

THE EXTRA MILE:

Why Electric Vehicles Make Sense for Hawai'i's Economy, Environment and Communities



Ulupono Initiative

April 11, 2019

The people of Hawai'i are beginning to feel the *aloha* for electric vehicles (EVs).

According to the Hawai'i State Department of Business, Economic Development and Tourism, there were 8,685 registered EVs in Hawai'i in February 2019, an increase of 26.1 percent from the same month the previous year.¹ While that growth is impressive, EVs still only account for less than 1 percent of the 1,073,686 total registered passenger vehicles in the state.

In recent years, much has been done by a wide variety of stakeholders – including government, the electrical utilities, nonprofits and private organizations – to increase EV adoption and awareness in Hawai'i. Ulupono Initiative, a Hawai'i-focused impact investment firm, is among these entities leading the charge. In addition to providing funding for EV-related programs and projects, Ulupono commissioned market research and collected data to inform its investment decisions.

This report by Ulupono outlines local and national facts and statistics about EVs, infrastructure, rates, environmental impact, fees and taxes, and policies. It also summarizes data collected from quantitative surveys conducted in Hawai'i by Honolulu-based Anthology Marketing Group to gain an understanding of the charging habits of Hawai'i EV drivers and the appeal of EV rentals with tourists.

¹ http://files.hawaii.gov/dbedt/economic/data_reports/energy-trends/Energy_Trend.pdf

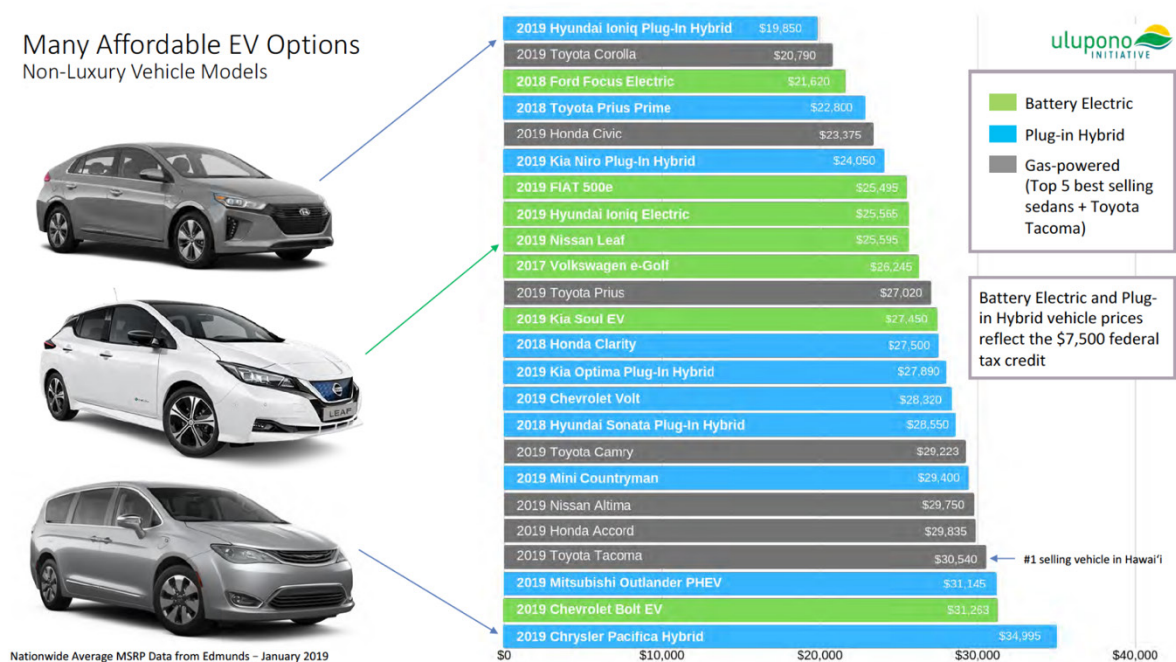


ELECTRIC VEHICLES IN HAWAII

ECONOMIC IMPACT

The economics of EVs

As EVs become mainstream and more models enter the marketplace, vehicle costs are increasingly becoming comparable to internal combustion engine (ICE) cars. A price ranking of non-luxury full-electric and plug-in hybrid vehicles (after the federal tax credit), along with the most popular ICE cars in the nation (including Toyota Tacoma, the top-selling vehicle in Hawai'i), illustrates how EVs and plug-in hybrids are cost comparable:



A key reason why EVs will become more affordable is the declining costs of their batteries. An "expected increase in mass manufacturing of lithium-ion storage should help drive battery prices to as low as \$70 per kilowatt hour by 2030," compared to the 2017 rate of \$208 per kilowatt hour.²

² <https://www.bloomberg.com/news/articles/2018-03-22/electric-cars-may-be-cheaper-than-gas-guzzlers-in-seven-years>

At the same time, the EV market is expanding. In 2018, total U.S. EV sales registered at 361,307, an increase of 81 percent from 2017.³ The strong sales performance of EVs in 2018 is largely attributed to Tesla's release of its highly anticipated Model 3, which accounted for nearly 140,000 of total U.S. EV sales that year.

Beyond Tesla, other car manufacturers have announced their commitments to going electric or expanding their electric lineup soon, including Volvo, Ford, Nissan, GM, Volkswagen, Audi, Mercedes Benz and Jaguar.⁴ In January 2019, Ford announced plans to electrify its popular F150 truck, the best-selling vehicle in the U.S.⁵

The increasing number and longevity of EVs means there are more opportunities for used EVs to return to the market. Like other secondhand cars, these vehicles are offered at a more affordable price, making EVs more accessible to a wider audience. A 3-year-old Nissan Leaf may be purchased used for \$10,000, one-third of the \$30,000 price tag it sold for brand new.⁶

Economic impacts on Hawai'i drivers

The cost of owning and maintaining an EV is also significantly lower than ICE cars. Though residing in a state with the highest electricity rates in the country, a Hawai'i EV owner will save on average \$507 per year by switching from gas to electricity for fuel, according to the Union of Concerned Scientists.⁷

EVs also require less maintenance due to fewer moving parts, no exhaust system and no oil changes. As Hawai'i Island EV-owner Jared

³ <https://www.greentechmedia.com/articles/read/us-electric-vehicle-sales-increase-by-81-in-2018#gs.11ne36>

⁴ <https://mashable.com/2017/10/03/electric-car-development-plans-ford-gm/#fzOoyJL5aiqu>

⁵ <https://www.caranddriver.com/news/a25933730/ford-f-150-electric-pickup-truck-confirmed/>

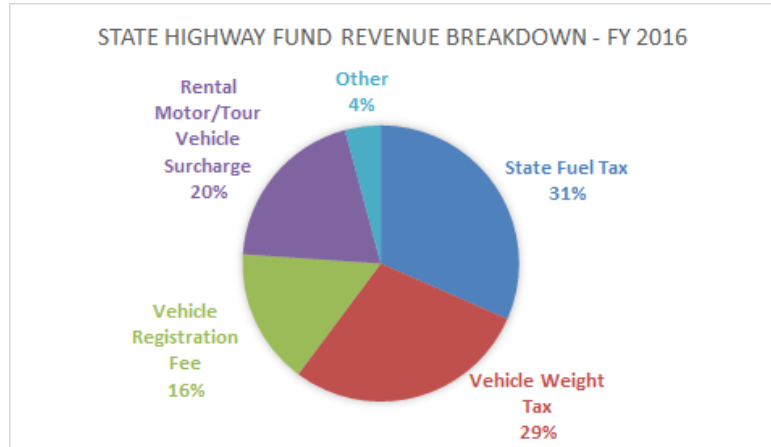
⁶ <https://www.consumerreports.org/hybrids-evs/great-time-to-buy-a-used-electric-vehicle/>

⁷ <https://www.ucsusa.org/sites/default/files/attach/2017/11/cv-report-ev-savings.pdf>

Terpak shared in an interview with Ulupono, the only routine maintenance he does on his Chevy Bolt is a check of its washer fluid.⁸

Economic impacts on the State of Hawai'i

While Hawai'i EV owners do not pay the state gas tax, they do contribute to the Hawai'i State Department of Transportation's Highway Fund via annual vehicle registration and



weight tax fees. Combined, these fees account for 45 percent of the state's annual highway revenue.

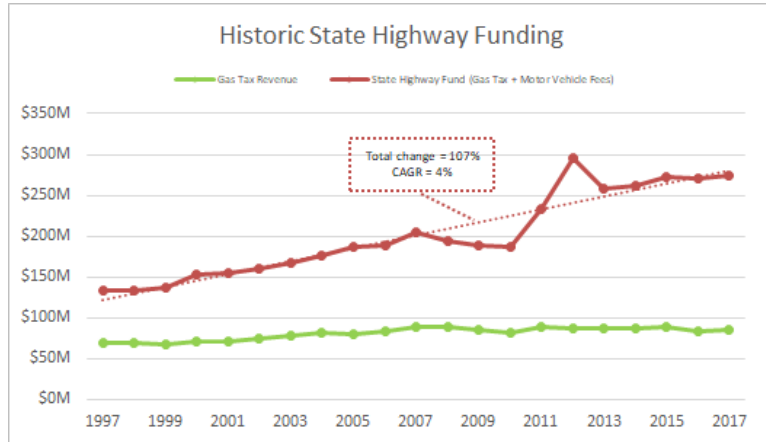
The graph on the following page shows that revenue generated from the state gas tax continues to increase.

However, as more people drive EVs and fuel-efficient cars such as hybrids, the long-term viability of the gas tax is in question. The Hawai'i State Department of Transportation is conducting a federally funded study to determine whether a Road Usage Charge offers a better long-term solution to ensuring the State Highway Fund remains intact. The new tax would charge all drivers – including EV owners – for each mile they drive.⁹

⁸ <https://youtu.be/rQrbvmdMapY>

⁹ <http://www.hawaiinewsnow.com/2019/03/12/state-proposes-nixing-fuel-tax-favor-charging-you-how-much-you-drive/>

EVs also help keep Hawai'i residents' money in the state. The math is simple: If all of the state's 1,073,686 cars were electric, and each owner enjoyed \$507 in savings per year, there would be a total savings of about \$537



Source: http://tax.hawaii.gov/stats/a5_3txcolrptarchive/

million per year. The millions of dollars currently spent on imported petroleum would remain in the state and, with extra cash in their pockets, local residents would be able to apply these funds toward better quality of life.

In 2018, Hawaiian Electric Co. (HECO) filed its Electrification of Transportation (EoT) Strategic Roadmap with the Hawai'i Public Utilities Commission.¹⁰ The report, created by the state's largest utility, is a guide outlining HECO's plans to, among other goals, accelerate the adoption of EVs and the buildout of EV infrastructure.

In its EoT Roadmap, HECO reports its analysis "shows that EoT will create economic benefits for Hawaiian Electric customers." It cites that "increased energy demanded by EV drivers to charge their vehicles creates benefits for all (of) Hawaiian Electric's customers, not just EV drivers. This is because as EV drivers demand more energy, the utility's fixed costs for generating and distributing energy are spread across more kWh units. This creates net benefits for **ALL** customers."¹¹

¹⁰https://www.hawaiianelectric.com/documents/clean_energy_hawaii/electrification_of_transportation/201803_eot_roadmap.pdf

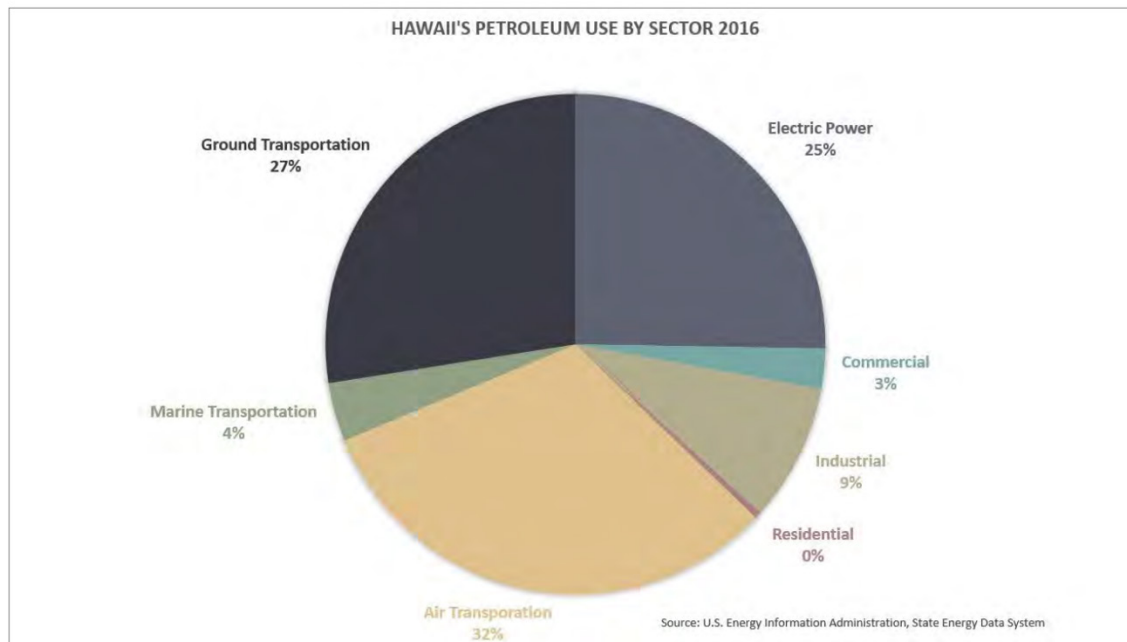
¹¹https://www.hawaiianelectric.com/documents/clean_energy_hawaii/electrification_of_transportation/201803_eot_roadmap.pdf

ELECTRIC VEHICLES IN HAWAI'I

ENVIRONMENTAL IMPACT

Elimination of fossil fuels

The majority of fossil fuels in Hawai'i are used to move people and goods. According to the Hawai'i State Energy Office, the transportation sector accounted for 63 percent of total petroleum use in 2016, with ground transportation making up 27 percent of total petroleum use.¹²



In 2017, the state's four county mayors jointly announced their pledge to eliminate fossil fuels from ground transportation by 2045. This commitment aligns with the state's clean energy goal of 100 percent by 2045, which has made significant progress. At the end of 2017, the Hawaiian Electric Companies, which services the counties of Honolulu, Maui and the island of Hawai'i, generated 27 percent of its electricity from renewable resources, while the Kaua'i Island Utility Cooperative – the Garden Isle's electrical utility – generated 44 percent from renewable resources.¹³ The transportation sector, on the other hand, was less than 1 percent renewable.

¹² http://energy.hawaii.gov/wp-content/uploads/2018/06/HSEO_2018_EnergyFactsFigures.pdf

¹³ https://puc.hawaii.gov/wp-content/uploads/2018/12/RPS-2018-Legislative-Report_FINAL.pdf

With Hawai'i's electrical generation well on its way to the state's 100 percent clean energy by 2045 goal, EVs are being instantly powered by up to 44 percent renewable energy and will be a strong complement to the full clean energy picture.

Zero emissions

Transportation is also responsible for the majority of the state's greenhouse gas (GHG) emissions. The Hawai'i State Department of Health reports that "the energy sector makes up the majority – 87 percent – of the state's greenhouse gas emissions. Approximately 53 percent of energy sector emissions are from transportation – excluding international bunker fuel – and 45 percent are from stationary combustion."¹⁴

EVs produce zero emissions at the tailpipe, whereas a typical ICE vehicle emits 4.6 metric tons of carbon dioxide per year.¹⁵ In aggregate, Hawai'i's ground transportation pollutes the air with 5.6 million metric tons of carbon dioxide annually, which amounts to 26 percent of the state's total GHG emissions per year.¹⁴ EVs offer an option to immediately address a significant contributor of GHG emissions.

At a local level, ICE vehicles emit air pollution directly into our communities, which disproportionately hurts our *keiki* and *kūpuna*. While Hawai'i is fortunate to have relatively clean air and steady trade winds; however, these do not address exhaust pollution at the curb. EVs essentially eliminate dirty and smelly fumes, creating a better experience for both drivers and pedestrians.

Clean transportation alternatives, such as EVs, can help combat climate change. When their full life cycle – from manufacturing

¹⁴ <https://health.hawaii.gov/news/files/2019/03/19-013-State-on-target-to-beat-2020-greenhouse-gas-emission-goal.pdf>

¹⁵ <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>

through disposal – is considered, EV emissions are “reduced by about 50 percent compared to ICEV (internal combustion engine vehicles) and by about 25 percent compared to HEVs (hybrid electric vehicles),” according to a Massachusetts Institute of Technology and Santa Fe Institute Report.¹⁶

In recognition of the important role emissions reduction will play in successfully mitigating climate change impacts, the State of Hawai‘i has recognized the Paris Agreement, is a member of the U.S. Climate Alliance, and has created the Hawai‘i Climate Change Commission¹⁷, which includes a focus on reducing emissions.

Energy efficient

EVs are three times more efficient than gas-powered vehicles. The U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy reports that “EVs convert about 59 to 62 percent of the electrical energy from the grid to power at the wheels. Conventional gasoline vehicles only convert about 17 to 21 percent of the energy stored in gasoline to power at the wheels.”¹⁸ Therefore, in addition to EVs being instantly powered by an amount of renewable energy, they also require roughly three times less energy to begin with.

Reusing and recycling batteries

Another environmental concern is related to EV batteries, which typically retain 70 to 80 percent of their capacity after seven to 10 years on the road.¹⁹ Though that amount isn’t enough to power a car, EV batteries are finding second lives around the world. For example, Nissan is recycling old batteries to power street lights in Japan.²⁰

¹⁶ <https://pubs.acs.org/doi/pdf/10.1021/acs.est.6b00177>

¹⁷ <http://climate.hawaii.gov/>

¹⁸ <https://www.fueleconomy.gov/feg/evtech.shtml>

¹⁹ <https://www.theguardian.com/sustainable-business/2017/aug/10/electric-cars-big-battery-waste-problem-lithium-recycling>

²⁰ <https://newsroom.nissan-global.com/releases/180322-01-e>

Renault is repurposing batteries for home energy storage units.²¹ And old Chevrolet Volt batteries were utilized to help power the General Motors Enterprise Data Center at its Milford Proving Ground in Michigan.²²

There are also efforts in the industry to establish a system and regulatory framework to recycle EV batteries. A company in Germany has developed its own recycling system for lithium-ion batteries, which it claims is eco-friendly.²³ As the worldwide EV market develops and matures, technologies are expected to improve and be joined by additional recycling solutions.

²¹ <https://www.bloomberg.com/news/features/2018-06-27/where-3-million-electric-vehicle-batteries-will-go-when-they-retire>

²² <https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2015/jun/0616-volt-battery.html>

²³ https://www.duesenfeld.com/recycling_en.html

ELECTRIC VEHICLES IN HAWAI'I

COMMUNITY IMPACT



Pictured above: Kaua'i EV Association

With more people buying EVs, there is more demand than ever for EV charging stations. Hawai'i ranks third in the nation for providing public charging networks per capita with a total of 570 EV charging ports.²⁴ However, high demand for additional charging stations is rapidly outpacing the existing infrastructure, which could hamper continued progress. In June 2018, there were 13 EVs per public charger in Hawai'i, up from eight EVs per station in October 2015.

To obtain up-to-date information on EV ownership and trends, Ulupono Initiative commissioned surveys conducted between 2016 and 2018 to assess the driving behaviors of drivers and visitors, and the state's public charging network.

Hawai'i's EV owners

Information captured in Ulupono's initial survey, conducted in 2016 by Honolulu-based Anthology Marketing Group, revealed that 71 percent of drivers preferred parking in structures with access to charging stations. Additionally, 73 percent stated that the availability of charging stations affected how likely they were to frequent establishments or businesses.

The survey also illustrated that a majority of local EV owners (80 percent) charged at home and, **if access were available**, 92 percent would charge their vehicles at work.

Additional findings indicated that just over half of EV drivers tend to avoid traveling long distances due to lack of available stations. Because 85 percent of EV drivers reported utilizing public charging stations, this modified behavior limiting commuting distances could gradually impact businesses without charging infrastructure.

²⁴ http://energy.hawaii.gov/wp-content/uploads/2018/06/HSEO_2018_EnergyFactsFigures.pdf



KEY FINDINGS REGARDING EV PUBLIC INFRASTRUCTURE IN HAWAI'I

Hawai'i is second in the nation in EV charging ports per capita, yet demand by EV drivers is simply outpacing the supply of EV chargers. Current law that requires at least one EV charger at public lots with 100 or more parking stalls has helped with a number of locations taking the lead and installing EV charging. But the law lacks enforcement, and installing chargers can be a lower priority for some and understandably tough to justify the costs.

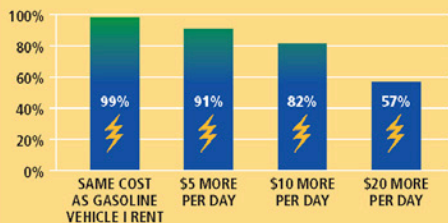
OVERALL

Most visitors surveyed said they probably would have rented an EV, if available. 1 in 4 "definitely" would.



"DEFINITELY WOULD" RENT EV

Research shows that among these strong advocates for EVs, we don't notice a significant drop until we reach the \$20 per day premium, where there is a 42-point decline in interest: 1 in 4 "definitely" would.



WHY RENT AN EV?

79% Green Option/
Positive for Environment

26% Definitely Would Have Rented an EV, If Available

WHY MAY NOT RENT EV:

45% Range Anxiety/
Concern About Finding Charging Stations

45% Don't Know Where Charging Stations Are Located

25% Additional Cost of Renting an EV

OPPORTUNITY

Meeting this demand among Hawai'i's roughly 10 million annual visitors would be one of the most immediate ways to further the state's goals and reap the broader societal benefits of reducing transportation fossil fuel usage.



From April 16 to May 15, 2018, a quantitative study of visitors to Hawai'i was performed in the form of an in-person intercept survey via iPads at the Daniel K. Inouye International Airport. A total of 600 interviews were completed with English-speaking visitors who rented a car during their stay in the islands (O'ahu: 200, Hawai'i Island: 100, Maui: 200, Kaua'i: 100). The margin of error for a total sample of this size (n=600) is +/- 4.00 percentage points with a 95% confidence level.

Another notable finding was that 68 percent of EV owners were receptive to paying a fee for charger usage. Acceptance of a usage fee tended to be higher for EV owners on neighbor islands at 81 percent.

Research questions gauged EV owners' access to charging ports and locations, average days of the week and distance each commuted, whether or not EVs were their primary means of transportation, and their responses to a variety of other queries.

Results showed that **resident Hawai'i EV drivers are generally dissatisfied with the Hawaiian Islands' existing charging network, rating it an average score of 4.26 out of 10.** The most common criticism was limited access to charging stations throughout the state, which further validates that demand is outpacing supply.

Interest high among visitors

In an in-person quantitative study of 600 travelers at the Daniel K. Inouye International Airport in Honolulu in April 2018, **a majority of visitors surveyed (56 percent) stated that they probably would have rented an EV if one was available.** More than a quarter responded that they definitely would have rented an EV if one was an option.

When questioned whether they would accept an additional fee to rent an EV, 91 percent stated they would be willing to pay an additional \$5, while more than half said they were willing to pay \$20 more per day.

With approximately 10 million people visiting Hawai'i annually, rental EV options provide an efficient means to further the state's clean energy goals. However, insufficient charging infrastructure across the Islands, and lack of vehicle options and rental facilities, remain major barriers.

Roadmap to an electric future

Policy plays an important role in regulating EV-related activities and setting benefits. In Hawai'i, EV drivers currently enjoy perks such as free parking in municipal and state lots and garages, and free high-occupancy vehicle (HOV) lane access for solo EV drivers.²⁵

Other states are setting EV policy examples designed to spur adoption. Currently, 16 states offer rebates and/or tax credits for EV charging stations, 14 states offer rebates and/or tax credits for vehicles, and 10 states have a zero-emission vehicle mandate.²⁶

An overall growth in public EV charging stations would need strong political support. The current Hawai'i State law requires a minimum of one EV station in public lots with 100 or more parking stalls. However, the law lacks notable enforcement. While some private locations have complied with the law, many property owners and businesses do not view complying as a top priority and find it challenging to justify the upfront investment.

Local stakeholders are leading the charge for the electrification-of-transportation movement. In 2016, a group of industry stakeholders formed Drive Electric Hawai'i, a coalition of county and state government agencies, utilities, nonprofit organizations and private entities working to promote the use of electric vehicles, cut fossil-fuel transportation and add more renewable energy options. Individual groups, including community-based associations, are also advocating and convening to raise awareness. One of these, the Big Island EV Association, is comprised of 216 EV drivers from across the County of Hawai'i.

²⁵ https://www.capitol.hawaii.gov/session2012/bills/GM1271_.PDF

²⁶ <https://www.americanprogress.org/issues/green/reports/2018/06/07/451722/plug-electric-vehicle-policy/>

Leading the charge

In order to maximize the role of EVs in reducing Hawai'i's dependence on imported fuel and fully benefit from this emerging market, it is critical that public- and private-sector stakeholders foster a supportive ecosystem for EVs by adopting progressive policy and ensuring that infrastructure, in the form of charging stations, keeps pace and precedes demand.

It should also be noted that postponing investments in such infrastructure is unlikely to generate cost savings. Requiring new facilities to be EV-ready adds less than 1 percent to the cost of development, while installing EV infrastructure post-construction costs three times more. Upfront investments are cost-effective, smart and essential future proofing.

Much remains to be done to match the increasing pace of the automobile industry in manufacturing EVs and best prepare for the oncoming transition to an electrified future. By acting now, Hawai'i stands to accelerate and capture economic, environmental, health and energy benefits across its communities. However, if drivers aren't confident that they can afford an EV or will be able to charge their vehicles, we risk slowing progress toward our state's ambitious renewable energy goals – including achieving 100 percent clean energy by 2045 – and contributing further to climate change and polluted air in our communities.



Ulupono Initiative is a for-profit, impact investment firm that strives to improve the quality of life for the people of Hawai'i by working toward solutions that create more locally grown food, increase clean renewable energy and better management of waste and water. For more information about Ulupono Initiative, please visit www.ulupono.com or connect with Ulupono on Twitter, Facebook, Instagram and LinkedIn.