



# Economic and Emissions Benefits of Electric Vehicles in Nevada

January 2019



SOUTHWEST ENERGY EFFICIENCY PROJECT

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**Authored by Matt Frommer**

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## About SWEEP

The Southwest Energy Efficiency Project is a public interest organization dedicated to advancing energy efficiency and clean transportation in Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming. For more information, visit: [www.swenergy.org](http://www.swenergy.org)

## About the Author

**Matt Frommer** is the senior transportation associate at SWEEP, where he focuses on electric vehicle policy and EV-grid integration. Matt received a Masters of the Environment in Sustainable Planning and Management from the University of Colorado in 2017. He focused his graduate studies on the electrification of rideshare fleets, and the expansion of electric-vehicle charging infrastructure in Colorado. Matt completed a capstone project with Rocky Mountain Institute's Mobility Transportation team before joining SWEEP. Prior to graduate school, Matt worked as an architect and city planner, specializing in urban mixed-used and residential projects both in the United States and internationally.

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## I. EXECUTIVE SUMMARY

With continued investment and supportive policies, electric vehicles (EVs) have emerged as the most promising clean transportation alternative to gas-powered vehicles. As automakers introduce more diverse and affordable EV models, and as the network of charging stations expands, the market for electric vehicles will continue to grow.

This paper analyzes the true societal value of electric vehicles. Are they really better for the environment? How does EV adoption affect the economy? The results of an economic and emissions impact analysis for EVs purchased and driven in Nevada finds that Nevada EVs today benefit consumers, the state economy, and the environment, and that these benefits will grow over time.

The transition from conventional gas-powered vehicles to EVs will deliver significant emissions reductions for local pollutants and greenhouse gases (GHGs) from the transportation sector. EVs also provide economic benefits in the form of fuel and maintenance savings for individual car owners, which translates into more local spending, more jobs, and a stronger Nevada economy.

When we consider the economic and environmental impact of EVs, the benefits are not fixed values, but instead are highly dependent on a number of local and regional variables ranging from energy prices to the composition of the electricity grid. While EVs do provide benefits in every state in the U.S., they are particularly attractive in Nevada, where relatively inexpensive and mostly coal-free electricity makes Nevada the best state in the Southwest to own an EV from both an economic and emissions perspective.

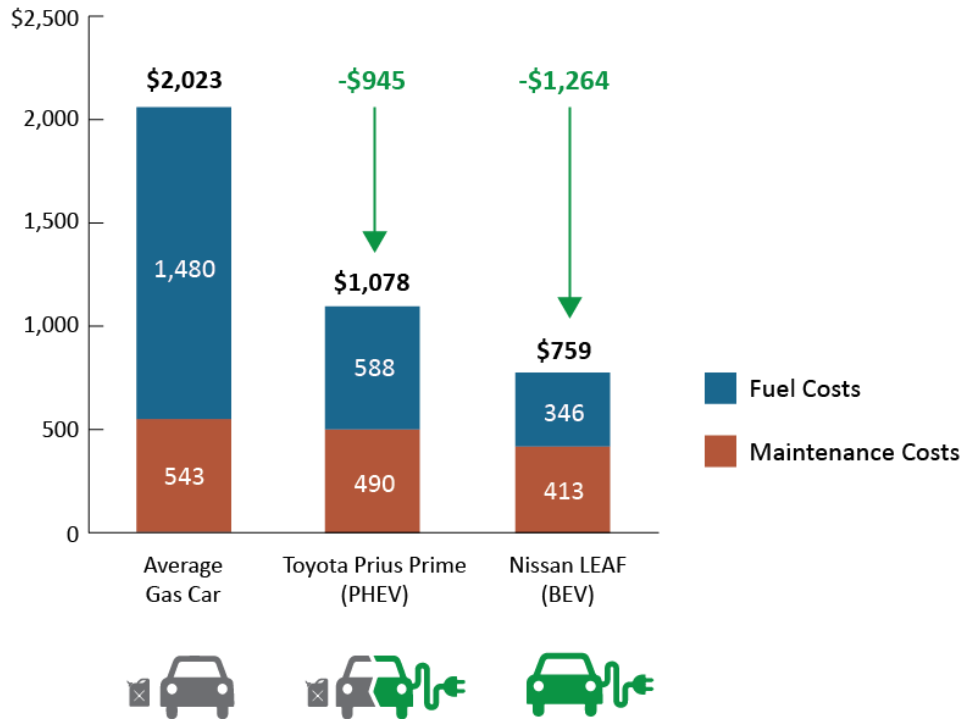
### Economic Benefits of Electric Vehicles

By supporting the adoption of electric vehicles, Nevada will:

**Save money for consumers through reduced fuel and maintenance costs.**

Because of their higher efficiency and the low cost of electricity compared to gasoline per unit of energy, EV owners pay the equivalent of \$1 per gallon to drive their EVs. The cost to recharge an EV is 70 percent lower than it is to refuel a gas-powered car, and these savings translate into local economic activity and new jobs. In Nevada, EV drivers can expect to save between \$945 and \$1,264 annually on fuel and maintenance costs, totaling between \$11,000 and \$15,000 over the life of the vehicle (Figure 1).

**Figure 1. Annual fuel and maintenance costs for the average gas car (26.1 mpg), Plug-in Hybrid Electric Vehicle (PHEV), and Battery-Electric Vehicle (BEV). Source: SWEEP**



**Stimulate the Nevada economy and create new jobs.**

In a high-growth EV scenario with about 650,000 EVs on the road in 2030, the total economic benefit to the state of Nevada in consumer savings could reach \$720 million per year. These savings would be invested in the local economy and create approximately 6,150 new jobs in Nevada, a number that would continue to increase with greater EV adoption.

**Keep energy spending local instead of importing gasoline from out-of-state.**

Nevada does not produce any oil for transportation consumption, so virtually all of its transportation fuel is imported from outside the state. As a result, about \$4 billion leaves the state economy every year (U.S. EIA, 2018). As Nevada transitions its transportation fuel source from gasoline to electricity, those energy dollars stay inside the state economy.

**Save money for all Nevadans by lowering electric bills.**

Managed EV charging will shift most charging to off-peak demand periods, which will allow more efficient use of electrical generating capacity, make it easier to integrate renewables, and exert downward pressure on electricity rates for all customers. A recent study in Arizona found that electricity ratepayers will save an average of \$180 annually by 2050 in a high-EV adoption scenario (MJB&A, 2018). Electricity customers in Nevada can expect similar long-term savings, regardless of whether they own an EV.

## Environmental Benefits of Electric Vehicles

### **Improve local air quality for Nevada residents.**

Electric vehicles have enormous potential to improve public health and lower healthcare costs for Nevada communities by reducing harmful tailpipe emissions. Nevada has retired 90 percent of its coal-fired generation since 2005 and, as a result, has the cleanest electricity grid and the greatest emissions reductions (compared to gas-powered cars) of any state in the Southwest (U.S. EIA, 2018). Of particular note are reductions of volatile organic compounds (VOCs) and nitrogen oxide (NOx) emissions, the two precursors to ground-level ozone, which cause respiratory issues, particularly for vulnerable populations such as children, seniors, and people with pre-existing conditions like asthma. EVs decrease VOC emissions by 99 percent and NOx by 84 percent when compared to the average gas-powered car. Clark and Washoe Counties face ozone and particulate challenges, and light-duty vehicle emissions are a significant source of pollutants that contribute to this problem (U.S. EPA, 2018). Supporting widespread adoption of EVs is an important strategy for improving air quality in the state.

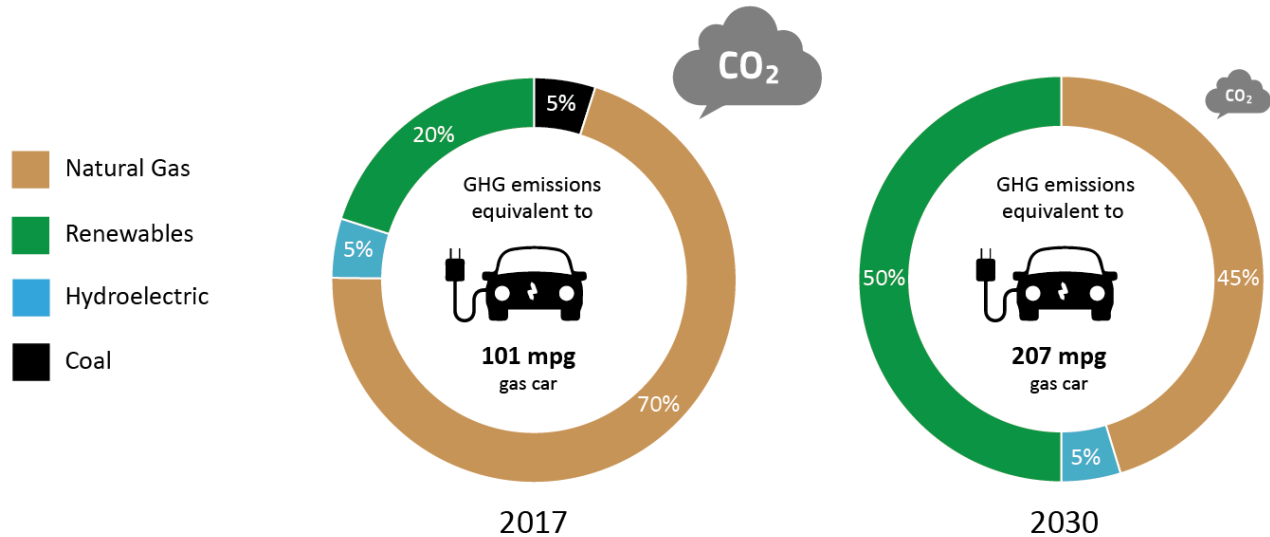
### **Reduce Greenhouse Gas (GHG) emissions**

Electric vehicles are a key global strategy to curb transportation emissions as we race to limit the extent of global warming and to prevent future environmental and economic disasters. EVs offer an opportunity for Nevada to leverage the successful decarbonization of its electricity sector and also to reduce emissions from transportation. In 2017, a new EV in Nevada released the same amount of GHG emissions as a gas-powered car with a 101-mpg fuel efficiency. Unlike gas-powered cars, where fuel efficiency is virtually fixed at the point of purchase, EV emissions benefits increase each year as the electricity grid gets cleaner. An increase in renewable generation from 20 percent in 2017 to the proposed Renewable Portfolio Standards (RPS) of 50 percent by 2030 would further reduce emissions, so by 2030, total GHG emissions from that same EV would equate to 207-mpg gas car.

A high-adoption EV scenario, with 650,000 EVs on Nevada's roads in 2030, would remove 1.6 million metric tons of carbon dioxide (CO<sub>2</sub>) per year from the state's transportation sector. These avoided emissions from EV adoption would have the same climate benefit as retiring one of the two 205-megawatt (MW) coal-fired generators at North Valmy Power Plant, the last utility-owned coal-fired power plant in the state.



**Figure 2. Nevada electricity grid mix and equivalent GHG emissions from electric vehicles compared to gasoline-powered cars (2017 vs 2030).**



### Policy Recommendations

The benefits of EVs are clear and, in the absence of federal leadership on clean energy, states and local governments must take the wheel on climate action and establish policies and programs that accelerate the adoption of EVs. Such policies in Nevada might include:

- **Electric Vehicle Purchase incentives:** A state rebate or tax credit toward the purchase of EVs and EV charging stations.
- **Clean Car Standards:** Join California and 13 other states in preserving the existing 2021-2025 fuel efficiency standards, and adopt Zero-Emission Vehicle (ZEV) standards to set baseline ZEV sales.
- **Expand utility investment programs in EV charging infrastructure:** Build off existing utility pilot programs and expand the network of EV charging stations and customer education programs.
- **Local government action:** Cities and counties can set meaningful targets with programs and policies to electrify municipal fleets, transit buses, school buses, taxis, transportation network companies (TNCs) such as Lyft and Uber, and all vehicles in the community.

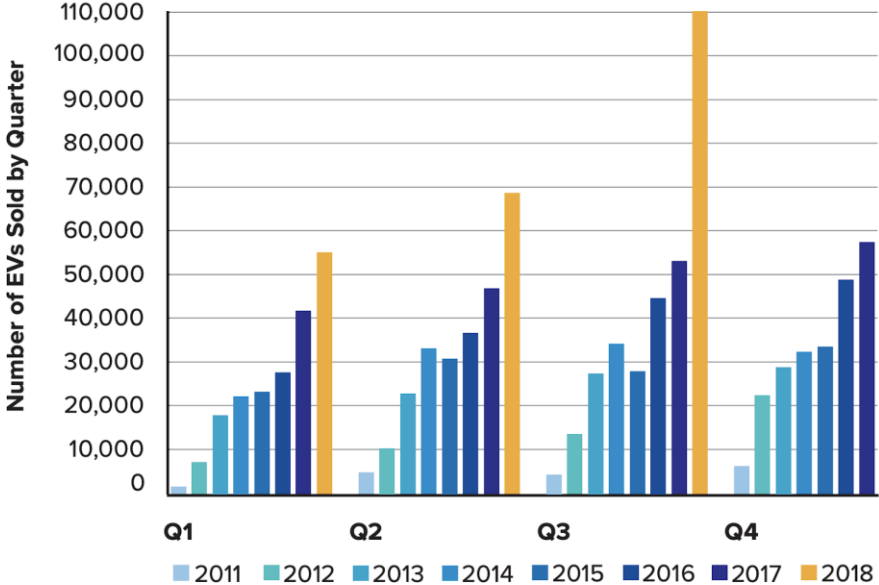
## II. BACKGROUND

### State of the Electric Vehicle Market

The U.S. electric vehicle market has reported 30 straight months of year-over-year sales growth and is showing no signs of slowing down (Inside EVs, 2018). This growth has been spurred by a combination of greater investment in EV charging infrastructure, the arrival of new and more affordable EV models on the market, and bold government policy goals, programs, and incentives.

The national electric vehicle market share, or the percentage of new car sales that are EVs, doubled from third quarter (Q3) 2017 to third quarter 2018 (EEI, 2018). Nevada is keeping pace with the national trend and currently ranks 12th in EV market share, with a rate that is quickly approaching 2 percent of all vehicles sold in the state (Alliance of Automobile Manufacturers, 2018). Even so, the Nevada EV market is still maturing and only 5,800 of the 2,335,000 total vehicles on Nevada’s roads, or just 0.25 percent, are electric.

**Figure 3. U.S. electric vehicle market quarterly growth (2011-2018). Source: *EEI***



In the last few months, sales growth has been driven by the Tesla Model 3, which accounted for over 50 percent of all EV sales in Q3 2018. The company continues to concentrate on lowering battery costs in an effort to reduce the price tag on the Model 3, to an anticipated base price of \$35,000. Even without the \$7,500 federal tax credit, such a price would compete with the average price for new vehicles, which was \$37,000 in October 2018 (KBB, 2018). Tesla’s success demonstrates that there is an emerging appetite for EVs in the American car market, and this proof of concept has motivated other auto manufacturers to shift their investments toward the production of long-range EVs.

In October, 2018, there were 43 different electric vehicle models on the market in the U.S., including 15 battery-electric vehicles (BEVs) with an all-electric range, and 28 plug-in hybrid-electric vehicles (PHEVs), which have both an electric motor and a back-up gasoline engine (Inside EVs, 2018). This new model availability is impressive when compared to the numbers from a couple of years ago, but the EV market is still maturing.

As a response to accelerating market growth and bold government climate policies, every major auto manufacturer in the world has announced a plan to electrify a significant portion of the vehicle fleet over the next 3 to 5 years. Ford recently announced an \$11 billion investment to reach its goal of 40 EV models by 2022 (Carey, 2018). The goal for General Motors: 20 EV models by 2023 (Korošec, 2017); for Volkswagen: 27 EV models by 2022 (Everts, 2018); and for Toyota: 10 BEVs by the early 2020's (Kageyama, 2017).

One of the biggest barriers to electric vehicle adoption has been a lack of model diversity. Over the last several decades, the U.S. car market has shifted away from traditional compact cars and towards larger vehicles like crossovers (CUVs), sports-utility vehicles (SUVs), and pickup trucks. In Nevada, 40 percent of new vehicle purchases are compact cars, and 40 percent are SUVs/CUVs, followed by pickups at 15 percent, and minivans at 5 percent. This is a shift from historical sales trends as only 27 percent of registered vehicles in Nevada are in the SUV/CUV classification (Alliance of Automobile Manufacturers, 2018).

In the early years of EV development, the high cost of lithium-ion batteries constrained battery sizes and guided early electrification efforts toward smaller and lighter EVs like the Nissan LEAF, Chevy Bolt, and Toyota Prius Prime. But as battery prices continue to decline, we are now seeing larger batteries in bigger vehicles and at a lower cost. According to multiple announcements from global automakers, by 2022, there will be at least 90 EV models on the U.S. market and almost one-third of those will be CUVs, SUVs, or trucks.

### III. ECONOMIC BENEFITS OF ELECTRIC VEHICLES

#### Declining Costs and Mass Market Potential for EVs

Some people have argued that EVs are a “rich man’s toy” or a luxury purchase for a niche market demographic of wealthy environmentalists. This may have been an accurate characterization during the “early adopter” phase, but it is changing quickly.

As with other clean energy technologies like solar photovoltaic energy, the cost of lithium-ion batteries is quickly progressing along the technology learning curve and has fallen by more than 80percent since 2010, from \$1,000/kilowatt hour (kWh) to around \$200/kWh. Many industry experts predict that the cost will cross the \$100/kWh threshold in 2019, which will further reduce the vehicle price tag (McMahon, 2018).

For context, the 2018 Chevy Bolt has a 60-kWh battery, which would have cost \$60,000 to produce in 2010, but in 2019, could cost as little as \$6,000, a 90 percent decrease that is passed on to the consumer. According to Bloomberg New Energy Finance, “Electric cars may be cheaper than their petroleum counterparts by 2025 if the cost of lithium-ion batteries continues to fall.” (Hodges, 2018).

According to the EIA’s Annual Energy Outlook from 2018, the average retail price for a new gasoline powered compact car is \$24,600, which is around the price of a 2018 Toyota Camry, the top-selling sedan on the market. When we factor in the federal EV tax credit of \$7,500, there are 17 EVs on the market today that are cost-competitive with the average gas-powered compact car (Table 1). After the tax credit, eight of these options are less expensive than the average gas car, and the other nine EVs recover the incremental cost through fuel and maintenance savings over the first 1 to 5 years.

**Table 1. List of the most affordable EV models on the market in 2018 compared to the \$24,600 price tag of the average gasoline-powered compact car. Source: SWEEP**

	Make	Model	Type	MSRP (\$)	After tax credit (\$)	Incremental Cost (\$)*	Payback Period (years)
1	Chevrolet	Bolt	BEV	37,495	29,995	5,395	4.2
2	Chevrolet	Volt	PHEV	34,095	26,595	1,995	2.1
3	Fiat	500e	BEV	32,995	25,495	895	0.7
4	Ford	Focus Electric	BEV	29,120	21,620	<b>-2,980</b>	-
5	Ford	Fusion Energi	BEV	31,400	23,900	<b>-700</b>	-
6	Honda	Clarity	PHEV	33,400	25,900	1,300	1.4
7	Hyundai	Ioniq Electric	PHEV	29,500	22,000	<b>-2,600</b>	-
8	Hyundai	Ioniq Plug-in Hybrid	BEV	24,950	17,450	<b>-7,150</b>	-
9	Hyundai	Kona	BEV	36,450	28,950	4,350	4.6
10	Kia	Soul EV	BEV	33,950	26,450	1,850	1.4
11	Kia	Niro	BEV	27,900	20,400	<b>-4,200</b>	-
12	Kia	Optima Plug In	PHEV	35,210	27,710	3,110	3.3
13	Mini	Cooper SE Countryman	PHEV	36,900	29,400	4,800	5.1
14	Mitsubishi	Outlander	PHEV	34,595	27,095	2,495	2.6
15	Nissan	Leaf	BEV	29,990	22,490	<b>-2,110</b>	-
16	Toyota	Prius Prime	PHEV	27,300	19,800	<b>-4,800</b>	-
17	Volkswagen	e-golf	BEV	31,345	23,845	<b>-755</b>	-

*\*Incremental Cost includes the \$7,500 federal tax credit.*

Additionally, the most recent data from U.S. car dealers indicate that 86 percent of new car buyers finance their vehicle purchase over an average loan period of 68 months (Delbridge, 2018). A BEV will save the average driver \$105 in fuel and maintenance costs starting in the first month of ownership. When accrued over a 68-month loan period, these savings would offset a \$7,140 EV purchase premium, and in many cases, provide net savings in the first month of payments.

## Consumer Savings

The incremental cost of buying an EV is offset by two big savings opportunities: first, purchasing incentives offered in the form of a \$7,500 federal tax credit or a state EV tax credit; and second, lower fuel and maintenance costs over the lifetime of the vehicle.

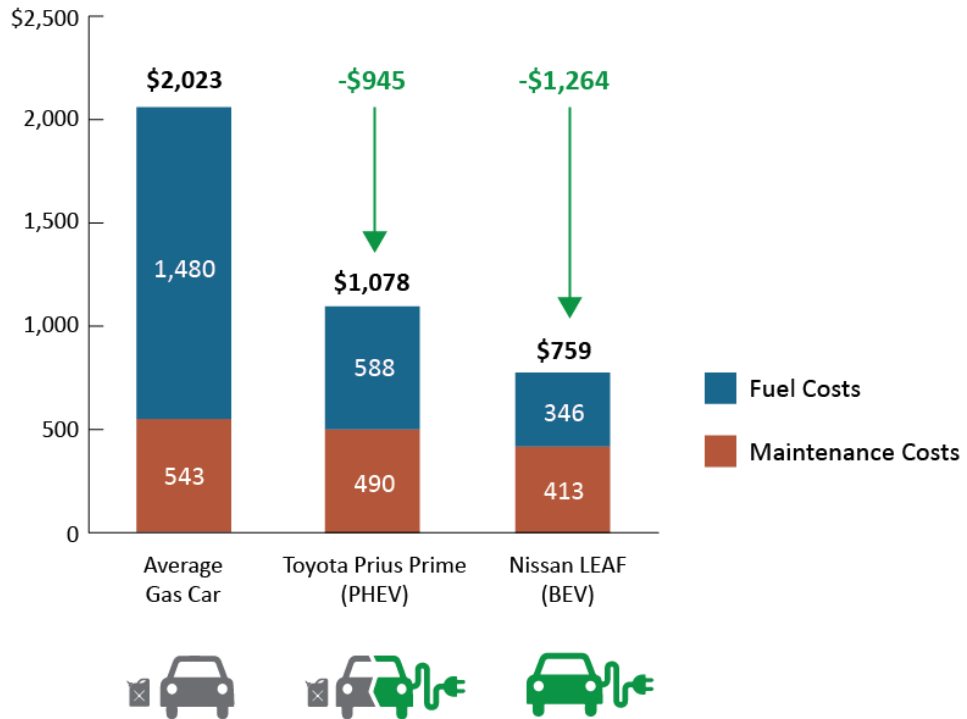
In states like Nevada, where gasoline prices are above-average and electricity prices are relatively low, the savings opportunity is greater than it is for the majority of Americans. The cost to recharge an EV in Nevada translates to about \$1 per gallon, approximately 70 percent lower than the average price of gasoline, which was \$3.24 per gallon as of October 2018. Additionally, since electric vehicle motors have fewer moving pieces and regenerative braking preserves brake components, the annual maintenance costs are 10 percent to 25 percent lower than they are for gas-powered vehicles (Palmer, 2017).

For the purposes of this study, we chose to evaluate the top selling EV models in 2018 against the average new gas-powered compact car, which costs \$24,600 and achieves a fuel efficiency rating of 26.1 mpg. The top selling PHEV in 2018 is the Toyota Prius Prime with a \$27,300 MSRP and an 8.8 kWh battery that provides 25 miles of all-electric range before switching to the gas engine. The Toyota Prius Prime has sold 22,500 units and, as of October 2018, had accounted for over 8 percent of total EV sales in 2018. PHEVs tend to provide less long-term savings than BEVs because they use gasoline, a more expensive fuel, for roughly 50 percent of their travel.

Battery Electric Vehicles (BEVs) like the Nissan LEAF, Chevy Bolt, and all Tesla models run exclusively on electricity and have larger batteries and longer ranges. Most of the new BEV models have 200+ mile ranges and the Tesla models average over 300 miles per charge, which is more than enough to support the daily driving habits for the average American, which is about 30 miles per day (Johnson, 2016). For this analysis, we chose the Nissan LEAF, which is the top-selling mass market BEV with 125,000 sales over the last six years and a retail price of \$29,990.

When we add up the fuel and maintenance savings for these vehicles, Nevada EV drivers can expect to save \$945 per year with a Toyota Prius Prime and \$1,264 per year with a Nissan LEAF, totaling between \$11,000 and \$15,000 over the life of the vehicle. The \$7,500 federal tax credit brings the price of a Toyota Prius Prime down to \$19,800 and the Nissan LEAF down to \$22,490. Even without these tax credits, the capital cost premium of buying an EV would be completely recovered by fuel and maintenance savings in two years for a Prius Prime and four years for a Nissan LEAF.

**Figure 4. Annual fuel and maintenance costs for the average gas car (26.1 mpg), Plug-in Hybrid Electric Vehicle (PHEV), and Battery-Electric Vehicle (BEV). Source: SWEEP**



### Macroeconomic Benefits for Nevada

We modeled a high-growth EV scenario, in which 26 percent of vehicles (650,000 vehicles) in Nevada would be EVs by 2030, which could provide a total economic benefit of \$720 million per year in consumer savings. These economic benefits are likely to increase alongside the price of gasoline which, according to the EIA’s 2018 Annual Energy Outlook projections, will increase 35 percent by 2030. The money saved from reduced fuel costs will result in consumers spending less disposable income on imported energy and more on local goods and services.

Nevada stands to gain additional economic benefits from EVs at a macro-economic level because of its unique energy market. Nevada does not produce any oil for motor vehicle consumption, so virtually all of its transportation fuel is imported from outside the state. As a result, about \$4 billion leaves the state economy every year (U.S. EIA, 2018). As Nevada transitions its transportation fuel source from gasoline to electricity, those energy dollars stay inside the state economy.

Producing and supplying energy is one of the least employment-intensive sectors of the economy, so shifting expenditures away from this sector and towards local goods and services will create more local jobs. An additional dollar of household spending will create 16 times more jobs than if that dollar is spent on fossil fuels (Roland-Holst, 2012). The jobs created by this additional spending are spread throughout the economy, not focused in the vehicle or alternative fuel sectors; therefore, all income levels will benefit from the fuel savings benefits of EVs.

Without the development of a detailed model that could predict the employment benefits of EVs, it is not possible to provide precise estimates of this impact. However, one methodology provides an approximate estimate of the scale of employment benefits offered by EV fuel savings in Nevada.

In 2012, Dr. David Roland-Holst, an economist at the University of California, Berkeley, analyzed the economic and job creation impacts of two EV market penetration scenarios for California. This analysis found that, if EVs comprise 15.4 percent of new vehicle sales by 2030, then nearly 50,000 additional jobs would be created in California from the fuel savings (compared to a baseline scenario). We can apply these calculations to the Nevada economy to estimate the approximate job creation under two different EV adoption scenarios.

The first “baseline” market penetration scenario comes from the U.S. Energy Information Administration (EIA) who estimates a 9.2 percent EV penetration in the Mountain region by 2030. These projections closely align with the Zero-Emissions Vehicle (ZEV) standard requirements if EV sales growth is projected forward beyond the current 2025 standards. At this moderate-growth rate, the total economic benefits of EVs would produce 2,176 new jobs in Nevada.

A high-growth EV scenario would result if Nevada were to reduce total light-duty GHG emissions 80 percent by 2050 over 2005 levels with 80 percent carbon-free electricity. This would result in a 26 percent EV penetration in 2030. In this high-growth scenario, the transition to EVs would produce 6,150 new jobs in Nevada, and almost 4,000 more than the moderate-growth scenario.

### **Benefits for All Electric Utility Customers**

As demonstrated by more mature EV markets on the West Coast, widespread electric vehicle adoption has the potential to increase electricity grid efficiency and save all electricity customers money on their electric bills.

The electricity grid is subject to large fluctuations in demand that resemble a sine-wave, where energy use clusters around peak consumption in the afternoon and then dips at night when people turn off the lights and go to sleep. In many cases, load growth increases peak consumption levels and leads to new and expensive power plants, and these additional costs are passed onto electricity ratepayers. Electric vehicles, however, offer a flexible load because they are parked 95 percent of the day and, therefore, are able to charge during off-peak demand periods and at times that will most benefit the electricity grid, thus improving grid efficiency.

EVs are a major grid asset and offer an opportunity for utilities to sell more electricity without necessarily having to increase their generation capacity. This improved grid efficiency will exert downward pressure on rates and benefit all electricity customers. This analysis has not yet been conducted in Nevada, but the issue has been studied in numerous other states.



One study by MJ Bradley in Colorado found that a high-growth EV scenario will save all electricity customers \$80 per year on their energy bills by 2050, regardless of whether they own an electric vehicle (MJB&A, 2017). A similar study in Arizona found that electricity ratepayers will save an average of \$180 annually by 2050 in a high-EV adoption scenario (MJB&A, 2018). The benefit will typically be greatest in states where there is a larger difference between the peak electricity consumption and average demand. A 2016 analysis found that Nevada Power and Sierra Pacific Power have the largest peak-to-average ratios in the region, so we would expect a larger benefit in Nevada (Salisbury, 2016).

Utilities can further capitalize on EVs as a distributed energy resource by introducing pricing signals or time-of-use (TOU) rates that incentivize off-peak charging. In Nevada, NV Energy, the major electric utility in Washoe and Clark counties, has introduced optional TOU rates for single-family residential customers with specific pricing for EV charging. This pricing strategy has proven to be an effective mechanism for load shifting from peak to off-peak demand periods.

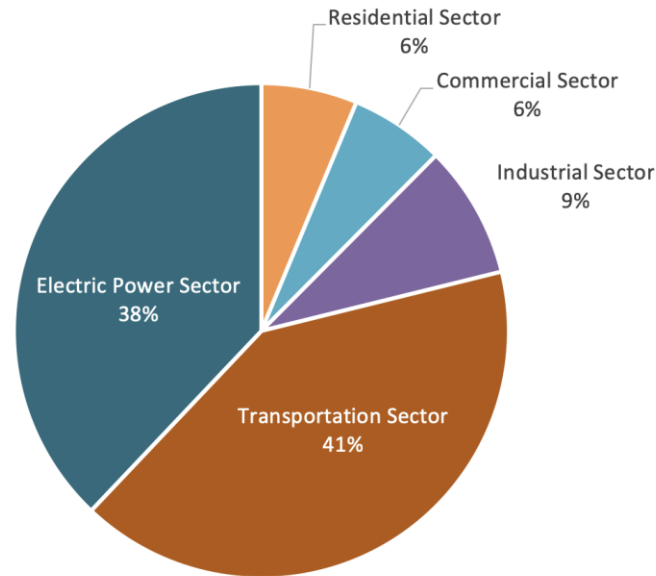
The grid benefits of EVs are particularly exciting when we look forward to a future of renewable energy in Nevada. Wind and solar are variable energy sources, so generation does not always align with electricity demand. For solar energy, TOU price signals can be coupled with flexible EV charging to maximize solar generation in the middle of the day when the sun is shining.

#### IV. EMISSIONS BENEFITS OF ELECTRIC VEHICLES

One common misconception about EVs is that they are not actually cleaner than gas-powered cars and that they merely displace air pollution from the tailpipe to dirty power plants. In reality, not only are EVs cleaner than gas cars in every state, but they are especially clean in Nevada, where the electric utilities have phased out coal-fired generation and replaced it with less carbon-intensive natural gas and renewable energy sources.

##### The Energy Picture in Nevada

In 2015, the transportation sector surpassed the electricity sector as the largest source of GHG emissions in the United States. The two largest energy sectors are trending in opposite directions. The electricity sector is reducing emissions through coal plant retirements, greater deployment of renewables, and energy efficiency measures. At the same time, the transportation sector is increasing emissions as the U.S. car market shifts from smaller, more fuel-efficient cars, to larger less efficient ones, and low gasoline prices encourage people to drive more. Electric vehicles offer an opportunity for the transportation sector to leverage the successes of the electricity sector to reduce emissions.

**Figure 5. GHG emissions by energy sector in Nevada (2017)***Source: EIA's State Carbon Dioxide Emissions Data*

In Nevada, the transportation sector accounts for 41 percent of GHG emissions while the electricity sector accounts for 38 percent. The recent shake-up in the biggest polluter rankings is mostly a result of the transition away from coal and toward less-carbon intensive fuel sources like natural gas and renewable energy. From 2005 to 2017, Nevada's electric utilities retired the Mojave Generating Station and the Reid Gardner Station, the two largest coal-fired power plants in the state, and reduced their share of coal-fired generation by 90 percent, from 46 percent of the electricity mix to just below 5 percent (Sourcewatch, 2018). That leaves North Valmy Generating Station as the last utility-owned coal-fired power plant in the state. NV Energy plans to retire the first unit in 2021, and the other in 2025, and replace it with over 1 gigawatts (GW) of solar PV generation and 100 MW of battery storage. With such a low share of coal-fired generation, the Nevada grid is the cleanest grid in the southwestern U.S. and, therefore, provides the greatest potential for emissions reductions through EV adoption.

Most of the retired coal-fired generation capacity has been replaced with natural gas, but a portion is now supplied with renewables, which grew from 5 percent of electricity generation to 20 percent between 2005 and 2017. The solar industry continues to grow in Nevada, which is widely known for having the nation's best solar resource. Nevada also has the country's largest geothermal energy potential, and is second only to California in geothermal power production (U.S. EIA, 2018).

Nevada's electricity grid is on track to get even cleaner. Nevada's current Renewable Portfolio Standards (RPS) requires the electricity sector to source 25 percent of its generation from renewables by 2025. In 2018, Nevada voted to update its RPS to a 50 percent renewable requirement by 2030, although under Nevada state law, the ballot measure must pass a second time in 2020 to take effect. If achieved, these renewable energy goals would cut GHG emissions from EVs in half by 2030.

## Air Quality Benefits

In the case of transportation, emissions can be thought of in two categories: criteria pollutants, which threaten local air quality and public health, and GHG emissions, the primary cause of global climate change. This analysis evaluates emissions for the following criteria pollutants: ground-level ozone precursors, such as volatile organic compounds (VOCs) and nitrogen oxides (NO<sub>x</sub>); particulate matter of 2.5 and 10 micrometers (PM<sub>2.5</sub> and PM<sub>10</sub>); carbon monoxide (CO); and sulfur dioxide (SO<sub>2</sub>). These pollutants cause respiratory issues, particularly for vulnerable populations such as children, seniors, and people with pre-existing conditions like asthma. As a result, these six criteria pollutants are regulated by the National Ambient Air Quality Standards (NAAQS) under the federal Clean Air Act.

Of particular relevance to Nevada is a chemical compound known as ground-level ozone (O<sub>3</sub>), which is formed when two criteria pollutants, VOCs and NO<sub>x</sub>, combine in the presence of sunlight. High in the atmosphere, ozone protects our planet from solar radiation, but close to the ground, O<sub>3</sub> becomes a dangerous pollutant. More commonly known as “smog,” high ozone levels accumulate in the hot Nevada summers and pose a serious threat to public health. Clark County, which contains Las Vegas and 74 percent of Nevada’s population, exceeded the NAAQS ozone limits in 2018 for the first time since 2012, and motor vehicle emissions were the main culprit. Both Washoe and Clark Counties also have a history of nonattainment for PM<sub>10</sub>, where levels exceeded the NAAQS as recently as 2015.

According to the American Lung Association’s “State of the Air Report” from 2017, the Las Vegas metro area ranks 10th for worst ozone pollution and the Reno-Sparks area ranks 10th for worst short-term particle pollution (PM) (ALA, 2017).

Unlike gas-powered cars, EVs have zero tailpipe emissions. For EVs, both the energy generation and the emissions byproduct are relocated from the vehicle to the power plant. In the case of Nevada, the highest polluting coal-fired power plant, North Valmy, is located outside the urban airshed and more than 200 miles from the main population centers in Washoe and Clark counties, and so this emissions displacement provides big air quality benefits for urban communities.

In order to calculate the emissions benefits for criteria pollutants and GHGs in Nevada, we used the Greenhouse gases, Regulated Emissions, and Energy use in Transportation Model or GREET, developed by the Argonne National Lab. The tool collects inputs (such as average vehicle fuel efficiency and electricity grid mix) and calculates the well-to-wheel emissions per mile for a variety of vehicle types, including conventional gas vehicles, PHEVs, and BEVs. For this analysis, we input Nevada-specific energy data to determine the emissions reductions for EVs compared to the average gas-powered vehicle.

Table 2 lists these values for 2017 and 2030, when an updated RPS standard would require Nevada to source 50 percent of its energy from renewables. The electric vehicle emissions benefits are

measured against the average new gasoline powered vehicle, which gets 26.1 miles per gallon (mpg) in 2017 and 35.5 mpg in 2030. As shown below, there are significant emissions reductions for every criteria pollutant as well as GHGs. Of relevance for Nevada, and for Clark County in particular, are the emissions reductions for VOCs, which for BEVs are reduced by 99 percent in 2017 and 100 percent in 2030; and for NO<sub>x</sub>, which are reduced 84 percent in 2017 and 88 percent in 2030.

Based on the current fuel economy standards, the EIA anticipates continued improvements in the fuel efficiency for new gas-powered cars from 26.1 mpg in 2017 to 35.5 mpg by 2030. Even with these trends, EV emissions benefits continue to grow each year. The 2030 projections shown in Table 2 below are conservative estimates as they do not account for highly anticipated technological advances in electric vehicles, such as solid-state batteries.

**Table 2. Percent Reduction in Emissions Compared to New Gasoline Vehicle**

Pollutant	2017 (Compare to 26.1 mpg gas vehicle)		2030 (Compare to 35.5 mpg gas vehicle)	
	Toyota Prius Prime (PHEV)	Tesla Model 3 (BEV)	Toyota Prius Prime (PHEV)	Tesla Model 3 (BEV)
VOC	-63%	-99%	-67%	-100%
NO <sub>x</sub>	-47%	-84%	-54%	-88%
PM <sub>10</sub>	-18%	-34%	-17%	-34%
PM <sub>2.5</sub>	-31%	-58%	-33%	-58%
SO <sub>2</sub>	-26%	-51%	-67%	-51%
CO	-49%	-99%	-56%	-99%
GHGs	-44%	-74%	-55%	-83%
MPGe (GHGs)	46	101	78	207

## Climate Benefits

The second air pollution category is GHG emissions (such as CO<sub>2</sub>), that cause global climate change. In 2018, the United Nations Intergovernmental Panel on Climate Change (IPCC) released a report detailing the catastrophic impacts of warming the planet 2 degrees Celsius (3.6 degrees Fahrenheit) (IPCC, 2018).

According to the report, human activity already has increased the temperature of the planet by 1 degree Celsius over pre-industrial levels, a warming that is accelerating the frequency and intensity of sea-level rise, drought, wildfires, and tropical storms, all of which puts large, vulnerable populations at considerable risk. There is still time to limit the warming to 1.5 degrees Celsius if we somehow, through energy market transformation and behavioral change, manage to reduce GHG emissions 45 percent below 2010 levels by 2030 and reach net-zero energy by 2050. For an American culture that has designed most of its cities around the car, electric vehicles represent one of the most promising opportunities for humans to decarbonize the transportation sector in the near-term.

Electric vehicles are only as clean as the electricity grid that charges them, and as the Nevada electricity sector continues to decarbonize and transition toward renewables, EVs will continue to become cleaner. In 2017, a new BEV in Nevada released the same amount of GHG emissions as a gas-powered car with a 101-mpg fuel efficiency. An increase in renewable generation from 20 percent in 2017 to 50 percent in 2030 would further reduce emissions and, in 2030, total GHG emissions from that same EV would equate to a 207-mpg gas car. Unlike gas-powered cars, where fuel efficiency is virtually fixed at the point of purchase, EVs reduce emissions over time in lock-step with the electricity grid.

A high-EV scenario with a 26 percent EV penetration and 650,000 EVs on Nevada's roads in 2030 would remove 1.6 million metric tons of CO<sub>2</sub> per year from the state's transportation sector. These avoided emissions from EV adoption would have the same climate benefit as retiring one of the two 250 MW coal-fired generators at North Valmy Power Plant, the last utility-owned coal-fired power plant in the state. Using the U.S. government's Interagency Working Group on Social Cost of Greenhouse Gas estimate of \$50/Metric Ton of GHG, the total societal benefits of EV adoption would be \$80 million in 2030. The social cost of carbon represents potential cost savings from avoiding the negative effects of climate change and have been traditionally used by federal agencies to value the climate impact of climate policies.

## V. POLICY RECOMMENDATIONS

The benefits of EVs are clear and, in the absence of federal leadership on clean energy, states and local governments must take the wheel on climate action and establish policies and programs that accelerate the adoption of EVs. Such policies in Nevada might include:

- **Electric Vehicle Purchase incentives:** A state rebate or tax credit toward the purchase of EVs and EV charging stations.
- **Clean Car Standards:** Join California and 13 other states in preserving the existing 2021-2025 fuel efficiency standards, and adopt Zero-Emission Vehicle (ZEV) standards to set baseline ZEV sales.
- **Expand utility investment programs in EV charging infrastructure:** Build off the success of existing utility pilot programs and expand the network of EV charging stations and customer education programs.
- **Local government action:** Cities and counties can set meaningful targets with programs and policies to electrify municipal fleets, transit buses, school buses, taxis, TNCs, and all vehicles in the community.

### EV Purchase Incentives

A recent study published by the National Association of State Energy Officials (NASEO) found that vehicle purchase incentives, such as rebates and tax credits for new electric vehicles, are the most effective policy tool for accelerating EV adoption (NASEO, 2018). These state incentives are combined with a \$7,500 maximum federal tax credit to reduce the upfront costs of new EV purchases.

The impact of this policy was clearly demonstrated in July of 2015, when Georgia's \$5,000 EV tax credit expired and they replaced it with a punitive \$200 EV registration fee. In June, Georgia's EV market share was 3.68 percent and the highest in the country, but after the tax credit expired and the EV fee was introduced, it dropped to 0.29 percent, where it stayed for the rest of the year. More than three years later, the Georgia EV market hasn't fully recovered and it remains in the middle of the pack with about 1 percent EV market share.

EV purchase incentives are currently available in 10 states and range from \$1,750 in Pennsylvania to as much as \$5,000 in Colorado, with an average purchase incentive of around \$3,000 (Slowik, 2018). Multiple studies have indicated a strong correlation between the size of the purchase incentive and an increase in EV sales. Connecticut designed its EV rebate program so that funds are focused on longer-range, all-electric vehicles (BEVs) that will provide the greatest emissions reductions. The program also set a price cap for eligible vehicles at \$50,000 to direct state funding toward those who need it and away from luxury vehicle purchases (Feinleib, 2018).

A number of other factors contribute to the success of the incentive program including the type of incentive (rebate vs. tax credit), how well the incentive is advertised, and the longevity of funding for the incentive. The most effective incentives are “cash on the hood” where the discount is available at the point-of-sale, through a dealership discount, rebate, or an assignable tax credit. The more successful EV tax credits are also refundable, which means that the customer can collect the full discount amount regardless of their tax appetite.

A Nevada EV purchase incentive would be particularly timely given the impending phase-out of the federal EV tax credits over the next several years. The federal EV tax credit is designed to begin phasing out once an auto manufacturer has sold 200,000 electric vehicles. Tesla was the first automaker to reach the 200,000-vehicle cap in Q3 2018, and so the available tax credit will be cut in half, from \$7,500 to \$3,750, starting on January 1, 2019. General Motors hit the same mark in Q4 2018, and Nissan, Toyota, and Ford are projected to follow soon after (EV Adoption, 2018). With the current climate politics in Washington D.C., it is unlikely that the federal EV tax credit will be revived or expanded in the near-future, which makes it all the more important for states to offer their own purchase incentives to avoid a slump in the EV market.

Nevada can explore its options for an EV purchase incentive through legislation. According to a survey conducted by the Nevada Conservation League in June and July of 2018, the Nevada public is very supportive of electric vehicles and is open to policies that would promote EV adoption: 75 percent of the respondents agree that EVs are a good way to improve urban air quality and reduce pollution, and another 61 percent support legislation that would reduce the EV sales tax for a limited time to spark EV sales. A rebate on the state general fund sales tax would amount to \$600 to \$1,000 for most EVs.

### **Adopt Advanced Clean Car Standards**

The federal fuel efficiency standards for new vehicles, which have doubled the average mpg for new vehicles over the last 40 years, have been one of the most successful U.S. policies in reducing GHG emissions. While California was granted the authority to define its own vehicle emissions policies, the fuel efficiency standards have been united under one national program since they were re-negotiated by the Obama Administration in 2010. The current standards are set to extend through 2025, but the Trump Administration is threatening to roll back the program, freezing fuel efficiency standards at 2021 levels, and is simultaneously challenging California’s authority to establish its own GHG emissions policies.

Nevada can promote clean transportation and reduce emissions by joining 14 other states in adopting the California Advanced Clean Car (ACC) standards, and by maintaining a commitment to the current fuel efficiency standards through 2025 and beyond. There are two separate parts to the policy: Low-Emission Vehicle or LEV standards, and Zero-Emission Vehicle standards, or ZEV standards. LEV standards set fleet-wide fuel efficiency targets for all new light-duty vehicles, including gas-powered vehicles, through 2025.



The second element is the ZEV standard, which has been adopted by nine other states and requires each automaker to sell a certain percentage of EVs in the state. Automakers tend to focus their EV distribution in ZEV states in order to meet the ZEV requirements. Studies have shown that these standards increase model availability and access to EVs by ensuring that automakers provide sufficient EV inventory and invest in EV advertising in the state. The standards also encourage dealerships to more actively promote the sale of EVs. According to the NASEO EV policy rubric, EV deployment targets like the ZEV mandate are one of the two most effective policies for states to support high EV adoption (NASEO, 2018).

Advanced clean car standards can be pursued either through legislation or administrative action. In 2018, Colorado Governor John Hickenlooper signed an executive order to initiate the adoption of the California LEV standards. Colorado has since adopted the California LEV standards and intends to introduce a ZEV rule-making in 2019.

### **Expand Utility Investment Programs in EV Charging Infrastructure**

Nevada was one of the first states in the country to allow utility ownership of EV charging stations. In 2017, the state legislature passed SB-145, which officially authorizes utility investment in EV charging demonstration programs. The bill outlined requirements for electric utilities to promote the expansion of EV charging infrastructure, including things like EV charging station incentives, optional time-of-use rates for EV charging, and EV charging education and awareness programs. In 2018, NV Energy, Nevada's largest utility, launched a \$15 million Electric Vehicle Infrastructure Demonstration (EVID) program. EVID provides a \$3,000 incentive for Level 2 and \$15,000 for DC-fast chargers installed in workplace, multi-family residential, and fleet applications. The program also provides discounted rates to customers who charge their EVs during off-peak demand periods.

These utility programs are exciting and should be expanded to accelerate EV adoption and maximize grid benefits for Nevada's electric utilities and their customers. Using the National Renewable Energy Laboratory's Electric Vehicle Infrastructure Projection Tool ([EVI-Pro Lite](#)), we can approximate how many charging stations would be required to support 10 percent EV penetration, which is the moderate-growth scenario that aligns with the ZEV goals. Such a charging network would include significant increases in the number of publicly-accessible Level 2 and DC-fast charging stations:

- 9,500 workplace plugs;
- 6,200 public Level 2 plugs (up from 486 today); and
- 1,123 DC-fast charging plugs (up from 154 today).

The state would need to install two or three times as many chargers to accommodate a high-EV scenario with a 26 percent EV penetration in 2030.



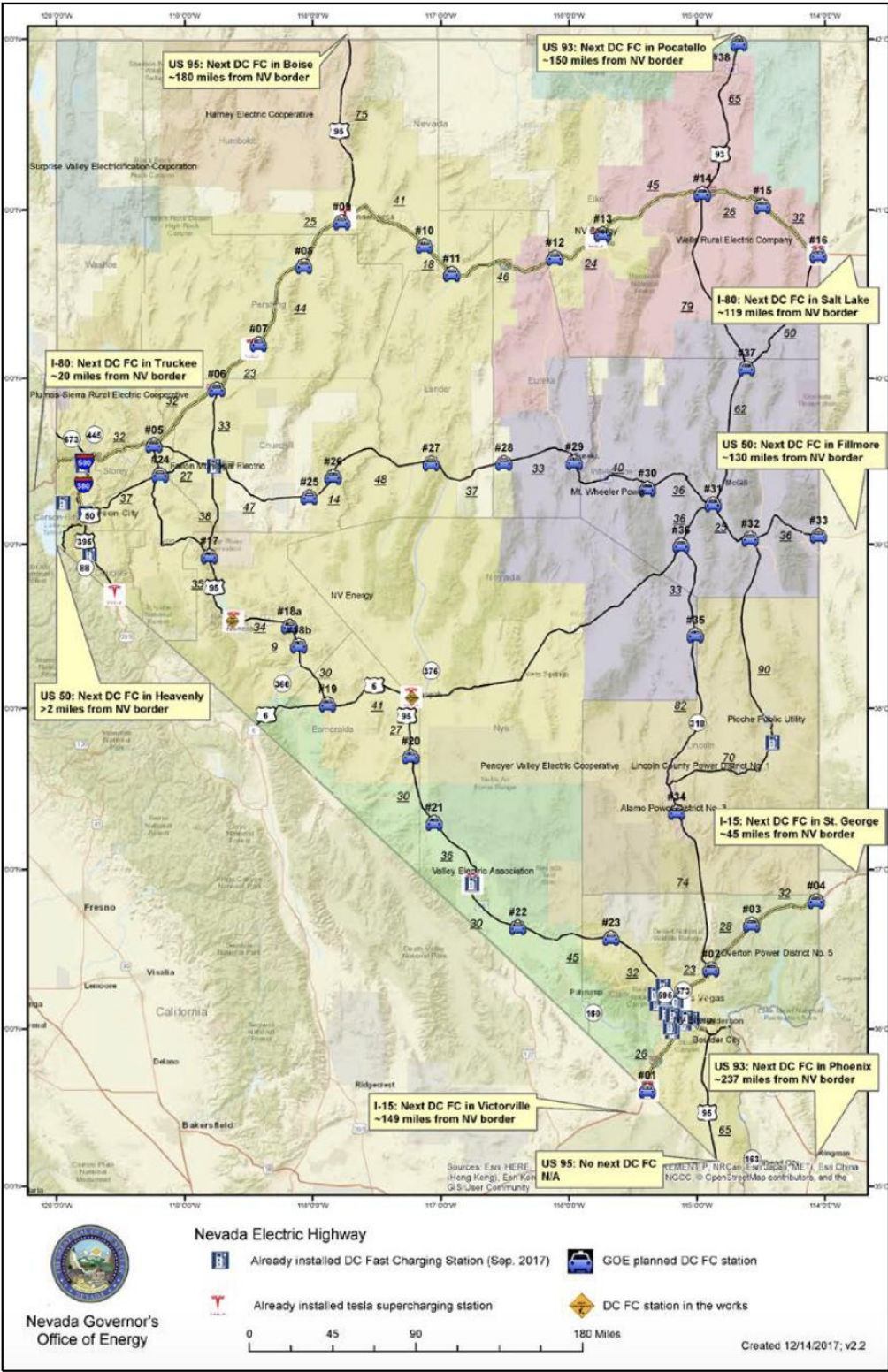
Electric utilities have much to gain from transportation electrification and the state can support the growth of EV charging infrastructure by encouraging utilities to develop more robust EV infrastructure investment plans. Incentives should continue to focus on key market segments like workplace charging, multi-family housing, and fleets, and should be scaled up to provide enough charging infrastructure to support deep penetration of EVs.

### **Highlight: The Nevada Electric Highway**

Nevada's efforts to promote and fund EV charging infrastructure through the Nevada Electric Highway Project should be applauded. The Governor's Office of Energy has taken on a leadership role in the expansion of the charging network, which includes 38 public charging locations that will be in operation by the end of 2020. In 2017, Nevada Governor Brian Sandoval joined seven other governors in the REV-West Plan, a Memorandum of Understanding to build a Regional Electric Vehicle Charging Corridor across the American West (AFDC, 2018). So far, Nevada has led the way in the planning and construction of the charging network. This continuous charging network along Nevada's main transportation corridors establishes a regional EV charging standard and reduces range anxiety for EV drivers on longer road trips.

Figure 6. The Nevada Electric Highway Initiative.

Source: Nevada Beneficiary Mitigation Plan



## Local Government Action

There are also opportunities for local governments to achieve their climate goals and reduce GHG emissions by supporting transportation electrification. Cities and counties in Nevada can accelerate EV adoption by setting bold electrification goals for their own municipal fleets and by working with transit agencies, school districts, taxi and TNCs (Uber and Lyft), electric utilities, and other influential agencies to provide electric transportation options for their communities. In order to meet their EV goals, local governments can implement policies and programs that have proven to increase the EV uptake such as:

- **Municipal EV Targets:** Local governments can establish incremental fleet targets for purchases of light-duty EVs and consider EV procurement for any vehicle replacements when suitable EV options are available with equivalent operational capability.
- **Consumer Education and Outreach Events:** Cities develop engagement and partnership programs to expand public awareness and education. They maintain an EV website and host EV Ride & Drive and EV 101 Workshop events with information on EV resources and rebates for consumers and drivers.
- **EV and eBikes group buy program:** [EV group buy programs](#) extend vehicle discounts to consumers through strategic partnerships and community-based outreach and marketing. Local dealerships provide limited-time EV discounts and, in exchange, the local government coordinates with local partners to educate the community and promote the program.
- **EV charging access and infrastructure:** Build city-owned public EV charging stations and offer incentives for residents, business, and multi-family properties owners to build their own charging stations.
- **Adopt [EV-Ready building codes](#)** to expand infrastructure and reduce the cost of charging station installation for future retrofits.
- [Electric car-sharing programs](#) provide greater transportation flexibility to residents, especially those that allow one-way trips. These initiatives should focus not just on electrification, but also on equity and access, with special deals for qualified low-income residents.

Nevada has a strong foundation of clean energy activism and local advocates can build on this momentum to advance transportation electrification. Communities in Reno and Las Vegas have launched campaigns to encourage their local governments to adopt 100 percent renewable energy goals through Sierra Club's Ready for 100 campaign (Sierra Club, 2018). They can further advance clean energy in their communities by becoming EV advocates and by promoting EV education and awareness.

The Regional Transportation Commission of Washoe County has established itself as a national leader in transit bus electrification. The commission recently ordered 17 new electric buses, which, when combined with the four electric buses in its existing fleet, will electrify one-third of the total bus fleet. Cities and local advocates can learn from this case study and work with transit agencies to secure electric bus grants through the VW settlement, build-out electric bus charging infrastructure, and get commitments to fully electrify bus fleets.

### **Highlight: Nevada VW Settlement Funds**

In 2018, the Nevada released the [Nevada Beneficiary Mitigation Plan](#), which allocates the \$25 million that the state will receive through the VW emissions cheating scandal settlement to projects that will reduce air pollution from vehicles. The plan set aside the maximum 15 percent, or \$3.75 million, to fund light-duty vehicle charging infrastructure and to support the goals of the Nevada Electric Highway Project. Another 80 percent will be used to replace older trucks, buses, and airport equipment with new low-emissions vehicles. In the first round of funding, 80 percent (or \$5.2 million) was awarded to electrify over 160 pieces of airport equipment.

## VI. CONCLUSION

Electric vehicles provide economic benefits to Nevada by reducing fuel costs and shifting consumption away from imported oil to more locally-produced electricity sources. These fuel savings become additional disposable income that will be spent mostly in the local economy, creating additional jobs in the state. At higher levels of market penetration, the fuel savings from EVs could produce thousands of jobs in Nevada in future years.

Our analysis shows that EVs will improve air quality by reducing emissions of criteria pollutants compared to comparable gasoline-fueled vehicles, and that these benefits improve over time as the electricity grid shifts away from fossil fuels and toward renewable energy. Reduction of all these pollutants provides public health benefits to the region by reducing respiratory ailments, especially in vulnerable populations such as children and the elderly.

SWEEP recommends that the state of Nevada take more action to spur the adoption of EVs. Important policies the state could adopt to promote EVs include:

- **Electric Vehicle Purchase incentives:** A state rebate or tax credit toward the purchase of EVs and EV charging stations.
- **Clean Car Standards:** Join California and 13 other states in preserving the existing 2021-2025 fuel efficiency standards, and adopt Zero-Emission Vehicle (ZEV) standards to set baseline ZEV sales.
- **Expand utility investment programs in EV charging infrastructure:** Reinforce existing utility pilot programs and expand the network of EV charging stations and customer education programs.
- **Local government action:** Cities and counties can set meaningful targets with programs and policies to electrify municipal fleets, transit buses, school buses, taxis, TNCs, and all vehicles in the community.

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