

# ELECTRIC Vehicle

*paradise*

How Hawai'i  
Can Lead the World  
in Deployment

September 2013



**BerkeleyLaw**  
UNIVERSITY OF CALIFORNIA

Center for Law, Energy &  
the Environment



UNIVERSITY of HAWAII®  
**MAUI COLLEGE**





## About This Report

The Maui Electric Vehicle Alliance (Maui EVA), funded by the Department of Energy Clean Cities EV Community Readiness Grant and associated cost-share partners and based at the University of Hawai'i Maui College, met with electric vehicle stakeholders in February and March 2013 on Moloka'i, Hawai'i Island, O'ahu, and Kaua'i, along with the Center for Law, Energy and the Environment at the University of California, Berkeley School of Law. After sharing research findings and learning about the challenges to electric vehicle deployment on the neighbor islands, the authors decided to capture the discussions in this policy report. All conclusions and recommendations are solely the authors' and do not necessarily reflect the views of those individuals interviewed.

## Authorship

The authors of this paper are Ethan N. Elkind, Bank of America Climate Policy Associate for UC Berkeley School of Law's Center for Law, Energy & the Environment (CLEE), and Anne Ku, Project Director of the Maui Electric Vehicle Alliance at University of Hawai'i Maui College.

Additional contributions to the report were made by: Margaret Larson, Transportation Energy Specialist at the Hawaii State Energy Office, Department of Business, Economic Development & Tourism, and Byron Washom, director of strategic energy initiatives at the University of California, San Diego.

Research support and review provided by: Tuong-Vi Faber at UC Berkeley School of Law.

## Acknowledgments

The authors wish to thank Clyde Sakamoto, Chancellor at University of Hawaii Maui College, for his support for this work. In addition, we are grateful to the following individuals across the state who shared their perspectives on the challenges of deploying electric vehicles in Hawaii during the neighbor island outreach conducted in February and March, 2013, arranged in order of visit:

### Moloka'i:

Jackie Cushman, Volt owner  
 Todd Yamashita, Moloka'i Dispatch  
 Matt Yamashita, Rising Sun Solar  
 Kanohowailuku Helm, I Aloha Moloka'i  
 Dr. Dan McGuire, Mitsubishi iMiev owner  
 John Wordin & Artice Swingle, neighborhood electric vehicle owners  
 Karen Holt, Moloka'i Community Service Council \*\*

### Hawai'i Island:

Will Rolston, County of Hawai'i  
 Victor Jensen, Big Island Electric Vehicle Association  
 Rick Castro, Islandwide Solar  
 Doug Teeple, Big Island EV Association  
 Curtis A. Beck & Patrick Moore, Hawai'i Electric Light Company (HELCO)  
 Graceson Ghen, Hawai'i Community College  
 Cam Muir PhD & Kolin Kettleison, University of Hawai'i, Hilo  
 David S. De Luz, Jr & Calvin K. Koga, Big Island Toyota

*Below: Blessing of the First DC Fast Charger in Maui - at the County Building in Wailuku, September 2012*



**O'ahu:**

Scott Sandifer, Enterprise Rent-A-Car O'ahu  
Crysttal Atkins, University of Hawai'i at Mānoa  
Dan Port, & Scott Cooney, Shidler College of Business,  
University of Hawai'i at Mānoa  
Josh Stanbro, Hawaii Community Foundation  
Catharine Lo & Jeffrey Mikulina, Blue Planet Foundation  
Mark Yamamoto & Jimmy Yao, Hawaiian Electric Com-  
pany (HECO)  
Yuko Chiba, Enterprise Honolulu

**Kaua'i**

Mark Stein, Enterprise Rent-A-Car Kaua'i  
Eric Knutzen, Kaua'i Community College  
Ben Sullivan, Office of Economic Development, County  
of Kaua'i  
Brad Rockwell & Jim Kelly, Kaua'i Island Utility Coopera-  
tive (KIUC)  
Gordon Talbo, Kaua'i Community College Automotive  
Program  
Susan Tai Kaneko, Kaua'i Economic Development  
Board (KEDB)  
Randy Francisco, Kaua'i Chamber of Commerce  
Doug Sears & Chris Valentino, Grand Hyatt Kaua'i \*\*  
Warren Doi, GreenCar Hawai'i \*\*  
Carla Matsushima, Kukio Auto Group

*\*\* by telephone*

**Maui**

Tim Torres, Jim Falk Motors Maui  
Michael Snyder, Hawaiian Electric Vehicle Network

Thanks to Steven Rymsha of Maui Electric Company  
(MECO), Brad Rockwell (KIUC), Mark Yamamoto and  
Jimmy Yao (HECO) for PV data.

Finally, we are grateful to Marc Antosch, Creative De-  
signer & Program Promoter, UHMC Edventure, for de-  
signing this policy paper.

*This material is based upon work supported by  
the Department of Energy under Award Number  
DE-EE0005553*

For more information, contact:  
Ethan Elkind at [Eelkind@law.berkeley.edu](mailto:Eelkind@law.berkeley.edu)  
Anne Ku at [anneku@hawaii.edu](mailto:anneku@hawaii.edu)



**Disclaimer**

This report was prepared as an account of work spon-  
sored by an agency of the United States Government.  
Neither the United States Government nor any agency  
thereof, nor any of their employees, makes any warran-  
ty, express or implied, or assumes any legal liability or  
responsibility for the accuracy, completeness, or useful-  
ness of any information, apparatus, product, or process  
disclosed, or represents that its use would not infringe  
privately owned rights. Reference herein to any specific  
commercial product, process, or service by trade name,  
trademark, manufacturer, or otherwise does not neces-  
sarily constitute or imply its endorsement, recommenda-  
tion, or favoring by the United States Government or any  
agency thereof. The views and opinions of authors ex-  
pressed herein do not necessarily state or reflect those  
of the United States Government or any agency thereof.



## Executive Summary: Why Electric Vehicles in Hawai'i Matter

Hawai'i stands poised for a mass adoption of electric vehicles,<sup>1</sup> pushing a global market for deployment. The island state, comprised of six populated, tropical, and remote islands in the heart of the North Pacific Ocean, represents a global tourist mecca and home to almost 1.4 million people. Despite abundant renewable resources, such as solar, wind, and geothermal, the islands still import most of their fuel at tremendous cost, both economically and environmentally.

The state's high energy costs, significant adoption of residential and commercial solar photovoltaic panels to reduce electricity costs, and limited driving range due to the island geographies make Hawai'i a logical fit for mass electric vehicle adoption – referring to vehicles that “plug-in” to the electric grid for some or all of their power (sometimes abbreviated as “EVs”).

The United States, and the world market, would benefit from significant uptake of electric vehicles in Hawai'i. The state received nearly 8 million visitors in 2012, offering these individuals an easy opportunity to rent an electric vehicle for an extended test drive, experience its benefits, and potentially purchase one upon return to their home states.<sup>2</sup> In addition, as deployment booms in Hawai'i, the increased car sales and charging infrastructure investment in a state with over one million registered vehicles can help decrease costs for electric vehicle buyers worldwide through larger-scale – and therefore marginally less expensive – production.

Hawai'i's residents will need to lead this effort by pushing for electric vehicle infrastructure investment on the islands. They can take advantage of this investment by purchasing electric vehicles – many of which come with competitive lease deals and price breaks as a result of recent competition among the automakers.



Top: A beach in Moloka'i

Bottom left: Maui Electric Vehicle Alliance kick-off meeting at the Grand Wailea, November 1, 2011

Bottom right: National Plug-in Day, UH Maui College, September 2012

With a comprehensive public charging network in place on each island, leaders in the visitor industry will then have greater confidence to boost electric vehicle purchases for car rental fleets and car sharing and accelerate the installation of charging infrastructure at hotels, vacation lodging, and other tourist destinations.

Yet much work remains. Like many states around the country, electric vehicle deployment in Hawai'i has been limited due to the high cost of many of the vehicles, the incomplete charging station infrastructure, and lack of awareness of the benefits of purchasing and driving an electric vehicle.

To educate the public about electric vehicles on the island of Maui, the University of Hawai'i, Maui College formed and organized a multi-stakeholder group for its U.S. Department of Energy-funded project called the Maui Electric Vehicle Alliance (Maui EVA or MEVA). After completing its Maui EVA report, Maui College partnered with the Center for Law, Energy and the Environment (CLEE) at the University of California, Berkeley School of Law to perform outreach on neighbor islands with two goals:

- 1) Report on Maui's deployment status; and
- 2) Assess the needs related to electric vehicles on the islands.

Representatives from the two schools visited the islands of Moloka'i, O'ahu, Hawai'i Island, and Kaua'i in early 2013, meeting with stakeholders on each island such as electric utilities, car dealers, rental car agencies, electric vehicle drivers, county leaders, and solar installers.

The neighbor island outreach informed this report, which summarizes the overarching barriers and opportunities for mass electric vehicle deployment in the State of Hawai'i (sometimes referred to here as the "state") and assesses the specific challenges and opportunities on each significantly populated island in the state.





## Top 4 Barriers to Increasing Statewide Electric Vehicle Deployment in Hawai'i

### **1) Insufficient Charging Station Infrastructure**

Many potential electric vehicle customers, including visitors, residents, businesses, and public agencies, are deterred from purchasing by an often inadequate public (i.e., non-home, hotel, and on-site commercial) charging station infrastructure that limits the range of all-battery electric vehicles.

### **2) Limited Supply and Public Outreach**

Some consumers are unfamiliar with electric vehicles and their performance and/or face difficulty finding dealers capable of servicing and promoting them.

### **3) High Upfront Costs of Vehicles and Electricity Charges**

Electric vehicles are sometimes priced higher in upfront costs than conventional, fuel-efficient vehicles and also require electricity at the highest rates in the nation.

### **4) Lack of Diverse Electric Vehicle Models**

Automakers have yet to introduce in Hawai'i electric options for choices popular in the tropics, such as convertibles, SUVs, and affordable pick-up trucks, with features like sufficient trunk space for luggage and four-wheel drive capability for off-road access – important considerations for visitors and residents alike.

## Overcoming the Barriers

Businesses, advocates, and government leaders should ensure that residents of Hawai'i, public agencies, and businesses adopt mass numbers of electric vehicles by:

- Continuing to improve electricity rate structures and coordinating business partnerships to install more fast-charging stations;
- Facilitating more corporate and public vehicle fleet purchases of electric vehicles and sharing promotional and car servicing resources; and
- Encouraging greater adoption of commercial and residential solar to lower electricity rates by removing restrictions on net metering customers.

### **SOLUTION #1**

#### ***Improve electricity rate structures and coordinate business partnerships to install more public charging stations***

Residents, visitors, and businesses alike require an adequate public charging network to feel confident purchasing or renting electric vehicles. Hawai'i's electric utilities and its energy regulators should therefore continue to expand and improve rate structures that encourage deployment of charging stations, while businesses and policy makers should facilitate commercial partnerships and financing mechanisms to unlock investment. Local stakeholders can contribute by providing initial seed funding for this infrastructure and ensure that businesses comply with state law requiring charging stations in parking lots with over 100 spaces.

### **SOLUTION #2**

#### ***Facilitate new fleet purchases of electric vehicles and share promotional and car servicing resources***

Car rental companies, businesses, and public entities should purchase electric vehicles for appropriate tasks to stimulate greater supply of vehicles and charging infrastructure, as directed under state law. These large entities should also coordinate vehicle servicing contracts to lower costs, ensure proper and efficient maintenance, and encourage greater car dealer investment.

### **SOLUTION #3**

#### ***Encourage greater adoption of commercial and residential solar by removing restrictions on net metering.***

Electric utilities and energy regulators should encourage more uptake of solar photovoltaic panels in order to lower electricity prices and therefore broaden the economic appeal of fueling transportation through electricity. The current threshold for further study of grid needs under the net metering program, in which ratepayers that generate renewable energy on-site receive a retail credit on their electricity bill for the value of the produced energy, has resulted in a backup of requests on many islands.



## The Current State of Electric Vehicles and Charging Infrastructure

### Electric vehicles description and deployment status

Electric vehicles are cars, trucks or any other types of vehicles that “plug-in” to use electricity either as their primary fuel or as a means to improve their fuel efficiency. There are three primary categories of electric vehicles:<sup>3</sup>

**1) Battery electric vehicles (BEVs)**, which use solely electric energy stored in a battery to power the electric motor. The battery is charged by plugging the vehicle into an electric power source. Such vehicles include, for example, the Scion iQ EV, the Nissan LEAF or the Tesla Model S.<sup>4</sup>

**2) Plug-in hybrid electric vehicles (PHEVs)**, which are powered by both an electric motor that uses energy stored in a battery and an internal combustion engine (or other propulsion source) that runs on fuel, such as gasoline or diesel. The battery is charged by plugging the vehicle into an electric power source. PHEVs can have either a parallel configuration, where both the electric motor and the engine can drive the wheels directly, or a series configuration, where the engine is used to generate electricity for the electric motor and only the motor can drive the wheels. The series PHEV is also called an extended range electric vehicle (EREV), such as the Chevy VOLT.

**3) Hybrid electric vehicles (HEVs)**, which, as with PHEVs, are powered by both an electric motor and an internal combustion engine (or other propulsion source). However, their battery cannot be plugged in for charging; it is charged by capturing and storing

energy that is normally lost during braking, known as regenerative braking. They can also be designed in either a parallel configuration or a series configuration. HEVs include, for example, the Toyota Prius, the Ford C-Max Hybrid or the Volkswagen Jetta Hybrid.<sup>5</sup>

In addition, Hawai'i state law recognizes “neighborhood electric vehicles” (NEVs), classified as vehicles designed to operate at a maximum of 25 miles per hour on streets with lower speed limits.

In recent years, an increasing number of automakers have joined the transition towards plug-in technologies. Today, all major automakers have plans to produce plug-in electric vehicles by 2015<sup>6</sup>, with some already on the market and new models expected in 2014, including the BMW i3, the Cadillac ELR, the Chevrolet Spark EV, the Fiat 500e, the Mitsubishi Outlander Plug-In Hybrid, and the Smart for Two Electric Drive.<sup>7</sup>

Early results from the introduction of these plug-in electric vehicles to the U.S. market have been promising, with first-year sales of both the Nissan LEAF and the Chevrolet Volt outselling the first-year sales of the popular, non-plug-in hybrid Toyota Prius, with 9,674 sales of Nissan LEAFs and 7,671 sales of Chevrolet Volts compared to 5,562 sales of non-plug-in Toyota Prius.<sup>8</sup> U.S. sales of plug-in electric vehicles more than doubled in the first half of 2013 compared to the same period in 2012, up to more than 40,000 from 17,500.<sup>9</sup> Full-year sales in 2012 more than tripled compared to 2011, up to about 52,000 from 17,000.<sup>10</sup>

# Charging options

There are three options available today to electric vehicle owners for charging their vehicle's battery. These options involve varying levels of power and charging speeds.<sup>11</sup>

- **Level 1 charging:** uses a 120 volt alternative current (AC) plug that is found in most standard household outlets. Depending on battery technology and vehicle, it adds approximately 2 to 5 miles of range per hour of charging. It is generally suited for overnight charging of PHEVs or extended parking, such as at an airport lot. Level 1 charging equipment is standard on plug-in electric vehicles and does not require installing additional charging equipment. Level 1 charging generally has less impact on the local electricity distribution grid than other charging options because it has a reduced intensity of energy demand.

- **Level 2 charging:** uses a 240 volt AC plug that requires installation of additional charging equipment. In particular, it usually requires the purchase of a new home or business charging unit and sometimes upgrades to electrical panels and a dedicated circuit for charging. Depending on battery technology and vehicle, it adds approximately 10 to 20 miles of range per hour of charging. Level 2 charging equipment is compatible with BEVs and PHEVs.

- **DC fast charging:** uses a 480 volt direct current (DC) plug that enables rapid charging at public charging stations along heavy traffic routes. A DC fast charge can add 60 to 80 miles of range in 20 minutes of charging to a BEV. This can charge a fully depleted battery up to 80 percent capacity in less than 20 minutes. DC fast charging equipment is not compatible with all plug-in vehicles, and not all vehicles accept the power it requires.

*The choice between Level 1, Level 2 or DC fast charging involves different trade-offs: while Level 1 charging requires a longer charging time, both Level 2 and DC fast charging involve higher costs, either in the form of a higher utility bills, additional charging equipment or upgrades, or expensive charging facilities.*



# State of Electric Vehicles in Hawai'i

## How Electric Vehicles Benefit from Hawai'i's Clean Energy and Fuel Goals

Electric Vehicles will both benefit from and help Hawai'i meet its environmental and energy laws. Despite an abundance of renewable resources, Hawai'i imports 86 percent of its energy in the form of fossil fuels. Of the total energy needed, 36 percent is used for power generation, 15 percent for industrial use, and the remainder in transportation.<sup>12</sup> The Hawai'i Clean Energy Initiative (HCEI), a partnership between the State of Hawai'i and the U.S. Department of Energy, seeks to reduce Hawai'i's dependence on imported fossil fuels by achieving a goal of 70 percent clean energy by the year 2030.<sup>13</sup> The overall goal for the transportation sector is to reduce the consumption of petroleum in ground transportation by 70 percent or approximately 385 million gallons per year by 2030 (this excludes the jet industry, which is also a significant user of petroleum fuels).<sup>14</sup>

Electric vehicles will help this task by decreasing the amount of petroleum needed for transportation and simultaneously enabling an increase in the amount of variable renewable energy, like wind and solar, that electric utilities can accommodate by providing a distributed network of vehicle batteries to store excess energy.<sup>15</sup> Electric vehicles can also charge on otherwise curtailed wind power when overall demand is at its lowest.

*Below:* Photovoltaic panels being installed at UH Maui College.  
*Right:* Kaheawa Wind Farm on Maui

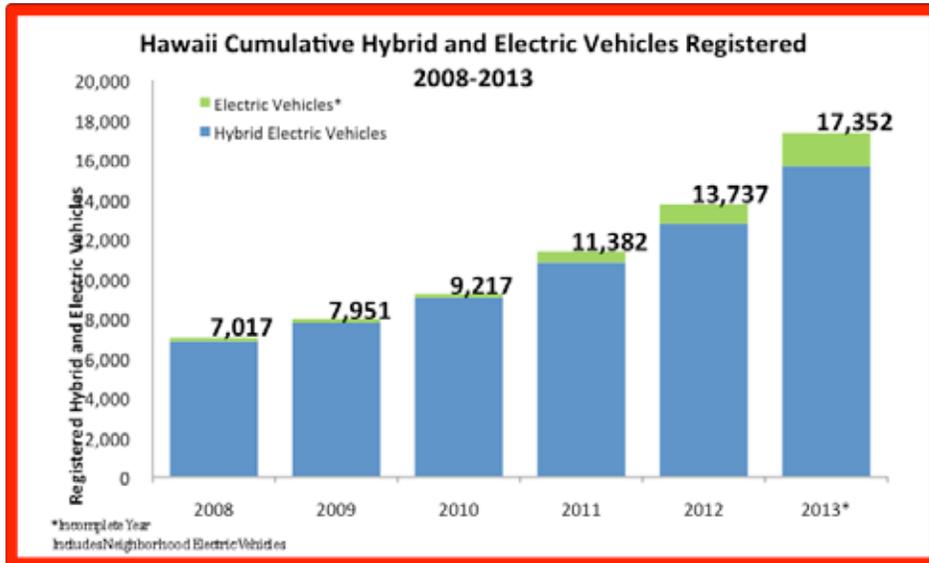
Overall, electric vehicles are more fuel-efficient vehicles, whatever the source of power. According to the Department of Energy, electric vehicles convert about 59-62 percent of the electrical energy from the grid to power at the wheels, while conventional gasoline vehicles convert only about 17-21 percent of the energy stored in gasoline to power at the wheels. So a gallon of fuel is as much as 45 percent more efficient when burned by the utility and transferred to an electric vehicle than when burned in the gas tank of a conventional car. If an electric vehicle receives energy from renewable energy sources, then no fossil fuels are burned or emitted from either the tailpipe or the utility company—a double win.<sup>16</sup>

Electric vehicle ownership will also be affected by the related renewable energy market. The decrease in price of solar panels in the last year has encouraged more households to add solar energy in the state's net metering program. With Hawai'i having the highest electricity rates in the nation, the payback period for both solar and electric vehicle purchases is relatively quick compared to other regions of the country. For example, the Maui Electric Company (MECO) estimates that 5% of their customers now have photovoltaics (PVs), and the number is growing rapidly.<sup>17</sup> Studies in California have shown that there is a high correlation between solar PV ownership and electric vehicle ownership, with nearly 39 percent of electric vehicle owners investing in PV installations.<sup>18</sup>



## Status of Electric Vehicle Deployment in Hawai'i

### 1. Vehicle Purchases (out of 1,077,697 registered vehicles in Hawai'i)<sup>19</sup>



Island	EVs*
O'ahu	1,371
Maui	266
Hawai'i	93
Kaua'i	53
Statewide	1,783

\*Registered passenger EVs which includes Plug in Hybrid and Neighborhood Electric Vehicles

Source: Monthly Energy Trends (Department of Business, Economic Development and Tourism), August 2013. Chart includes Neighborhood Electric Vehicles. Figures updated September 4, 2013

### 2. Corporate/Government Fleets

Some of the owners of the largest fleets in the state include:

- State of Hawai'i
- City and County of Honolulu
- County of Maui
- Hawaiian Electric Company (HECO)
- Maui Economic Opportunity, Inc. (MEO) a nonprofit agency
- Maui Electric Company (MECO)

Below: The Hawaii EV Ready Program allocated \$475.5K to the State for 10 EVs and over a dozen Level 2 charging stations

Other owners of fleets include construction companies, moving van companies, and companies with delivery trucks; however, their vehicle pools are almost exclusively medium to heavy-duty or specialized utility vehicles. Electric vehicle options are not available in these categories currently. But the commercial market is poised to offer electric vehicles soon, and stakeholders may soon be willing to plan for this change.

The State of Hawai'i has a large fleet of vehicles on Maui, many of which are trucks and utility vehicles. Currently, it has only introduced electric vehicles into its fleet on O'ahu, where the charging infrastructure is more developed.





### 3. Rentals

Enterprise Rent-A-Car and Green Car Hawaii both began renting electric vehicles to customers starting in 2010 and 2011. Enterprise Rent-A-Car was the first agency in Hawai'i to offer electric vehicles for rent and introduced the Nissan Leaf to their O'ahu fleet. It currently has approximately 30 electric vehicles for rent.<sup>20</sup> Bio-Beetle ECO Car Rentals was the first rental car company to offer electric vehicles on Maui.

In November 2012, Roberts Hawai'i, a provider of bus and shuttle services, agreed to transport GreenCar Hawaii clients to their electric vehicles. The arrangement will provide visitors a "sustainable, full-circle transportation solution with an express shuttle to and from the airport and car-sharing at the hotel."<sup>21</sup> Given that Roberts Hawai'i is the state's largest tour and transportation company, it is likely that this development will spread and benefit visitors on other islands if the initial market investment proves profitable.

*Top:* Enterprise Rent-A-Car and Bio Beetle ECO Rental Cars at National Plug-in Day in Maui, 2012 *Right:* GreenCar Hawai'i at Grand Hyatt at Poipu in Kaua'i



#### 4. Charging Installations

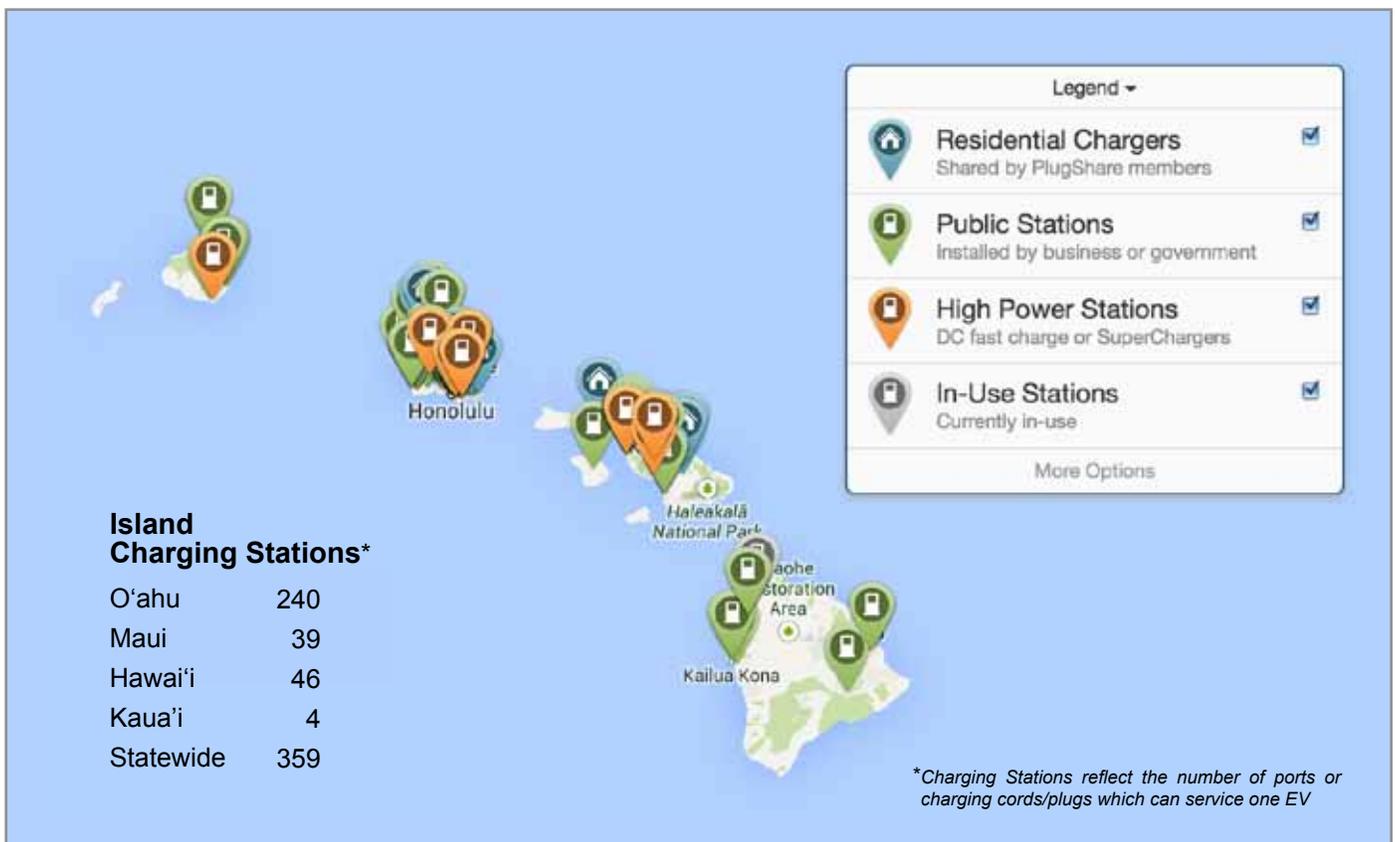
Electric vehicle owners need convenient options for recharging in order to feel comfortable purchasing the vehicles. For the majority of the general public, the convenience of recharging options is a key consideration when deciding whether to purchase an electric vehicle. While Level 1 charging may meet the needs of many electric vehicle owners by offering them the convenience of charging at home,<sup>22</sup> access to additional charging infrastructure will provide options for those who cannot charge at home as well as to alleviate battery range anxiety and charger congestion.

To address the need, companies and multi-tenant office buildings will need to invest in workplace charging infrastructure, which analysts expect to become the second most frequent location for recharging.<sup>23</sup> The public and private sector will also need to deploy more public charging stations. According to the U.S. Department of Energy, the United States currently has 6,331 public charging stations<sup>24</sup>, which is unlikely to be sufficient to meet future demand and to adequately address the range anxiety of electric vehicle users planning trips beyond commute distances, or the increasing congestion at charging stations.<sup>25</sup>

Public sector entities have facilitated the funding and siting of public access charging stations.

For example, the U.S. Department of Energy awarded \$115 million in grant funding to launch the “EV Project” in 2009 and 2010, which in part will help bring charging stations to metropolitan areas throughout the United States. Partner matches have raised the total value of the EV Project to approximately \$230 million.<sup>26</sup> In addition, the major Japanese automakers, including Nissan, Toyota, Honda, and Mitsubishi, are partnering to financially support new charging stations.<sup>27</sup>

Like other states, Hawai'i has a diversity of charging companies and electric vehicle models, which creates challenges, particularly for visitors. For example, each company uses a different access scheme and billing process. OpConnect in Hawai'i allows for multiple means to access and pay for charging. AeroVironment uses key fobs<sup>28</sup> but only for a charging station at a particular location; they are not interchangeable. Eaton and Coulomb both have credit card payment access, though charges vary by station. Schneider Electric makes use of a key fob held by the charging station host. This proliferation of charging stations, access, usage, and payment methods can be confusing to electric vehicle drivers, especially visitors who may be driving and charging for the first time or may not be familiar with locally installed charging stations, even if they have experience with electric vehicles at home.<sup>29</sup>



The lack of charging station payment standardization has become an increasing challenge across the nation, including Hawai'i, as more charging stations from a greater variety of manufacturers are installed. An adequate public charging infrastructure will require clear guidelines for the right to access, the right to use, and payment and interoperability procedures.

Charging equipment costs for some property owners have been addressed by nearly \$1.5 million in American Recovery and Reinvestment Act (ARRA) funds awarded to Better Place and AeroVironment in 2011. These vendors solicited new charging station hosts throughout Hawai'i. According to the Honolulu Clean Cities' report, this solicitation process helped educate the early adopters of charging equipment. The ARRA funds helped subsidize some equipment and site inspection costs while the host site shared the installation and other costs, although not all host site owners who were contacted chose to participate.<sup>30</sup>

## Existing State and Federal Incentives for Electric Vehicles

Hawai'i has a number of electric vehicle incentive programs. In 2010, the Hawai'i State Department of Business, Economic Development and Tourism (DBEDT) State Energy Office received a total of \$4 million in federal ARRA funds for transportation energy transformation, of which roughly half was given to residents and businesses in the form of tax rebates to lower the initial cost of electric vehicles. Through the EV Ready Rebate program, residents who purchased electric vehicles between August 2010 and April 2012 were eligible for up to a \$4,500 rebate off the purchase of a single plug-in electric vehicle.<sup>31</sup> The funds were depleted by May 2012.<sup>32</sup>

Car rental agencies also provide special rates, including "kama'aina"<sup>33</sup> discounts for Hawai'i residents, to encourage local residents to experience electric vehicles. Electric vehicle renters rushing to the airport for return flights also enjoy the added benefit of not being required to fill their tank (recharge) upon return, a savings in both time and cost. One local car rental agency, the Hawaiian Electric Vehicle Network (HEVN), projected to open in early 2014, committed to reselling its electric vehicle fleets in Hawai'i, thus providing a new venue for consumers to purchase electric vehicles at pre-owned prices.



Finally, in 2009, the State of Hawai'i announced new vehicle purchasing guidelines for the County and State that require preference be given to plug-in electric vehicles.<sup>34</sup> In response to this requirement, dealers and automakers are offering flexible lease arrangements that allow county and state agencies to work within their budget cycles.<sup>35</sup>

### Other state incentive programs include the following:

**EVSE tax rebates:** The DBEDT EV Ready Rebate program provided residents and businesses with an incentive of up to \$500 for one charging station (all funds exhausted by May 2012).<sup>36</sup>

**Free charging equipment:** The complement to DBEDT's EV Ready Rebate program, the EV Ready Grant program resulted in the installation of hundreds of additional charging stations, placing Hawai'i in the national forefront for deployment. This program awarded \$2.3 million in federal stimulus funds to six organizations.

**Discounted utility rates for electric vehicle charging:**

According to a recent report by the Northeast Group, only 6% of utilities in the United States offer special rates for electric vehicles.<sup>37</sup> These utilities include the three privately owned electric utilities operating under the parent Hawaiian Electric Company (HECO). They received approval from the Hawai'i Public Utilities Commission for two new electric vehicle pilot charging rates to encourage business customers to open new public electric vehicle charging facilities metered separately from other uses. The new rate removes the expensive "demand charge"<sup>38</sup> typically imposed on commercial customers for businesses that provide direct current fast charging. A second rate allows the Hawaiian Electric Companies to operate up to 25 publicly accessible DC fast charging facilities across O'ahu, Maui County and Hawai'i Island, where drivers could recharge their vehicles for a per-session fee.<sup>39</sup>

**Renewable Energy:** For residents of Hawai'i, the most important benefit of electric vehicles may be the ability to charge their vehicles using solar panels at home. Many electric vehicle owners contacted by MEVA cited their rooftop photovoltaic (PV) installations as a financial reason for dedicating surplus energy to an electric vehicle. Hawai'i currently ranks third in cumulative solar capacity per capita in the United States.<sup>40</sup>

**Parking Incentives:** State laws enacted between 2009 and 2012 provide electric vehicles users with specific benefits and protections. These include two or more hours of free municipal parking, and a full day of free parking at the airport for vehicles with electric vehicle license plates. Parking spaces are also designated for exclusive electric vehicle use, with access to charging required for large public properties (over 100 parking spaces). Residents of multi-unit dwellings, such as condominium owners, also have a protected right to install charging systems on or near their parking stalls. On O'ahu, cars with electric vehicle license plates also have access to the high-occupancy vehicle lane on freeways.

**Federal Policies/Incentives:** The federal government recently increased the average miles per gallon (mpg) that the U.S. automobile market must meet for 2025 to 54.5 mpg, which is double the current average.<sup>41</sup> This new policy may force auto manufacturers to produce and sell more electric vehicles in the U.S. market.<sup>42</sup> In addition, the federal government provides a tax credit of up to \$7,500 per electric vehicle since 2008. It allows a credit for up to 200,000 electric vehicles per manufacturer, then phases down to 50% and 25% over time.<sup>43</sup> Locally, some auto dealers offer flexible lease arrangements that allow consumers to take advantage of the federal tax credit up-front.<sup>44</sup>



Above: Nissan LEAFs parked at Queen Ka'ahumanu Center during the launch of JUMPSmart Maui, the Japan-US smart grid demonstration project on Maui, June 15, 2013

# Statewide Barriers to Adoption and Proposed Solutions

## Insufficient Charging Station Infrastructure

According to respondents to MEVA outreach, businesses and public entities are often reluctant to invest in charging equipment or dedicate a parking spot for charging. Even if the total cost of ownership and long-term returns reveal compelling gains, buyers often have other more pressing concerns, or they may be overwhelmed by the complexity and effort required. And many are unconvinced that a strong consumer demand exists for more charging stations. For example, hotels and other property owners are reluctant to make new investments in charging infrastructure after recent recession-related cutbacks, layoffs, and bankruptcies. Businesses are especially cautious given that energy is typically their single biggest expense after personnel. Finally, the lack of a standard for DC fast charging equipment translates into a hesitancy to invest out of fear that the standards are incompatible.

Property owners have also voiced concern to MEVA that they will pay a public relations price if parking spaces reserved for electric vehicles and electric vehicle charging are left unused, while customers with non-electric vehicles are frustrated by parking limitations. Hawai'i State Law Act 89/SB2747 (2012) requires larger property owners to designate electric vehicle parking spaces and provide access to charging stations,<sup>45</sup> and the contents of the law have been communicated to those affected. However, the law is not currently enforced, has no mechanism for enforcement or penalty for violation, and community awareness of its provisions remains limited, resulting in little pressure on property owners to comply.

In addition, charging stations cost more to install on Hawai'i compared to the mainland, partly because materials need to be imported and labor costs are among the highest in the nation.<sup>46</sup> Unique site considerations can also result in delays and additional expense. These include Special Management Areas (SMA), permits, trenching, upgrades, environmental factors, flood zones, and security. Based on data collected by the State Energy Office, charging station installations in Hawai'i can range from \$4,000 to \$25,000, with a relatively simple project in Hawai'i typically costing approximately \$6,000 to \$8,000 per station.

Hawai'i is also a challenge for installation of charging stations because of flood control mandates and SMAs that form the coastal zone management system. Most of the properties frequented by tourists are located in these areas, and under some conditions the charging stations must be elevated or are subject to additional requirements. Environmental conditions on a tropical island also pose a challenge for installation and maintenance. High salt content in the air, humidity, and full sun exposure can lead to equipment degradation and malfunction. For example, staff at one Maui installation site reported that the equipment rusted within months of installation. Owners therefore need to purchase charging equipment with protective covers or anticipate higher replacement costs because of shorter lifespans for the equipment.

Convenient locations for charging stations are not always ideal in terms of cost savings or feasibility. Electric panels may be located far away from the parking space where installation is needed, resulting in high trenching costs for buried cables. Older properties may not have sufficient electric capacity to accommodate the additional load of charging an electric vehicle and thus may require upgrades to their electric panels, such as new or replacement breakers.

### Solutions

**Local leaders should analyze and plan for optimal charging site locations on each island and coordinate private sector involvement to implement.**

Each island will require systematic, advance planning to determine the most optimal locations for charging locations, based on traffic patterns and environmental and geographic factors, among others. Some entities have already undertaken this analysis for specific islands. Local residents, businesses, and public officials will then need to identify and coordinate charging site locations and installations based on this analysis. Certain businesses in key locations may be amenable to hosting charging stations in order to attract more customers. Business associations and public entities can also bundle charging site bids among multiple sites and request proposals from charging station manufacturers to lower costs. State leaders can help by enforcing existing laws regarding electric vehicle parking requirements and by offering incentives for property owners to install charging stations.

## Limited Supply and Public Outreach

Some consumers are unfamiliar with electric vehicles and their performance or face difficulty finding dealers capable of servicing and promoting them. The lack of on-island servicing means electric vehicle owners often have to wait for visits to their island from off-island technicians for routine servicing. In addition, some consumers harbor misconceptions about electric vehicles or believe that ownership entails inconvenience. Moreover, residents and visitors on a number of islands lack access to electric vehicles through car rental companies and dealerships that do not supply them.

### Solutions

**Local leaders should encourage island dealers and rental car agencies to supply electric vehicles.**

Car rental agency and dealer purchases of electric vehicles will address the supply and servicing limitations for residents and visitors. Deployment of a more comprehensive charging infrastructure will also allay visitor industry concerns that customers may not want electric vehicles due to the limited range of all-battery versions and the lack of quick and easy charging stations in key locations.

## High Costs of Vehicles and Electricity

One of the most commonly articulated barrier from consumers is that they consider electric vehicles “too expensive.” The initial cost of an electric vehicle is higher than comparable non-electric vehicles. For example, only two dealerships offer electric vehicles on Maui, and selection is limited to the Nissan LEAF, the Chevrolet Volt, and the Toyota Plug-In Prius. If a desired vehicle is not available for sale on the island, Maui residents must pay additional shipping costs: \$300 from O’ahu or \$1,000 from the mainland (with rates subject to change from shipping companies). New leasing options, however, have increased electric vehicle uptake, although leasing costs are higher than on the mainland due to shipping.<sup>47</sup>

In addition, Hawai’i’s electricity rates are the highest in the country, and islands such as Maui, Moloka’i and Lāna’i have higher rates than O’ahu.<sup>48</sup> This cost can affect the total cost of ownership (although offset by high gas prices) and can pose a risk for charging station owners who are not set up to pass costs on to users.

An adequate infrastructure for visitors with limited time requires faster charging than Level 2 stations can accommodate. The DC fast charging stations that meet this need pose their own challenge, as they can result in demand charges (although 25 stations may be exempt under new proposed rates by HECO), as well as potential changes to a business property’s rate schedule, discussed previously.

Current rules for investor-owned utilities in the islands prevent many residents from lowering their electricity costs by limiting the penetration of renewable energy under the net energy metering program. The net metering program allows customers to receive a retail credit for the renewable energy they produce on-site, such as from rooftop solar panels. These retail credits can greatly offset the cost of charging an electric vehicle. In Hawai’i, Public Utilities Commission Rule 14 governs the interconnection of distributed generation systems like rooftop solar panels.<sup>49</sup> This rule, based on the similar Rule 21 in California, requires a study of the impact of new distributed generation systems on a utility grid system, if the proposed system fails a series of prescribed screens. Many neighborhoods in Hawai’i have reached the point at which a study (and the associated additional expense to the customer) is required, at a time when both residential and commercial energy producers are interested in adding more distributed generation. This trigger point is commonly referred to as a “cap” on net metering because it adds time and expense to any new distributed generation systems. The trigger point is currently set at 15 percent penetration in each distribution circuit.<sup>50</sup>

### Solutions

**Car dealers and rental firms should increase education and outreach efforts and utilities should expand and promote renewable energy and charging station incentives.**

To address the high cost of some electric vehicle models, car dealers will need to continue promoting competitive lease deals and financing options to interested customers and ensure that this effort takes place on each island. Rental car companies can also promote electric vehicles to customers and then sell used models to residents at a discount.

The high cost of electricity to charge electric vehicles can be offset by installing on-site renewable energy generation, such as rooftop solar panels. Many solar installers offer competitive lease deals to remove upfront costs. However, utilities and state regulators will need

to reexamine the 15 percent threshold currently limiting net metering opportunities for customers in key areas. Utilities should also examine customer responses to the new, lower rates for charging equipment to gauge how effective the programs have been and to develop ways to ensure that more customers take advantage of them.

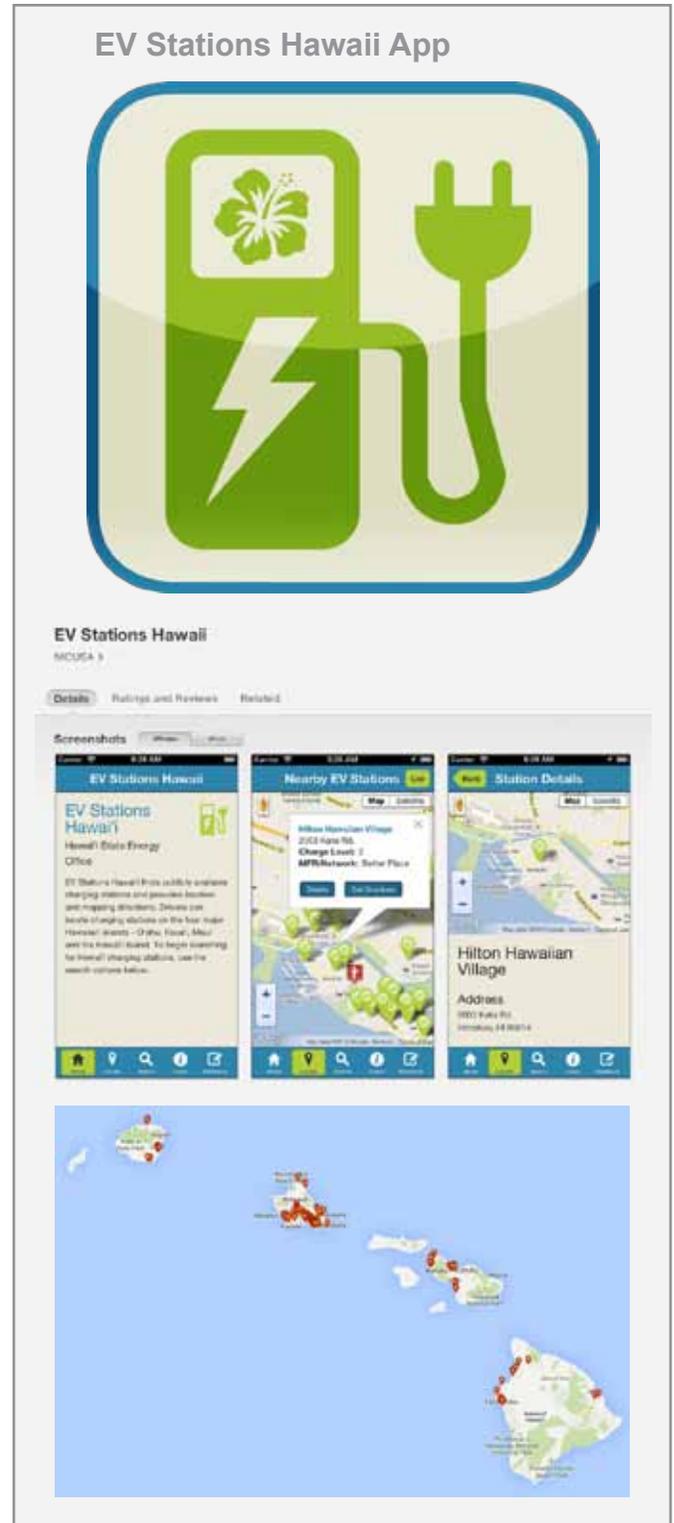
## Lack of Diverse Electric Vehicle Models

Automakers have yet to introduce in Hawai'i electric options for choices popular in the tropics, such as convertibles, SUVs, and affordable pick-up trucks, with features like sufficient trunk space for luggage and four-wheel drive capability for off-road access. Most current electric vehicles available in Hawaii are relatively small and passenger-oriented and not meant for off-road travel.

### Solutions

**Automakers will need to introduce more diverse electric vehicle models to the state, while car dealers and rental agencies and fleet owners should purchase more models for eventual resale to residents.**

As automakers continue to develop innovative new plug-in models, they should consider marketing these versions to Hawai'i residents and fleet owners. Some existing sport utility models, such as the Toyota RAV4 electric vehicle, are only sold in California due to that state's air quality regulations. However, models like the RAV4 electric vehicle would be well-suited to Hawaii. Residents and public sector and visitor industry fleet owners may be more likely to purchase electric vehicles with a greater diversity of options.

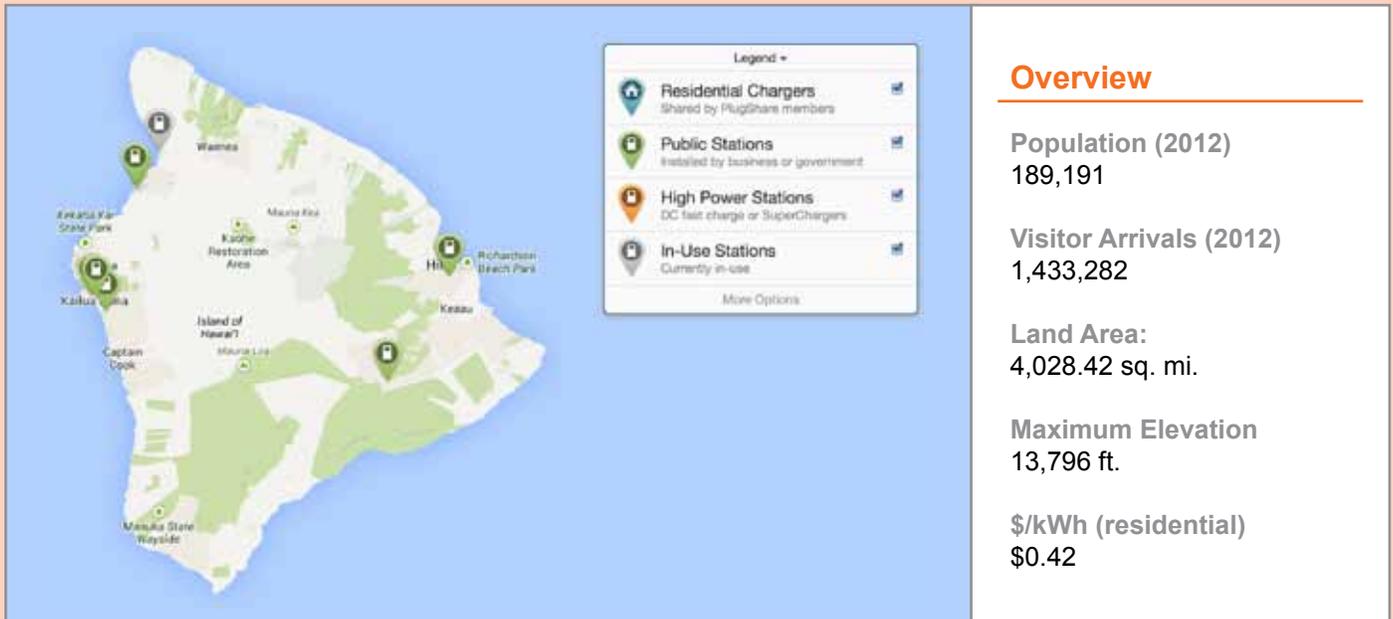


Above: The Hawaii State Energy Office launched a free mobile application of public EV charging stations in Hawai'i for Apple and Android smartphones and other mobile devices. It is the only state to have its own app for the location of charging stations. Search for "EV Stations Hawaii" to download.



# Hawai'i Island

Hawai'i, commonly referred to as the "Big Island," is the state's largest island, with a dry, volcanic west side that features most of the luxury resort hotels, a mountainous center, and lush east side, featuring the old industrial and agricultural center of the island. The island is 93 miles across from its farthest points, with 4,028 square miles of land area – roughly 62% of the total land in the Hawaiian Islands.



## Barriers to Electric Vehicle Adoption on Hawai'i Island

### Visitors:

- 1) Lack of electric vehicle rental car options:** rental car companies on the island do not make electric vehicles available to visitors to rent.
- 2) Lack of charging stations in key locations:** as the biggest island, geography limits the range of electric vehicles. For example, most battery electric vehicles cannot drive between the two largest cities of Hilo and Kona. ARRA funding contributed to charging stations in some west-side resorts, but these stations are not strategically located to allow circumnavigation of the island by battery electric vehicles.

### Residents:

- 1) Lack of dealer support:** battery electric vehicles currently are not sold on the Big Island, despite the presence of two Nissan dealers. As a result, these vehicles are not marketed to residents and no local servicing exists. Residents need to wait for an off-island technician to visit the island for check-ups and servicing.
- 2) Inadequate public charging station infrastructure:** as discussed, residents cannot circumnavigate the island without public charging stations in key points between major destinations.
- 3) Net metering restrictions:** 3,955 HELCO residents and 344 businesses have on-site renewable energy generation. As a result, some residential circuits on the island, such as in Hilo and Kona, have already reached the 15 percent saturation level, triggering expensive and time-consuming studies to add additional rooftop solar that can reduce the costs of owning an electric vehicle.

**4) Need for off-road electric vehicle models:** some island residents drive off-road and therefore require four-wheel drive vehicles, while no electric vehicle models exist to fit this need currently.

#### Fleets:

**1) Lack of service options:** As with residents, fleet owners are reluctant to invest in electric vehicles without on-island service capability, either through dealers or trained technicians. Of note, the County of Hawai'i has begun integrating Chevy Volts into its fleet.

**2) Cautious culture:** some island residents noted a culture reluctant to take risks on new technologies among fleet owners.

## Solutions:

### Public charging stations at key locations around the island

Currently, most battery electric vehicle drivers are unable to circumnavigate the island on a single charge, or even travel between the two major cities on the island. Prime tourist destinations are therefore unreachable, and the utility of the battery electric vehicle is diminished for residents and visitors alike. However, placement of public charging stations at eight or nine key locations around the island would completely solve the range issue facing drivers and therefore remove a major barrier to electric vehicle adoption on the Big Island. A local association of electric vehicle drivers is attempting to locate commercial property owners willing to host a charging station and secure funding for the station. However, this group will need both private and public sector support to deploy adequate public charging stations.



### Improved maintenance of existing public charging stations

The Big Island has a small network of public charging stations, primarily at hotels concentrated on the west side of the island. Local drivers rely on this network for trips, yet they have noted that often these charging stations are inoperable for various reasons. Charging station owners across the island, perhaps with support from electric vehicle drivers and the public sector, should develop a plan to ensure that these installations remain operable and have a system for maintenance.

### Car dealer support and servicing for electric vehicles

No car dealers on the Big Island currently sell or service battery electric vehicles (although they do sell plug-in hybrid electric vehicles), partly out of concern for the upfront costs of training technicians and investing in the servicing infrastructure. As a result, electric vehicles are not heavily promoted to island residents, and electric vehicle owners must wait for servicing trips from off-island dealers. Electric vehicle advocates and public officials should encourage Big Island car dealers to sell and service battery electric vehicles, perhaps by expanding the public charging network to allay dealer concerns that range anxiety will depress sales.

### Rental car agencies adoption of electric vehicles

Rental car companies on the Big Island currently do not provide electric vehicle options for customers. Both residents and visitors would benefit from the option to rent an electric vehicle, and existing companies should consider purchasing electric vehicles for their fleet, particularly once the island expands its public charging infrastructure and begins servicing electric vehicles on the island.

### Lease deals and secondary electric vehicle rental market selling to residents

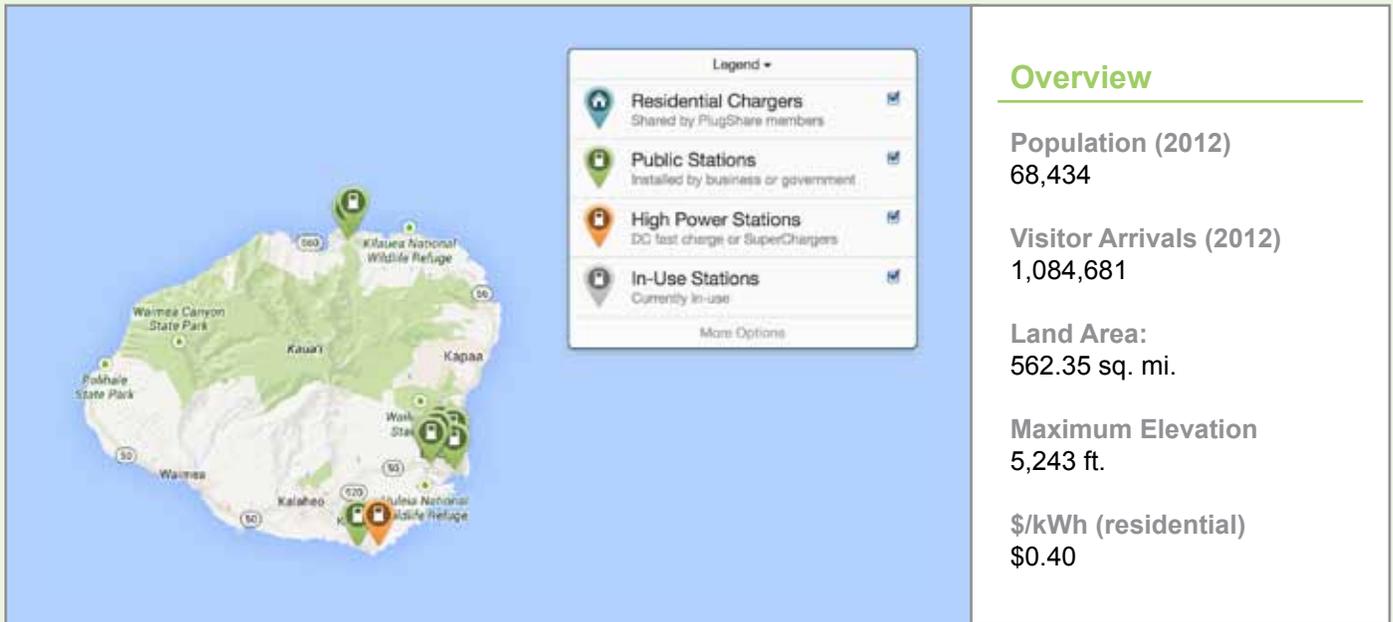
Island residents need access to attractive electric vehicle lease deals and the secondary market for electric vehicles on other islands. Neighbor island car dealers should market to Big Island residents, where leases save most residents with rooftop solar money. Car dealers should also consider selling used electric vehicles to island residents.

### Remove the net metering “cap”

The 15 percent restriction on new net metering customers hampers solar uptake among Big Island residents, making electric vehicles financially impractical to purchase or lease. Hawaii Electric Light Company (HELCO), Hawai'i's utility, should lift this restriction and allow more solar net metering customers to boost electric vehicle adoption.

# Kaua'i

Kaua'i is a lush island at the western edge of the state, approximately 33 miles long by 25 miles wide. With a population close to 70,000 people, it has a relatively small residential base but with substantial tourists. Unique among the islands, its electricity is provided by a rural-owned utility cooperative which has the some of the most aggressive renewable energy policies in the state. The island has extensive renewable uptake (7.5 megawatts of installed residential and commercial capacity, plus an additional 7.5 megawatts from power purchase agreements, with a system peak of 72 megawatts). Kaua'i has one DC fast charger at a South Shore hotel and a few level two public charging stations.



## Rental Car Fleet:

The first and only car share company to operate in Hawai'i was GreenCar Hawai'i, with an exclusively clean energy car company that launched its business on Kaua'i in 2010, and expanded to O'ahu at the end of 2011.<sup>51</sup> The major rental car companies at the airport in Lihue do not currently offer electric vehicle options on the island.

## Barriers to Electric Vehicle Adoption on Kaua'i

### Visitors:

- 1) Lack of electric vehicle rental car options:** rental car companies at the airport do not make electric vehicles available to visitors to rent (although, as discussed, at least one electric vehicle rental car company is based at the Grand Hyatt in Poipu).
- 2) Lack of charging stations in key locations:** most electric vehicles cannot conveniently drive from the southern to the northern ends of the island, such as

Princeville, or to the popular Waimea Canyon overlook, due to the lack of fast-charging infrastructure. ARRA funding contributed to one fast charging station at a South Shore hotel, but this site is not centrally located for the island.

### Residents:

- 1) Need for off-road electric vehicle models:** some island residents drive off-road and therefore require four-wheel drive vehicles, while no electric vehicle models exist to fit this need currently.
- 2) Additional public charging station infrastructure needed:** as discussed, residents may have difficulty traveling to key destinations on the island without more public charging stations in key points.
- 3) High price:** without a lease deal, the high upfront costs make electric vehicles cost-prohibitive to residents.

## Fleets:

**1) Lack of awareness:** many fleet owners have not considered electric vehicle options or received information about the potential cost savings associated with an electric vehicle fleet. Notably, Kaua'i County has begun integrating LEAFs into its "Green Motor Pool Pilot."

**2) Concern about inadequate charging infrastructure:** as discussed above, the island lacks charging stations in key locations.

## Solutions:

### Public charging stations at key locations around the island

Electric vehicle drivers in Kaua'i cannot conveniently get from the south end near the airport and hotels to the north side of the island. Public and private sector entities should partner to site charging stations at or near Princeville in the north. The prime tourist destination of Waimea Canyon could also benefit from a charging station, if feasible. Placement of public charging stations in these few locations would solve the range issue facing drivers and therefore remove a major barrier to electric vehicle adoption.

### Rental car agencies adoption of electric vehicles

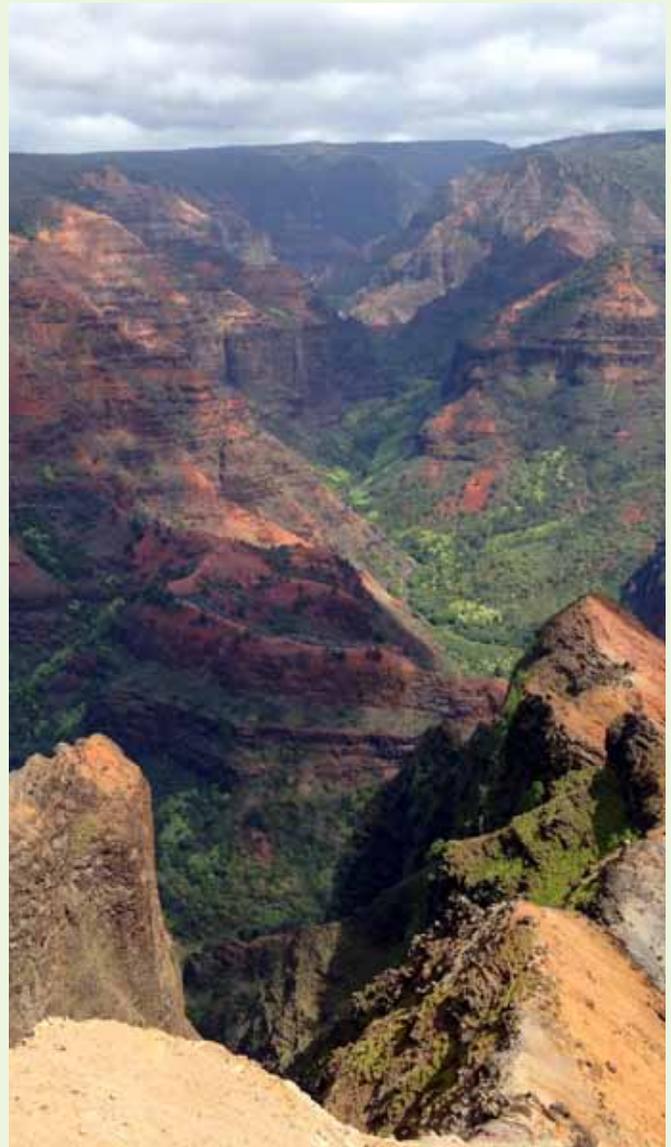
Rental car companies at the airport currently do not provide electric vehicle options for customers. Both residents and visitors would benefit from the option to rent an electric vehicle, and existing companies should consider purchasing electric vehicles for their fleet, particularly once the island expands its public charging infrastructure and begins servicing electric vehicles on the island.

### Lease deals and secondary electric vehicle rental market selling to residents

Island residents need access to attractive electric vehicle lease deals and the secondary market for electric vehicles on other islands. Neighbor island car dealers should market to Kaua'i residents, where leases save most residents with rooftop solar money. Car dealers should ensure that used electric vehicles are available to island residents.

### Electric vehicle charging rate

Kaua'i Island Utility Cooperative (KIUC) does not yet have a special rate for electric vehicle charging infrastructure. Such a rate could eliminate excess electricity charges for property owners with charging stations and encourage more residents to install home charging equipment.



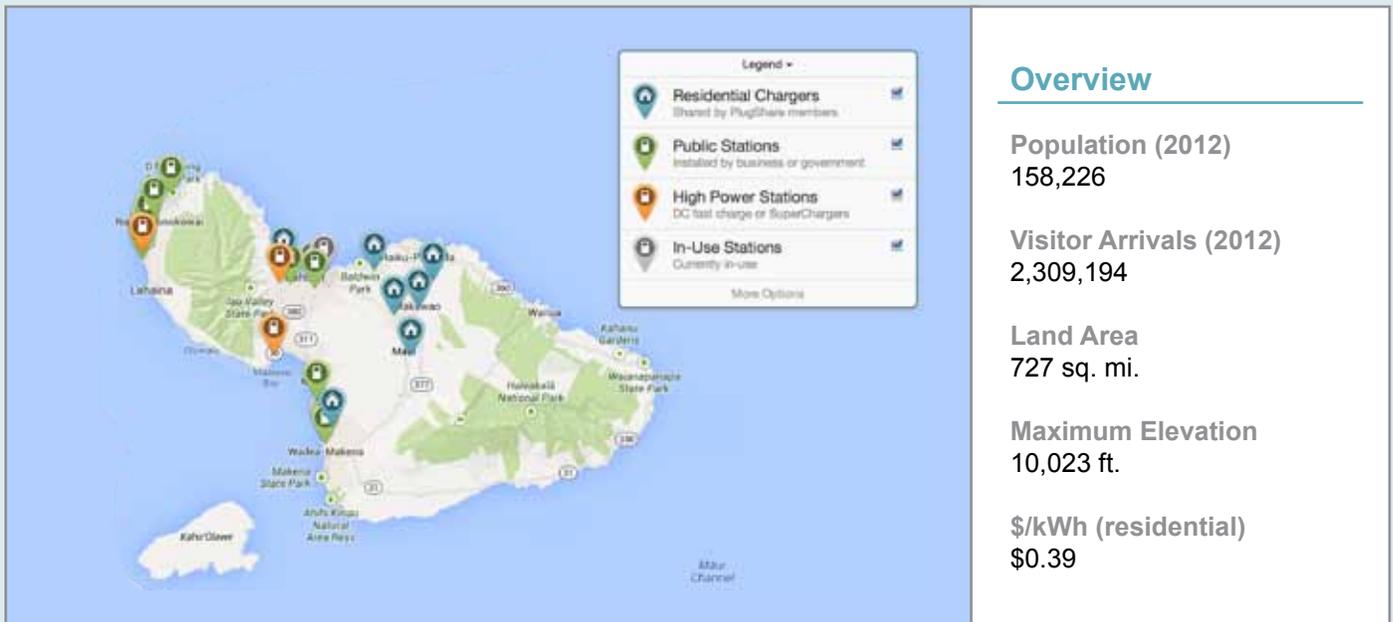
Above: Waimea Canyon on Kaua'i

Below: GreenCar Hawai'i at Grand Hyatt at Poipu in Kaua'i



# Maui

On any given day, approximately 25 percent of Maui County's population are visitors—over two million annually.<sup>54</sup> The island is one of the most popular for visitors, with resort centers along both of its two west-facing shores. Visitors can rent battery electric vehicles from airport rental car companies and use public charging, although many key destinations are unreachable with the current infrastructure. Dealers on the island sell Chevrolet Volts, Nissan LEAFs, and the Toyota Plug-in Prius. Overall, Maui has the second-largest land mass in the state, with roughly 727 square miles over two main volcanic masses connected by an isthmus.



With private and public investment and the presence of the Maui EVA, the island ranks second to O'ahu for electric vehicle sales and infrastructure (although soon to be first in DC fast charging). From 2011 to 2012, the charging infrastructure on Maui has more than tripled, from six Level 2 charging stations to over 20 publicly accessible stations with more in process.<sup>55</sup> The county installed its first DC fast charging station at the Maui County Building in Wailuku in September 2012 and the Japan-U.S. Smart Grid Demonstration Project, renamed JUMPSmart Maui, introduced five DC fast charging stations in 2013. An all-electric vehicle car rental company will be opening by early 2014 as well. Ultimately, Maui may soon achieve the largest deployment of electric vehicles per capita in the nation.<sup>56</sup>

## Rental Car and Other Fleets

More than other regions of the country, car rental fleets make up a significant portion of Maui's vehicle population. Although the Department of Motor Vehicles does not track rental cars separately, and car rental companies' fleet size is a closely-guarded secret, a generally accepted estimate of the number of rental cars in the total car population on Maui is 15-20%, based on the resident population, visitor population, and percent of visitors who use rental cars as their primary form of transportation.<sup>57</sup>

Currently, only two companies offer electric vehicle options in their car rental fleets: Enterprise Rent-A-Car and Bio-Beetle. Bio-Beetle was the first to offer electric vehicles on Maui: a Nissan LEAF and later a Chevrolet Volt. In addition, a new independent car rental company is in development: Hawaiian Electric Vehicle Network (HEVN).<sup>58</sup>

## Barriers to Electric Vehicle Adoption on Maui

### Visitors:

1) **Lack of awareness of electric vehicle rental car options:** rental car companies, hotels, and other visitor services entities on the island do not seriously promote electric vehicles as an option for visitors to rent. In addition, more rental car companies should purchase electric vehicles for their fleet.

2) **Lack of charging stations in key locations:** Maui needs additional charging stations for popular tourist destinations such as the road to Hāna and Haleakalā.

### Residents:

1) **Additional public charging station infrastructure needed:** as discussed, residents may have difficulty driving to key points on the island without more public charging stations.

2) **Net metering restrictions:** as of June 2013, 4,554 MECO customers (which also include Moloka'i and Lāna'i) had on-site solar. As a result, some residential circuits on the island have already reached the 15 percent saturation level, triggering expensive and time-consuming studies to add additional rooftop solar.

### Fleet:

1) **No suitable electric vehicle models:** currently, no agency or corporate fleet in Maui has adopted electric vehicles, with the exception of “test” vehicles, although some fleet owners are examining options.<sup>59</sup> According to fleet owners, equivalent electric vehicle models to replace existing fleet vehicles do not yet exist.

2) **High cost of electric vehicles:** many fleet owners find that existing electric vehicle options are not affordable or cheaper non-electric vehicle models will work

3) **No current need for new vehicles:** some fleets are relatively new and/or not growing, and therefore they are not in need of replacement vehicles.

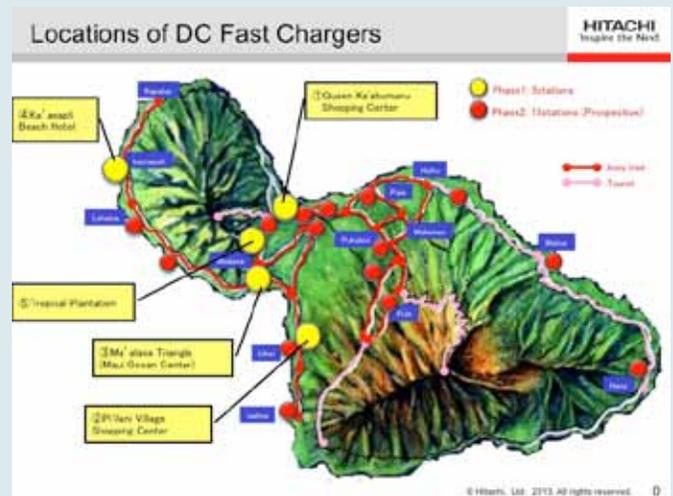
## Solutions:

### Rental car agency and visitor services should promote electric vehicle options

Rental car companies with electric vehicle options should market them to customers. In addition, hotels and travel agencies that offer package visitor deals should promote electric vehicle car rentals as an option. These visitors would therefore be able to try electric vehicles for an extended test-drive that could encourage purchase when they return to their home states or countries.

### Additional public charging stations at key locations

Electric vehicle drivers may have difficulty traveling to key destinations, as noted above. Public and private sector actors should address this need by siting new charging stations along the route.



Proposed locations of DC Fast Chargers based on traffic and demand. Source: Hitachi, JUMPSmart Maui project

### Lease deals and secondary electric vehicle rental market selling to residents

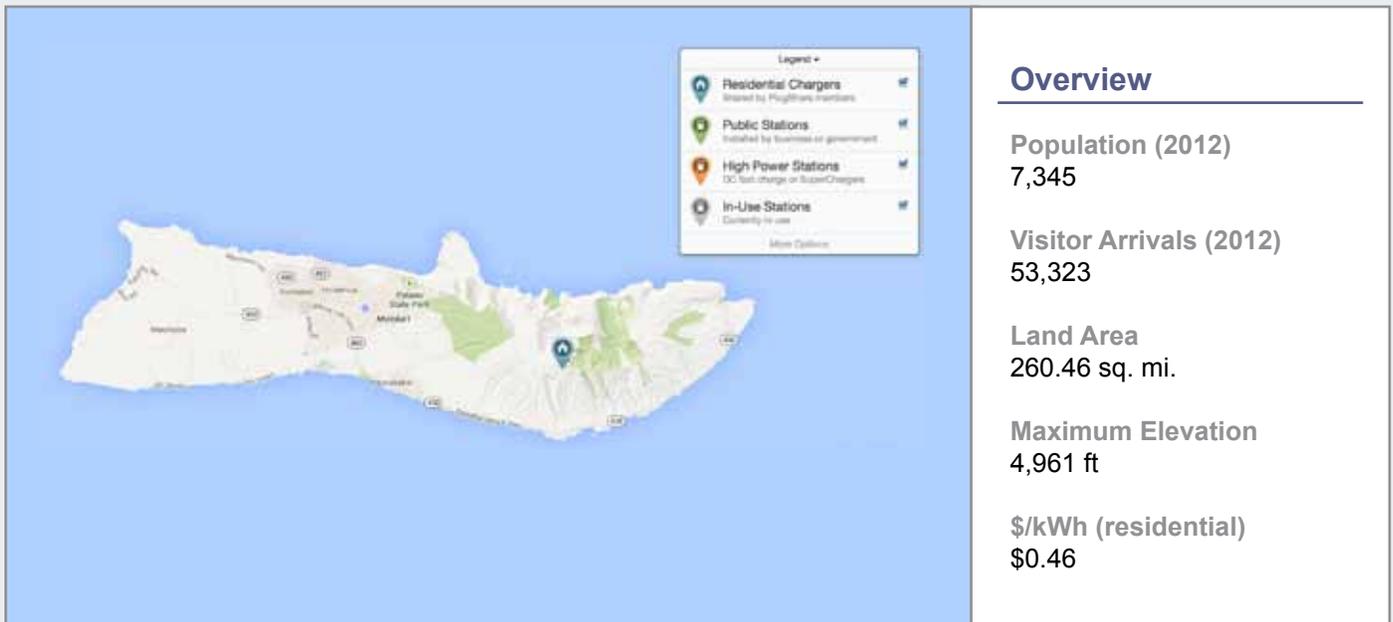
Island residents need access to attractive electric vehicle lease deals and the secondary market for electric vehicles. Car dealers should market to island residents, where leases save most residents with rooftop solar money. Car dealers and rental agencies should also consider selling used electric vehicles to island residents.

### Remove the net metering “cap”

As with other islands, the 15 percent restriction on new net metering customers hampers solar uptake among Maui residents, making electric vehicles financially impractical to purchase or lease. MECO, Maui's utility, should lift this restriction and allow more solar net metering customers to boost electric vehicle adoption. Notably, MECO offers special time-of-use (TOU) rates for a home combined with an electric vehicle charging station and dedicated TOU rates for electric vehicle charging through a separate meter. Special TOU tariffs for electric vehicles are offered on a pilot basis for a maximum of 300 meters until the end of September 2013, and the utilities have requested an extension beyond this date.<sup>60</sup>

# Moloka'i

Moloka'i represents one of the state's smaller islands in terms of population and visitors. It measures roughly 38 miles wide by 10 miles long. The island's minimal tourist infrastructure and wilderness areas attract an eco-conscious tourist that may be more amenable to sustainable car rentals such as electric vehicles. In addition, the island residents consider sustainability as one of their core values, with a number of "off-grid" homes and hunting and fishing commonplace for sufficiency purposes. The high gasoline and electricity prices, combined with low-incomes, means that many residents could benefit from electrical vehicles as a cost-saving measure.



## Barriers to Electric Vehicle Adoption on Moloka'i

### Visitors:

The two rental car agencies on the island currently do not own any electric vehicles to rent to visitors. In addition, the island has no public charging infrastructure or charging options available at the one hotel on the island or house and condominium rentals.

### Residents:

**Residents of Moloka'i face multiple barriers to purchasing or leasing electric vehicles:**

**1) High price:** the generally low levels of income on the island make expensive electric vehicle purchases a non-starter. Less expensive lease options, however, can be cost-effective for many residents.

**2) Lack of public charging stations:** the island cannot be traversed by a battery electric vehicle such as a Nissan LEAF given the distances and lack of public charging stations.

**3) Net metering restrictions:** for many island residents, charging an electric vehicle is cost-prohibitive without rooftop solar arrays to lower the electricity bills through net metering. However, many residential circuits on the island have already reached the 15 percent saturation level, triggering expensive and time-consuming studies to add additional rooftop solar.

**4) No electric vehicle dealers:** this small island has no car dealers. The nearest electric vehicle dealer is in Maui, but the psychological and financial barrier of needing to ship cars for servicing may discourage residents, while the small size of the market means off-island car dealers do not have a strong business incentive to promote cars to island residents.

**5) No secondary market through rental car companies:** without an electric vehicle rental car company on the island, residents face challenges to having the opportunity to buy second-market vehicles.

**6) Need for off-road electric vehicle models for large families (ohanas):** many Moloka'i residents drive off-road for hunting, fishing, recreation, and family gatherings. They therefore require four-wheel drive vehicles that can also fit many family members. No electric vehicle models exist to fit this need currently.

## Solutions:

### Electric vehicle-focused rental car agency

Moloka'i visitors and residents alike would benefit from an electric vehicle rental car agency, either as a new business or as a dedicated portion of the fleet at the existing rental car agency.

### Public charging stations

The island could use at least three public charging stations to benefit visitors and residents. The island's only hotel, Hotel Moloka'i, is centrally located and could attract new visitors and residents to its restaurant/bar with a charging station. In addition, many visitors stay in rental condominiums on the west end of the island, where a charging station would help them in addition to helping the residents who drive to the beaches and other recreational amenities on that side of the island. Finally, the east end of the island is a popular tourist destination with many homeowners who could use a charging station.

### Lease deals and secondary electric vehicle rental market selling to residents

Island residents need access to attractive electric vehicle lease deals and the secondary market for electric vehicles on other islands. Neighbor island car dealers should market to Moloka'i residents, where leases save most residents with rooftop solar money. Car dealers should also consider selling used electric vehicles to island residents.

### Remove the net metering "cap"

The 15 percent restriction on new net metering customers hampers solar uptake among Moloka'i residents, making electric vehicles financially impractical to purchase or lease. MECO, Moloka'i's utility, should lift this restriction and allow more solar net metering customers to boost electric vehicle adoption.

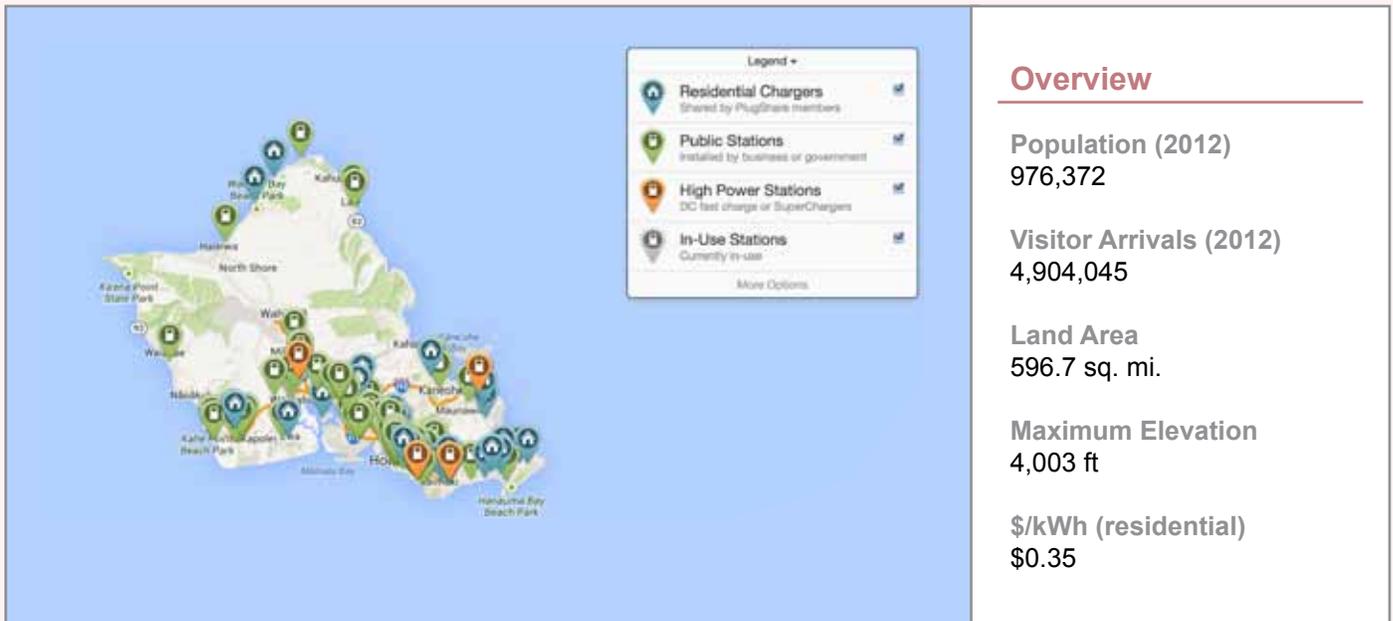


Top: The best view of Moloka'i is from the air

Above: Dr Dan brought the first 100% electric vehicle to Moloka'i in November 2011 - the Mitsubishi iMiev

# O'ahu

O'ahu is Hawai'i's most populated island, with almost one million residents. The island contains the capital city of Honolulu on its south shore and popular tourist destinations on the north shore. At its longest points, O'ahu is 44 miles long and 30 miles wide. The island received substantial ARRA funding to install charging stations.



## Rental Car Fleet

The first car share company to operate in Hawai'i, Green Car Hawai'i, is an exclusively clean energy car company that launched its business on Kaua'i in 2010, and expanded to O'ahu at the end of 2011. It has kiosks and charging stations at timeshare properties and a major hotel.<sup>61</sup> In addition, Enterprise Rent-A-Car on the island offers electric vehicle options.<sup>62</sup>

## Barriers to Electric Vehicle Adoption on O'ahu

### Visitors:

- 1) Lack of awareness of electric vehicle rental car options:** some rental car companies, hotels, and other visitor services entities on the island do not promote electric vehicles as an option for visitors to rent.
- 2) Lack of charging stations in key locations:** unlike other islands in Hawai'i, O'ahu has a fairly extensive charging network. However, additional charging stations would be helpful on the north end of the island, to

allow drivers from Honolulu to travel to the North Shore and back without concern for losing charge or encountering occupied chargers.

### Residents:

- 1) Need multi-unit dwelling charging options:** many residents in Honolulu, Hawai'i's largest city, live in apartment buildings without personal garages for their vehicles. These residents will need charging stations in their apartment parking lots or easy access to public charging in urban areas.
- 2) Additional public charging station infrastructure needed:** as discussed, residents may have difficulty circumnavigating the island without more public charging stations in key points.
- 3) Net metering restrictions:** As of June 2013, 22,343 residences and 691 businesses have on-site solar. As with other islands, some residential circuits on O'ahu have already reached the 15 percent saturation level, triggering expensive and time-consuming studies to add additional rooftop solar to lower the cost of home-charging an electric vehicle.

## Fleets:

1) **Lack of awareness:** many fleet owners have not considered electric vehicle options or received information about the potential cost savings associated with an electric vehicle fleet.

## Solutions:

### Rental car agency and visitor services should promote electric vehicle options

Rental car companies with electric vehicle options should market them to customers. In addition, hotels and travel agencies that offer package visitor deals should promote EV car rentals as an option. These visitors would therefore be able to try electric vehicles for an extended test-drive that could encourage purchase when they return to their home states or countries.

### Additional public charging stations at key locations

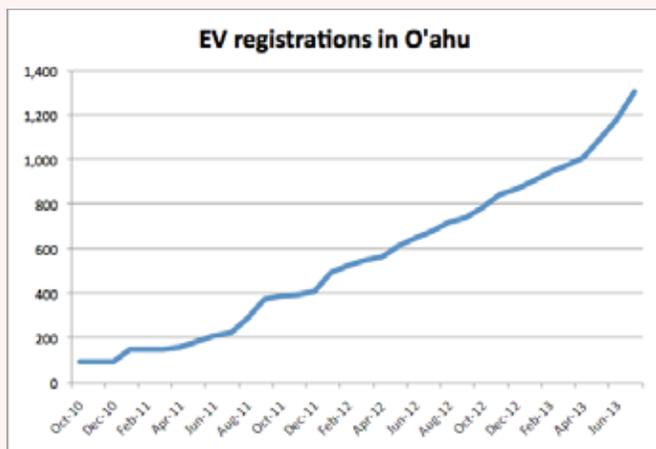
Electric vehicle drivers in Honolulu may have difficulty traveling to the north shore of the island and back due to the small number of charging options available. Public and private sector actors should address this need by siting new charging stations along the route.

### More multi-unit housing charging stations

Condominium and apartment associations should offer electric vehicle charging stations in their garages to allow access for tenants and owners.

### Remove the net metering “cap”

As with other islands, the 15 percent restriction on new net metering customers hampers solar uptake among O’ahu residents, making electric vehicles financially impractical to purchase or lease. HECO, O’ahu’s utility, should lift this restriction and allow more solar net metering customers to boost electric vehicle adoption.



Source: DBEDT, Monthly Energy Trends



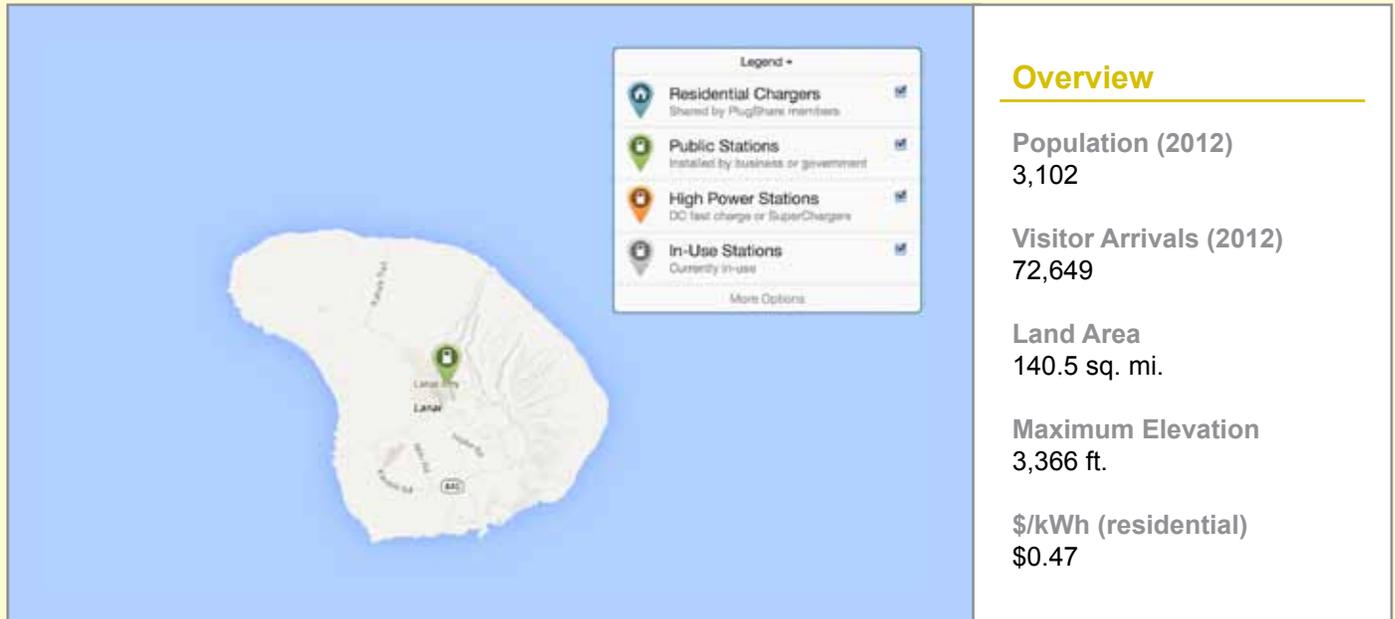
Top: The 'Iolani Palace in the capitol district of downtown Honolulu

Below: Honolulu, Hawai'i



# Lānaʻi

Lānaʻi is a largely privately owned island, with one major hotel resort destination and a distance of approximately 18 miles from its farthest points. The new majority owner of Lānaʻi, Larry Ellison, publicly stated that he would like to bring more electric vehicles and renewable energy to the island, to make the island a “little laboratory” for sustainability.<sup>52</sup> Change may happen quickly on Lānaʻi because Ellison is an “early adopter” and has a business interest in sustainability. He has not yet released official plans.



Currently, the island’s Four Seasons Manele Bay resort installed one Level 2 charging station, with plans for more, but the local car rental company is waiting for four-wheel drive vehicles before adding electric vehicles to its fleet.<sup>53</sup>

Due to the island’s majority private ownership and the not-yet-public plans regarding renewable energy and electric vehicles, this report does not address barriers and solutions for Lānaʻi.





## Conclusion: Electric Vehicles Beyond the Islands

Hawai'i can lead the way for electric vehicle deployment, selling the benefits to 8 million visitors and leading a global market for vehicle and charging infrastructure purchases. However, the state must continue its positive momentum on electric vehicles by taking steps now to ensure this future. Enforcement of existing state policies on electric vehicles, improved electricity rate structures, and deployment of key charging facilities on various islands represent some of the most important actions that policy makers, businesses, and residents can help facilitate.

In some respects, Hawai'i foreshadows a potential energy future for the rest of the country and world, with high energy costs and significant renewable potential and deployment. Electric vehicles are poised for mass adoption on the islands, given these high costs and limited geography. But public and private leaders will have to address the challenges described in this report to make Hawai'i a true electric vehicle paradise and inspire action around the globe.

## Endnotes

- 1 Per Hawaii Revised Statutes §291-71, an electric vehicle refers to a four-wheel vehicle powered in whole or in part by a battery with at least four kilowatt hours of energy storage, rechargeable from an external source.
- 2 Audrey McAvoy, “Record Numbers of Tourists Come to Hawaii in 2012,” *The Associated Press*, January 25, 2013. Available at <http://news.yahoo.com/record-numbers-tourists-come-hawaii-2012-spend-record-152228403.html> (accessed August 14, 2013).
- 3 For more discussion on the three categories of electric vehicles, please visit: <http://www.afdc.energy.gov/vehicles/electric.html> (accessed July 31, 2013).
- 4 For more examples, please visit: <http://www.fueleconomy.gov/feg/findacar.shtml> (accessed July 31, 2013).
- 5 For more examples, please visit: <http://www.fueleconomy.gov/feg/findacar.shtml> (accessed July 31, 2013).
- 6 Tom Turrentine, Ryan McCarthy, Kevin Nesbitt, Joshua Cunningham, and Josh Boone, “Taking Charge: Establishing California Leadership in the Plug-In Electric Vehicle Marketplace,” *California Electric Plug-In Vehicle Collaborative*, p. 22. Available at [http://www.evcollaborative.org/sites/all/themes/pev/files/docs/Taking\\_Charge\\_final2.pdf](http://www.evcollaborative.org/sites/all/themes/pev/files/docs/Taking_Charge_final2.pdf) (accessed July 31, 2013).
- 7 Antony Ingram, “Six New Plug-In Electric Cars Coming for 2014,” *Green Car Reports* website, April 11, 2013. Available at [http://www.greencarreports.com/news/1083492\\_six-new-plug-in-electric-cars-coming-for-2014](http://www.greencarreports.com/news/1083492_six-new-plug-in-electric-cars-coming-for-2014) (accessed July 31, 2013).
- 8 John Voelcker, “Electric Cars ARE Coming, But It Will Be Slow: Why Is This So Hard To Grasp?” *Green Car Reports* website, March 30, 2012. Available at [http://www.greencarreports.com/news/1074544\\_electric-cars-are-coming-but-it-will-be-slow-why-is-this-so-hard-to-grasp](http://www.greencarreports.com/news/1074544_electric-cars-are-coming-but-it-will-be-slow-why-is-this-so-hard-to-grasp) (accessed July 31, 2013).
- 9 Justin Doom, “Sales of U.S. Plug-In Vehicles Double as Makers Expand Offerings,” *Bloomberg*, July 19, 2013. Available at <http://www.bloomberg.com/news/2013-07-19/sales-of-u-s-plug-in-vehicles-double-as-makers-expand-offerings.html> (accessed on July 31, 2013).
- 10 *Id.*
- 11 For more discussion on the three charging options, please visit: <http://www.pluginamerica.org/drivers-seat/understanding-electric-vehicle-charging>, [http://www.afdc.energy.gov/fuels/electricity\\_infrastructure.html](http://www.afdc.energy.gov/fuels/electricity_infrastructure.html) and [http://www.afdc.energy.gov/vehicles/electric\\_batteries.html](http://www.afdc.energy.gov/vehicles/electric_batteries.html) (each accessed July 31, 2013).
- 12 “Monthly Energy Trends,” State of Hawai‘i Department of Business, Economic Development and Tourism, November 2012. Available at [http://hawaii.gov/dbedt/main/whats\\_new/info/economic/data\\_reports/energy-trends](http://hawaii.gov/dbedt/main/whats_new/info/economic/data_reports/energy-trends) (accessed December 2012).
- 13 “Hawai‘i is the most fuel-dependent state in the nation,” Hawai‘i Clean Energy Initiative (n.d.). Available at <http://www.hawaiicleanenergyinitiative.org> (accessed March 2013).
- 14 Anne Ku, Susan Wyche, and Selene LeGare, “EVs in Paradise: Planning for the Development of Electric Vehicle Infrastructure in Maui County,” *Maui Electric Vehicle Alliance*, University of Hawaii, Maui College, December 12, 2012 (Revised February 12, 2013), pp. 10-11. Available at <http://www.mauieva.org/report/> (accessed August 1, 2013).
- 15 “Maui County Data Book,” County of Maui, December 2011. Available at <http://hisbdc.org/Portals/0/MCDB/2011/PDF/2011%20Maui%20Data%20Book%20reduced%20size.pdf> (accessed August 8, 2013).
- 16 “Electric Vehicles,” U.S. Department of Energy, Fuel Economy website (n.d.). Available at <http://www.fueleconomy.gov/feg/evtech.shtml> (accessed August 8, 2013).
- 17 “State Electricity Profiles,” U.S. Energy Information Administration, January 30, 2012. Available at <http://www.eia.gov/electricity/state> (accessed August 8, 2013).
- 18 “California Plug-In Electric Vehicle Driver Survey Results,” Center for Sustainable Energy California, May 2013, p. 5. Available at [http://energycenter.org/sites/default/files/docs/nav/transportation/cvrip/survey-results/California\\_Plug-in\\_Electric\\_Vehicle\\_Driver\\_Survey\\_Results-May\\_2013.pdf](http://energycenter.org/sites/default/files/docs/nav/transportation/cvrip/survey-results/California_Plug-in_Electric_Vehicle_Driver_Survey_Results-May_2013.pdf) (accessed August 8, 2013).
- 19 “Monthly Energy Trends,” Department of Business, Economic Development & Tourism, Research & Economic Analysis, July 2013, p. 2. Available at [http://files.hawaii.gov/dbedt/economic/data\\_reports/energy-trends/Energy\\_Trend.pdf](http://files.hawaii.gov/dbedt/economic/data_reports/energy-trends/Energy_Trend.pdf) (accessed August 14, 2013).
- 20 “Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii,” State of Hawai‘i Department of Business, Economic Development and Tourism, December 2012, p. 16. Available at: <http://energy.hawaii.gov/wp-content/uploads/2011/09/EVReportMauiElectricVehicleAlliance2012.pdf> (accessed August 7, 2013).
- 21 “Roberts Hawai‘i and GreenCar Partner to Take Cars Off the Road,” PR Newswire, November 19, 2012. Available at <http://www.prnewswire.com/news-releases/roberts-hawaii-and-green-car-partner-to-take-cars-off-the-road-179931421.html> (accessed August 8, 2013).
- 22 Nearly 87 percent of electric vehicle charging is expected to take place at home with Level 1 Charging. See “Strategic Technology and Market Analysis of Electric Vehicle Charging Infrastructure in North America,” Frost & Sullivan, July 26, 2012. Available at <http://www.frost.com/prod/servlet/press-release.pag?docid=264030714> (accessed August 1, 2013).
- 23 “Public & Workplace Charging,” Drive Clean website. Available at [http://driveclean.ca.gov/pev/Charging/Public\\_and\\_Workplace\\_Charging.php](http://driveclean.ca.gov/pev/Charging/Public_and_Workplace_Charging.php) (accessed August 2, 2013).

- 24 “Electric Vehicle Charging Station Locations,” U.S. Department of Energy, Alternative Fuels Data Center website. Available at [http://www.afdc.energy.gov/fuels/electricity\\_locations.html](http://www.afdc.energy.gov/fuels/electricity_locations.html) (accessed August 2, 2013).
- 25 Anton Wahlman, “Charter Congestion a Problem for Electric Cars,” The Street website, February 20, 2013. Available at [http://www.greencarreports.com/news/1082594\\_electric-car-charger-congestion-at-least-in-california](http://www.greencarreports.com/news/1082594_electric-car-charger-congestion-at-least-in-california) (accessed August 2, 2013).
- 26 For more information on The EV Project, please visit: <http://www.theevproject.com/overview.php> (accessed August 1, 2012).
- 27 Anna Mukai and Yuki Hagiwara, “Japan Automakers Team Up to Add EV Charging Stations,” Bloomberg News, July 31, 2013. Available at <http://www.detroitnews.com/article/20130731/AUTO0104/307310019#ixzz2bykc0QvI> (accessed August 14, 2013).
- 28 A key fob, also known as RFID (radio frequency identification) card, contains unique identity information used to communicate at close proximity with a device to permit access. See Mary Catherine O’Connor, “RFID is the Key to Electric Vehicle Recharging Stations,” RFID Journal, November 21, 2008. Available at <http://www.rfidjournal.com/article/articleview/4464/1/1/> (accessed August 8, 2013).
- 29 Anne Ku et al., p. 53.
- 30 B. Goldstein, personal communication, November 2012.
- 31 “Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii,” p. 18.
- 32 *Id.* See also Anne Ku et. al, pp. 28-29.
- 33 Kama’aina refers to Hawaii residents with a valid state identification.
- 34 “Departmental Guidelines for Acquisition of New Vehicles,” State of Hawaii, January 1, 2010. Available at <http://energy.hawaii.gov/wp-content/uploads/2012/08/Vehicle-Purchasing-Guide-20102.pdf> (accessed August 8, 2013).
- 35 Anne Ku et al., pp. 30-32.
- 36 “Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii.”
- 37 “United States Smart Grid: Utility Electric Vehicle Tariffs,” Northeast Group, July 2012. Available at [http://www.northeast-group.com/reports/Utility\\_Electric\\_Vehicle\\_Tariffs\\_Brochure\\_NortheastGroupLLC.pdf](http://www.northeast-group.com/reports/Utility_Electric_Vehicle_Tariffs_Brochure_NortheastGroupLLC.pdf) (accessed August 8, 2013).
- 38 A demand charge is designed to encourage or force energy conservation. It assesses a per kW charge in addition to the per kWh charge that measures actual use, and is based on a one-time maximum use. Demand charges are based on a 12-month look-back period, so a single spike in energy use affects billing for up to a year.
- 39 “Hawaiian Electric Companies offer new rates for public EV charging,” DBEDT & HELCO, July 10, 2013. [http://www.hawaiicleanenergyinitiative.org/storage/pdf-news-releases/HECO\\_EVRates\\_7.10.13.pdf](http://www.hawaiicleanenergyinitiative.org/storage/pdf-news-releases/HECO_EVRates_7.10.13.pdf) (accessed August 1, 2013).
- 40 Tony Dutzik and Rob Sargent, “Lighting the Way,” Environment Massachusetts, July 2013, p. 6. Available at [http://environmentmassachusetts.org/sites/environment/files/reports/Lighting\\_the\\_way\\_MA\\_scrn.pdf](http://environmentmassachusetts.org/sites/environment/files/reports/Lighting_the_way_MA_scrn.pdf) (accessed August 22, 2013).
- 41 “EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017-2025 Cars and Light Trucks,” U.S. Environmental Protection Agency, August 2012, p. 1. Available at <http://www.epa.gov/oms/climate/documents/420f12051.pdf> (accessed August 8, 2013).
- 42 “Electric Vehicle Information Technology Systems” Pike Research, 2012. Available at <http://www.pikeresearch.com/research/electric-vehicle-information-technology-systems> (accessed August 2012).
- 43 “Federal Tax Credits for Electric Vehicles,” U.S. Department of Energy, Fuel Economy website, (n.d.). Available at <http://www.fueleconomy.gov/feg/taxevb.shtml> (accessed August 8, 2013).
- 44 Anne Ku et al., p. 30.
- 45 State of Hawai‘i. (2012). Twenty-sixth legislature, Act 89 (12) / SB 2747. Available at [http://www.capitol.hawaii.gov/session2012/bills/GM1190\\_.PDF](http://www.capitol.hawaii.gov/session2012/bills/GM1190_.PDF) (accessed August 8, 2013).
- 46 “What is the typical salary of an electrician?” Degree Directory website (n.d.). Available at [http://degreedirectory.org/articles/What\\_is\\_the\\_Typical\\_Salary\\_of\\_an\\_Electrician.html](http://degreedirectory.org/articles/What_is_the_Typical_Salary_of_an_Electrician.html) (accessed August 8, 2013).
- 47 Anne Ku et al., p. 21.
- 48 “Effective Rate Summaries,” Hawaiian Electric Company, Inc., October 4, 2012. Available at <http://www.mauielectric.com/vcmcontent/StaticFiles/FileScan/PDF/EnergyServices/Tariffs/HECO/EFFRATESOCT2012.pdf> (accessed August 8, 2013). Sophie Cocke, “Fact check — Hawai‘i has the Highest Electricity Rates in the Nation,” Civil Beat, November 7, 2011. Available at <http://www.civilbeat.com/fact-checks/2011/11/07/13341-fact-check-hawaii-has-the-highest-electricity-rates-in-the-nation/> (accessed August 8, 2013).
- 49 Please see the latest update/amendment to Rule 14 at <http://puc.hawaii.gov/wp-content/uploads/2013/04/2011-11-29-PUC-Press-Release-HECO-Rule-14h-Approval.pdf> (accessed August 14, 2013).
- 50 Anne Ku et al., p. 67.
- 51 “Electric car rental firm expands to O‘ahu,” Hawai‘i Clean Energy Initiative, December 3, 2011. Available at <http://www.hawaiicleanenergyinitiative.org/imported-20101004182628/2011/12/3/electric-car-rental-firm-expands-to-oahu.html> (accessed August 8, 2013).

## Endnotes

- 52 Interview with Larry Ellison, CNBC, October 2, 2012. Transcript available at <http://www.cnbc.com> (accessed August 8, 2013).
- 53 Anne Ku et al., pp. 22 and 45.
- 54 Average daily census is 48,961, based on 2.1 million total visitors. Resident population of Maui was over 150,000 at the 2010 U.S. Census. “Maui County Data Book,” County of Maui, December 2011. Available at <http://hisbdc.org/Portals/0/MCDB/2011/PDF/2011%20Maui%20Data%20Book%20reduced%20size.pdf> (accessed August 8, 2013).
- 55 Anne Ku et al., p. 56.
- 56 *Id.*, p. 5.
- 57 “Maui County Data Book,” County of Maui, December 2011. Available at <http://hisbdc.org/Portals/0/MCDB/2011/PDF/2011%20Maui%20Data%20Book%20reduced%20size.pdf> (accessed August 8, 2013).
- 58 HEVN is organized under ACT 209 (2011) Sustainable Business Corporation (SBC), a new State of Hawai‘i class of corporation legally required to pursue a material positive impact on society and the environment, as measured by a third party standard and reported publicly (also known as “B Corps” in other U.S. states).
- 59 Anne Ku et al., p. 43.
- 60 “EV Pilot Rates Commonly Asked Questions,” Maui Electric Company (n.d.). Available at <http://www.mauielectric.com/vcmcontent/MECO/RenewableEnergy/EV%20Commonly%20Asked%20Questions.pdf> (accessed August 8, 2013).
- 61 “Electric car rental firm expands to O‘ahu,” Hawai‘i Clean Energy Initiative, December 3, 2011. Available at <http://www.hawaiicleanenergyinitiative.org/imported-20101004182628/2011/12/3/electric-car-rental-firm-expands-to-oahu.html> (accessed August 8, 2013).
- 62 “Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii,” p. 8.

## Photo Credits

*cover:*

photo by Cynthia Chung

*inside:*

abstract black & white

photo by Justice J. Franich

*page 1:*

photo by Harvey Reed

*page 6:*

photos courtesy of UHMC

*page 7:*

photo courtesy of DBEDT

*page 8:*

photo by Cynthia Chung

*Pages 15*

photo courtesy of HEVN

*page 26:*

photo by Selene LeGare

*page 27:*

photo by Maureen Murphy

Other photos by Ethan Elkind and Anne Ku

*Pages 6, 16-26*

Charging Station Maps courtesy of Plugshare.com

## About the Authors

**Ethan Elkind** is the Climate Policy Associate with a joint appointment at the UC Berkeley School of Law and the UCLA School of Law. In this capacity, he serves as the lead author of UCLA-UC Berkeley's grant-funded series of policy reports on business solutions to combat climate change. He taught at the UCLA law school's Frank Wells Environmental Law Clinic and served as an environmental law research fellow. He has a background in the California Environmental Quality Act (CEQA), climate change law, environmental justice, and other environmental law topics. In 2005, he co-founded The Nakwatsvewat Institute, Inc., a Native American nonprofit organization that provides alternative dispute resolution services and support for tribal governance, justice and educational institutions. His book on the history of the modern Los Angeles Metro Rail system will be published by University of California Press in January 2014.

B.A. Brown University, 1998

J.D. UCLA, 2006

**Anne Ku** directs the Maui Electric Vehicle Alliance, a Department of Energy Clean Cities funded EV-readiness project since October 2011, which has seen the stakeholders multiply ten-fold and its reach extended to the neighboring islands of Kaua'i and Hawai'i. The project's main focus is on developing adequate infrastructure for mass adoption of electric vehicles to reduce reliance on fossil fuel imports and increase EV charging from renewable energy sources. The plan to deliver an electric vehicle paradise to the millions of visitors depends on local residents and businesses paving the way. Anne's previous experience in the energy sectors in the USA and Europe resulted in the publication of her multi-contributor book "Risk and Flexibility in Electricity: an introduction to the fundamentals and techniques" available from Riskbooks. She is an adjunct lecturer at UH Maui College.

B.S.E. Duke University, 1986

M.Sc. London School of Economics, 1987

Ph.D. London Business School, 1995



**Center For Law, Energy & the Environment (CLEE)**

Berkeley Law  
2850 Telegraph Ave, Suite 335  
Berkeley, CA 94705-7220  
[clee.berkeley.edu](http://clee.berkeley.edu)

**University of Hawai'i Maui College**

Chancellor's Office  
310 W. Ka'ahumanu Ave  
Kahului, HI 96732  
[maui.hawaii.edu](http://maui.hawaii.edu)