electricity grid region. The EPA's power profiler tool *(www.epa.gov/cleanenergy/energy-and-you/how-clean.html)* provides a zip code look-up to determine primary utility and grid region. Cities listed here were assigned to grid regions based on the primary utility serving the city. Cities served by multiple utilities, some of which are in different regions, are indicated with an asterisk.

The regional electricity emissions data used in this analysis are based on the most recent version of the EPA's eGRID database (which includes power-plant emissions from 2009) available at the time of publication.

Good	Better	Best
MRO East (MROE) - 40 Madison	**WECC Southwest (AZNM) - 49** Phoenix, El Paso,* Las Vegas, Albuquerque, Tucson	**NPCC Upstate NY (NYUP) - 115** Buffalo
MRO West (MROW) - 39 Omaha, Minneapolis	**FRCC All (FRCC) - 48** Jacksonville,* Miami	**ASCC Miscellaneous (AKMS) - 110** Juneau
SPP South (SPSO) - 38 Oklahoma City, Tulsa	**ERCOT All (ERCT) - 48** Houston, San Antonio, Dallas, Austin, Fort Worth, Arlington	**NPCC NYC/Westchester (NYCW) - 84** New York City
RFC Michigan (RFCM) - 38 Detroit	**SERC Tennessee Valley (SRTV) - 46** Memphis,* Nashville, Louisville*	**WECC California (CAMX) - 78** Los Angeles, San Diego, San Jose, Oakland, San Francisco, Sacramento, Long Beach, Fresno
SERC Midwest (SRMW) - 37 St. Louis	**SERC South (SRSO) - 46** Atlanta	**NPCC New England (NEWE) - 75** Boston
HICC Oahu (HIOA) - 36 Honolulu	**ASCC Alaska Grid (AKGD) - 44** Anchorage	**WECC Northwest (NWPP) - 73** Seattle, Portland
SPP North (SPNO) - 35 Kansas City,* Wichita	**HICC Miscellaneous (HIMS) - 42** Hilo	**RFC East (RFCE) - 64** Philadelphia, Baltimore, Washington, DC*
WECC Rockies (RMPA) - 34 Mesa,* Denver, Colorado Springs	**RFC West (RFCW) - 42** Chicago, Indianapolis, Columbus, Milwaukee, Cleveland	**SERC Virginia/Carolina (SRVC) - 60** Charlotte, Virginia Beach, Raleigh
	NPCC Long Island (NYLI) - 41 Hempstead	**SERC Mississippi Valley (SRMV) - 57** New Orleans

Table ES.2. ANNUAL FUEL-COST SAVINGS FROM DRIVING ON ELECTRICITY IN THE 50 MOST POPULOUS CITIES IN THE UNITED STATES

Regional Global Warming Emissions Rating 

CITY	UTILITY	ANNUAL SAVINGS COMPARED WITH A 27 MPG GASOLINE VEHICLE ($/YR)		
		Standard Rate Plan	TOU-WH	TOU-EV
Albuquerque	Public Service Company of New Mexico	900	1,110	1,110
Arlington	TXU Energy	1,010		
Atlanta	Georgia Power	1,000	1,140	1,140
Austin	Austin Energy	1,020		
Baltimore	Baltimore Gas and Electric Company	1,020	1,080	1,080
Boston	NSTAR	850	950	950
Charlotte	Duke Energy	1,090	1,030	1,030
Chicago	ComEd	990	1,020	
Cleveland	Cleveland Public Power	980		
Cleveland	First Energy—The Illuminating Company	1,140		
Colorado Springs	Colorado Springs Utilities	1,080	1,160	1,160
Columbus	AEP Ohio (Columbus Southern Power Company)	1,140	1,140	1,140
Columbus	City of Columbus	1,030		
Dallas	TXU Energy	1,010		
Denver	Xcel Energy	990	1,060	1,060
Detroit	DTE Energy Company	880	1,000	1,020
El Paso*	The Electric Company (El Paso Electric)	1,010	1,060	1,060
Fort Worth	TXU Energy	1,010		
Fresno	Pacific Gas and Electric Company	250	650	1,190
Houston	Entergy Texas	1,080	1,150	1,150
Houston	TXU Energy	1,000		
Indianapolis	Indianapolis Power and Light Company	1,180		1,220
Jacksonville*	Jacksonville Electric Authority	970	1,050	
Kansas City*	Kansas City Power and Light	1,150	1,110	1,110
Las Vegas	NV Energy	970	1,180	1,220
Long Beach	Southern California Edison	150	690	930
Los Angeles	Los Angeles Department of Water and Power	840	1,030	1,030

Continued on next page

Table ES.2 (CONTINUED)

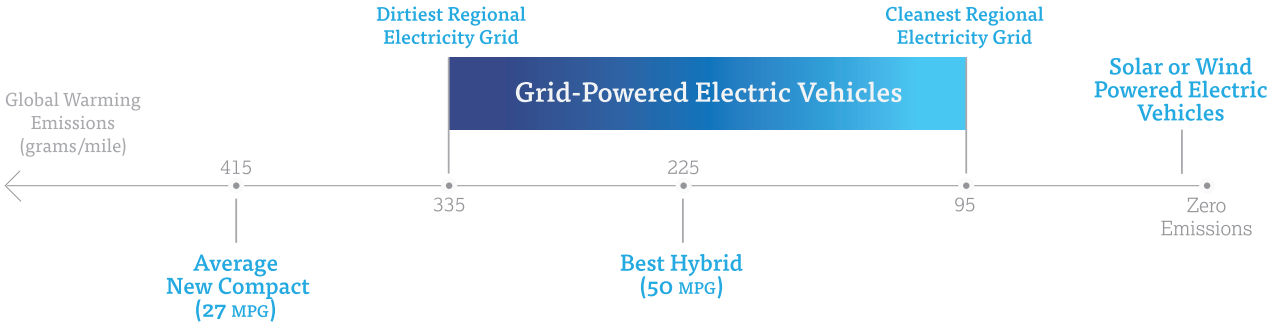
CITY	UTILITY	ANNUAL SAVINGS COMPARED WITH A 27 MPG GASOLINE VEHICLE ($/YR)		
		Standard Rate Plan	TOU-WH	TOU-EV
Louisville*	Louisville Gas and Electric	1,140	1,200	1,200
Memphis*	Memphis Light, Gas and Water Division	1,100		
Mesa*	City of Mesa	1,050		
Miami	Florida Power and Light Company	940	1,050	1,050
Milwaukee	WE Energies	920	1,140	1,140
Minneapolis	Xcel Energy	1,030	1,180	1,180
Nashville	Nashville Electric Service	1,050		
New York City	ConEdison	710	1,050	1,050
Oakland	Pacific Gas and Electric Company	50	500	1,120
Oklahoma City	Oklahoma Gas and Electric Company	1,160	1,220	1,140
Omaha	Omaha Public Power District	1,070		
Philadelphia	PECO Energy Company	770		
Phoenix	APS	870	1,130	1,090
Portland	Portland General Electric	990	1,110	1,140
Portland	Pacific Power	1,010	1,040	1,040
Raleigh	Duke Energy	1,090	1,030	1,030
Raleigh	Progress Energy	1,060	1,170	1,170
Raleigh	Piedmont Electric Membership Corporation	1,010	1,150	1,150
Sacramento	Sacramento Municipal Utility District	840	1,070	1,070
San Antonio	San Antonio Public Service (CPS Energy)	1,090		
San Diego	San Diego Gas and Electric	330	850	840
San Francisco	Pacific Gas and Electric Company	130	560	1,140
San Jose	Pacific Gas and Electric Company	170	590	1,170
Seattle	Seattle City Light	1,060		
Tucson	Tucson Electric Power	1,020	1,070	1,150
Tulsa	Public Service Company of Oklahoma	1,170	1,200	1,170
Virginia Beach	Dominion Virginia Power	1,080	1,180	1,180
Washington, DC*	Pepco	950	840	840
Wichita	Westar Energy	1,100		

Notes:
(1) Vehicle assumptions: Electric vehicle efficiency of 0.34 kWh/mile, gasoline vehicle efficiency of 27 miles per gallon, 11,000 miles per year of driving, and $3.50-per-gallon gasoline. Annual gasoline costs are $1,420. For example, in Albuquerque, an EV charged on the standard rate plan is estimated to cost $520 annually, resulting in annual savings of $900 compared with fueling a gasoline vehicle.
(2) Cost savings on standard rate and TOU-WH assume EV charging is added to the average household electricity consumption. This consumption is based on state-level data (except for California) from the U.S. Energy Information Administration. In California cities, baseline electricity usage was estimated on the basis of tiered-rate assumptions.
(3) Charging assumptions: 3.3 kW Level 2 (from a 240-volt outlet). The amount of off-peak charging varies by utility and rate plan, ranging from 76 percent for the rate plan with the shortest window of off-peak times (five hours for San Diego Gas and Electric) to 94 percent for the rate plan with the longest window of off-peak times (Las Vegas has a 19-hour off-peak period). The remainder of charging is distributed equally throughout the rest of the day. See the methodology in Appendix B for further details.
(4) Based on an inquiry to ComEd in Chicago, the TOU rate is available only on a whole-house basis. Jacksonville Electric Authority also offers only a TOU-WH rate.
(5) TOU-WH rates do not include estimates to changes in household electricity-consumption costs that may occur as a result of switching from a standard rate plan.
(6) TOU rates for Pacific Gas and Electric are under review and are expected to change in the spring of 2012.
(7) The regional electricity emissions data used in this analysis are based on the most recent version of the EPA's eGRID database (which includes power-plant emissions from 2009) available at the time of publication. Utility rate information was collected between March 2011 and January 2012.

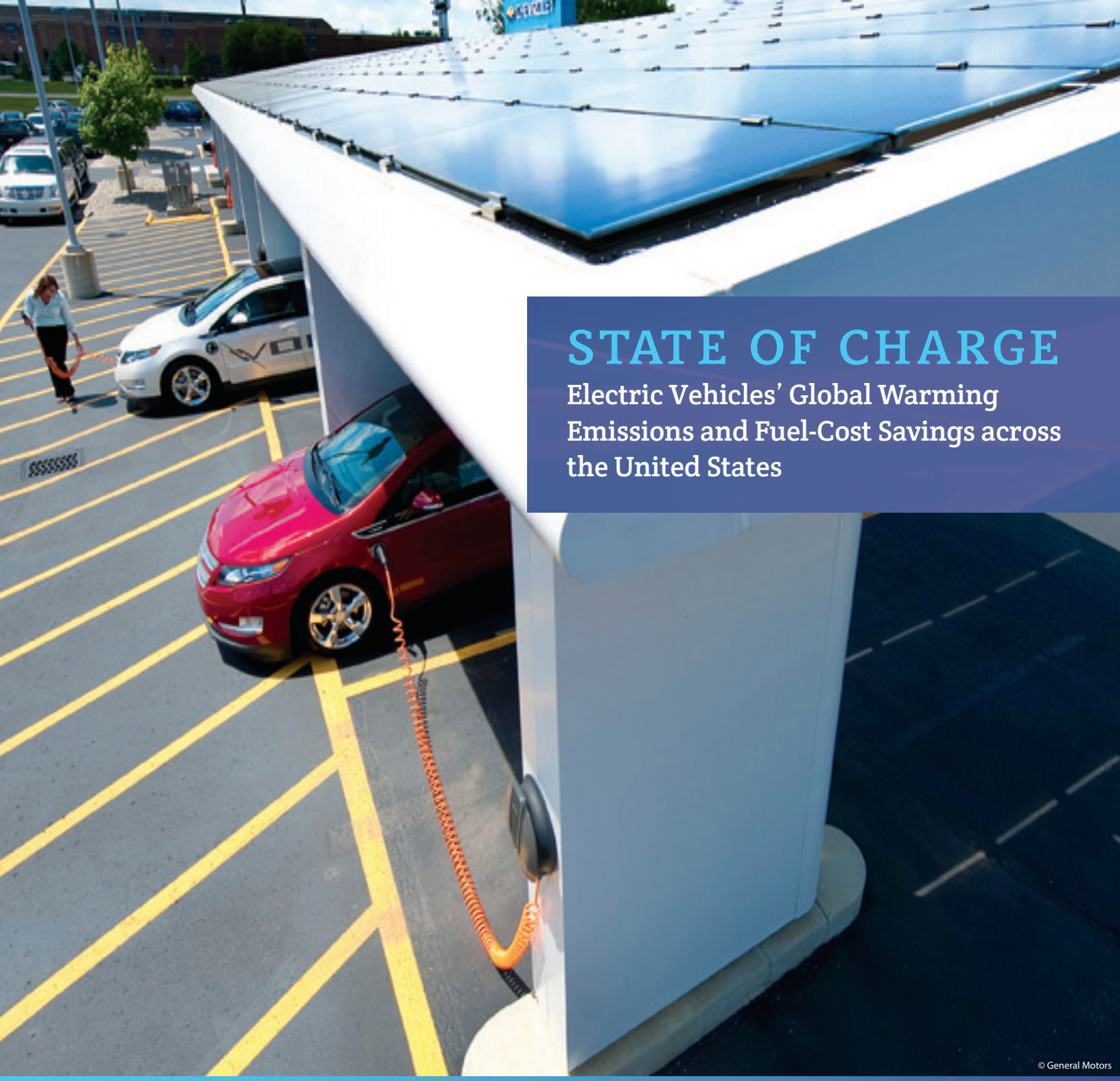
* These cities are served by multiple utilities in different electricity grid regions. The electricity grid regions assigned to these cities were determined by the utility listed.

Figure ES.5. GLOBAL WARMING EMISSIONS OF ELECTRIC VEHICLES COMPARED WITH GASOLINE-POWERED VEHICLES

Electric vehicles have **lower global warming emissions** than the average gasoline-powered vehicle, but how much lower depends on how clean your region's electricity grid is.



Notes: Gasoline mpg comparisons are for combined city/highway EPA fuel economy ratings. Full fuel-cycle accounting is used both for electric vehicle and gasoline vehicle emissions. Global warming emissions per gallon of gasoline are 11,200 grams/mile while electric emissions vary by regional electricity grid and are based on 2009 power plant data from the EPA's eGRID2012 database (the most recent version available). EV efficiency is 0.34 kWh/mile, equivalent to the efficiency of the Nissan LEAF battery-electric vehicle.



STATE OF CHARGE

Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States

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The full text of this report is available on the UCS website at *www.ucsusa.org/clean_vehicles.*

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