

EVs in Paradise: Planning for the Development of Electric Vehicle Infrastructure in Maui County

Submitted by:

University of Hawai'i Maui College

310 W. Ka'ahumanu Avenue

Kahului, HI 96732-1617

UNIVERSITY of HAWAII®
MAUI COLLEGE



December 12, 2012

Revised February 12, 2013

Prepared by: Anne Ku, Susan Wyche, and Selene LeGare for Maui Electric Vehicle Alliance (Maui EVA)

An electronic version of this report can be downloaded from: <http://mauieva.org>

This report was funded by the United States Department of Energy through the Clean Cities Community Readiness and Planning for Plug-In Electric Vehicles and Charging Infrastructure DE-FOA-0000451 award no. DE-EE0005553. The report is issued by the University of Hawai'i Maui College and is intended for public release. For questions or comments regarding this report, please contact: Office of the Chancellor, University of Hawai'i Maui College, 310 W. Ka'ahumanu Ave., Kahului, HI 96732, Tel. 808-984-3500.

Disclaimer: The Maui EVA, established by the University of Hawai'i Maui College, prepared this document to guide the planning and implementation of mass adoption of electric vehicles (EV) and charging infrastructure for Maui County. The recommendations within this report were written at a time when EV-related laws, regulations, and industry practices are undergoing rapid change. As a result, state and county governments and the organizations that serve them must strive to continuously update their knowledge regarding industry, utility, resident and visitor expectations and requirements for the deployment of charging infrastructure. The recommendations provided herein are intended to assist the stakeholders to advance EV readiness but do not represent a definitive legal framework for the installation of charging infrastructure.

The recommendations in this report reflect best practices and lessons learned elsewhere, or were developed locally in response to situations unique to Maui. Neither the sponsoring organizations nor any of their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information or process disclosed within this document. The views and opinions of authors expressed herein do not necessarily reflect those of the organizations who developed the document.

Executive Summary

This publicly releasable report is intended to provide an overview and crucial information for those tasked with implementing a plan for a mass deployment of electric vehicles (EVs) and charging station (EVSE) infrastructure in Maui County. After a year of conversation, consultation, and collaboration, the project stakeholders have found that plug-in electric vehicles (PEVs) provide an important piece of the solution to meeting Hawai'i's Clean Energy Initiative goals of reducing the state's reliance on petroleum for transportation and power generation, particularly for the purpose of absorbing renewable energy into the utility energy mix in the form of wind power generated at night.

Hawai'i's unique EV laws, generous EV and EVSE rebates, local utility time-of-use and special EV tariffs, and federal tax credits all motivate the adoption of EVs and deployment of public charging infrastructure. Continued outreach, education, and training is needed to better understand costs and benefits of such new technology, and provide an informed workforce for automotive servicing, first responders, and the visitor industry—which serves over two million people a year, and places over 20% of the vehicles on Maui's roads.

Maui is uniquely positioned to deploy EVs, not only because of its mild weather, short distances, and high gasoline prices, but because the visitor industry is in an advantageous position to lead EV purchasing through car rental fleets, car sharing, and installation of charging infrastructure at hotels, vacation lodging, and tourist destinations. Resident drivers will be able to take advantage of these amenities, and embrace the increasing variety of EV models and types of vehicles slated to appear on the market in the near future.

Most importantly, EVs offer significant value as a “manageable load.” Charging can be shifted to advantageous times through time-of-use rates, or directly controlled using more complicated communications and control technologies in the charging unit. The opportunity provided by the Japan-U.S. Smart Grid Demonstration Project, which will provide Maui with access to advanced technology to integrate EVs into its utility grid system, coincides with an anticipated period of rapid EV and charging station infrastructure growth.

This report examines barriers and solutions to EV readiness, benefits and incentives, EV and charging station deployment, the utility and smart grid, local ordinances, outreach and education, and proposes recommendations for each group of stakeholders. A final report to the Department of Energy in May 2013 will provide additional timelines, goals, and costs of implementation to achieve Maui's goal of having the highest EV deployment per capita in the nation. Two additional reports produced from this grant by our partners, the State of Hawai'i Department of Business, Economic Development, and Tourism, and Honolulu Clean Cities are available online (see Attachments on page 14).

Foreword

At the launch of this project in November 2011, only a handful of Maui-based delegates had seen a plug-in electric vehicle, much less driven one. When the first Chevy Volt on island rolled into the hotel parking lot for display at the kick-off meeting, participants gathered around it like kids at Christmas. It was not until May 2012 that one could go to a dealer, try, buy, and drive off with a new EV, and charging stations were scarce: two at Jim Falk Motors, the auto dealer for the LEAF and the Volt, and two in front of Maui Electric Company, the local utility.

Few people on Maui knew about the federal and state tax incentives for purchasing EVs or installing charging stations. Even fewer knew about the state EV laws for required charging stations in large parking lots, and benefits for EV drivers, such as free parking. The relatively high price tag of the Chevy Volt, and the lack of EV models in general (the Nissan LEAF had to be pre-ordered online), made EVs an “invisible” possibility.

Things began to change over the next few months. By March 2012, Better Place installed Level 2 charging stations at seven locations. A celebration was held in a shopping center where one of the charging stations was installed, and several EV owners showed up with their Volts and LEAFs. People arrived early and stayed late—talking “cars,” filling out surveys, and getting test rides with EV owners willing to share the experience.

Finally, in May 2012, the first “inventory” of Nissan LEAFs arrived that could be test driven from the dealer, and that same month, the state rebate funds meant to encourage EV sales dried up. But even without the rebate incentives, a transition was underway: interest in EVs had been awakened. The press carried front page stories on almost every EV event. The Maui EVA Facebook page gained “friends” daily. Maui Electric Vehicle Alliance—which had started out as a small group of selected stakeholders with responsibility for planning EV charging infrastructure—found its ranks growing, not only locally, but nationally, and even internationally.

Here are a few of the milestones in this journey:

- February 2011 First Nissan LEAFs arrive in Hawai‘i
 - April 2011 First Chevy Volt ordered by local resident arrives on Maui
 - October 2011 UHMC awarded Department of Energy planning grant
 - October 2011 First Chevy Volt for local dealership arrives on Maui
 - November 2011 Bio-Beetle offers first electric rental car on Maui
 - December 2011 Maui EVA receives national recognition by Green Tech Media
 - January 2012 Japan-U.S. Smart Grid Demonstration Project partners join Maui EVA
 - March 2012 Better Place rolls out charging stations at seven locations on Maui
 - April 2012 Maui EVA holds first public EV conference on Maui
 - May 2012 Hawai‘i State Tax Rebates for EVs and charging stations end
 - May/June 2012 Nissan ships 16 LEAFs to Jim Falk Motors
-

- June 2012 Enterprise Rent-A-Car brings EVs to Maui
- August 2012 Maui EVA joins the Rocky Mountain Institute's Project Get Ready
- August 2012 Maui Chapter of Electric Auto Association founded
- September 2012 First DC fast charging station installed at Maui County building in Wailuku
- September 2012 Mayor's Proclamation of National Plug-In Day on Maui
- September 2012 Electric cars, bicycles and scooters appear in 90th annual Maui Parade and Fair
- December 2012 Delivery of DOE publicly releasable report

The picture is bright going forward. Sales of EVs are increasing. Charging stations will continue to be installed across Maui, along with more DC fast charging stations. Manufacturers will be delivering new models, including the SUVs and minivans popular with local families. UH Maui College will begin offering its first classes on EVs and will install eight charging stations along with an additional solar-charged carport. The Japan-U.S. Smart Grid Demonstration Project is planning the introduction of five DC fast charging stations as a part of its project in 2013, and partner Hitachi just received UL certification of its quad-port DC charging stations. Later next year, the much-anticipated all-EV car rental company will be opening. We believe that Maui will soon achieve the largest deployment of EVs per capita in the nation.

With the delivery of this report, with its recommendations to the various stakeholders who together can help prepare Maui County for a mass deployment of EVs, anticipate more change in 2013 and beyond. It's time to get ready. Charge!

Anne Ku, Maui Electric Vehicle Alliance (EVA) Project Director

Acknowledgements

Aloha! We would like to thank the many people who made this report possible through their time, energy, and generous sharing of information, insights, and ideas. We have tried to identify all of those who contributed along the way, and hope we have left no one off our list. Cars are endemic to the American way of life, and Hawaiians are very fond of their cars, so a project of this kind must eventually involve everyone in the community. As Kimeokeo Kapahulehua reminded all of us when he provided the Hawaiian cultural blessing for the Maui EVA Kick-Off meeting, electric vehicles have the potential to embody the traditional means of transportation in Hawai'i—powered by the sun and the wind. It will take all of the people mentioned here, and more, to make that vision a reality. Mahalo!

Partners

Clyde Sakamoto, Chancellor and Principal Investigator, University of Hawai'i Maui College (UHMC)

Margaret Larson, Vehicle Specialist, Hawai'i State Energy Office, Department of Business, Economic Development and Tourism (DBEDT)

Byron Washom, Director of Strategic Energy Initiatives, University of California San Diego (UCSD)

Editor

Susan Wyche, Director, Office of Grant Development, UHMC

Writers

Anne Ku, Maui EVA Project Director, UHMC

Selene LeGare, Writer/Editor, UHMC

Supplementary Reports

June Chee, Intern, Honolulu Clean Cities (HCC)

Margaret Larson, Vehicle Specialist, DBEDT

Advisors

Ethan Elkind, Environmental Law Fellow, University of California Berkeley School of Law

Jim Motavalli, author of *High Voltage* and a blogger for the New York Times and Car Talk

Greg Nakao, Electrical Engineer, County of Maui

****Chris Reynolds, Operations Superintendent, Maui Electric Company (Maui Electric Company (MECO))**

Dave Rolf, Executive Director, Hawai'i Automobile Dealers Association (HADA)

****Michael Snyder, President and CEO, Hawaiian Electric Vehicle Network (HEVN)**

Contributors

David Almeida, California Center for Sustainable Energy
Kauai Awai-Dickson, MECO
Ramsey Brown, Hawai'i Energy
Jim Burness, ClearEnergy Inc.
Conrad Copeland, MECO
Frank Emura, Hitachi
Mike Ferry, California Center for Sustainable Energy
James Griffin, Public Utilities Commission
Ben Holland, RMI/Project Get Ready
Marc Matsuura, Hawaiian Electric Company (HECO)

Michele McLean, Department of Planning, County of Maui
Justin McNaughton, Green Car Hawai'i
Mathew McNeff, MECO
Scott Mercer, Volta Industries
Osamu Onodera, NEDO
Carlos Perez, HECO
David Peterson, Nissan North America
Todd Ritter, EVStructure
Leon Roose, HNEI
Kazuyuki Takada, NEDO
David Tester, MECO
Mark Yamamoto, HECO
Jimmy Yao, HECO

Working Group Members

Brad Albert, Rising Sun Solar
Christine Andrews, member-at-large
Kelcie Ann Kawamura, MECO
Robert Aquino, IBEW
****Mark Ausbeck, INNOVATE Hawai'i, High Technology Development Corporation (formerly HTDC-MEP)**
Darryl Barber, member-at-large
Andrew Beerer, Kihei Community Association
William Bennett, Energy Consulting Associates
Debasis Bhattacharya, UHMC
David Bliss, Charge Bliss
Tim Botkin, UHMC
Irene Bowie, Maui Tomorrow
Alix Buchter, Maui No Ka Oi Magazine
Chuck Carletta, UHMC

****Andrew Carson, UHMC**
Shay Chan Hodges, member-at-large
Jennifer Chirico, UHMC
Don Couch, Maui County Council
Damian Farias, Maui Toyota
****David Fisher, Maui Venture Consulting**
John Foy, Enterprise Rent-A-Car
Lance Gilliland, Honua Kai Resort
Dave Gleason, Maui Lani Golf Course
Brian Goldstein, Better Place Hawai'i
Doug Grandy, California Onsite Generation
Barry Helle, Wailea Old Blue
Rob Hilbun, Sunset Electric
Lance Holter, The Sierra Club
Robert Hoonan, Grand Wailea Resort & Spa
Thomas Hussey, UHMC Automotive
Myles Inokuma, Roberts Hawai'i

Kenshi Itaoka, Mizuho Bank
Harry Johnson, Roberts Hawai'i
Ellsworth Kalawaia, Honua Kai Resort & Spa
Kimoeko Kapahulehua, Hana Pono
Joel Katz, UHMC
Brian Kealoha, Chevron Energy Solutions
Ken Kelly, National Renewable Energy Lab
Brian Konyk, Silent Indoor Generator Systems
Chris Lovvorn, Castle and Cooke
Justin MacNaughton, Green Car Hawai'i
**Doug McLeod, County of Maui
Eriko Miyamori, Mizuho Bank
**Mike Morris, Maui YMCA
**Ipo Mossman, County of Maui
Jeff Murray, Fire Chief, County of Maui
Takuya Nishida, Mizuho Bank
Scott O'Neill, Jim Falk Motors of Maui
Philip Ohta, Maui District Parks (State Parks
Division)
Jung Park, UHMC
Randy Piltz, Native Hawaiian Chamber of
Commerce

Terri Pollino, AeroVironment
David Raatz, MEDB
Shawn Racoma, The Whaler on Ka'anapali
Beach
Michael Reiley, HNU Energy
**Carol Reimann, Maui Hotel and Lodging
Association
George Reioux, MEO
Victor Reyes, independent
Milton Rickard, Aston Ka'anapali Shores
Cliff Ryden, Blue Pacific Energy
Chris Sbarbaro, Enterprise Rent-A-Car
Ray Shimabuku, IBEW
Wendy Shimizu, MECO
Shaun Stenshol, Bio-Beetle ECO Rental Cars
Kyle Takushi, UHMC
**Charmaine Tavares, member-at-large
Tadahiro Togami, Hitachi
Charlie Vartanian, A123
Terryl Vencl, Maui Visitors Bureau
Pam Wolf, Bio-Beetle ECO Rental Cars
Stuart Zinner, UHMC

Press and Media Support

Mike Albert, UHMC
Nicole Beattie, UHMC
Rita Goldman, Maui No Ka Oi
Chris Hamilton, Maui News
Peter Liu, Kaiscapes
Deanna Kamakeeaina Reece, UHMC
David Kvasnicka, Maui Now

Debra Lordan, Maui Weekly
Wanda Moore, Akaku TV
Jim Motavalli, Car Talk & Mother Nature
Network
Teya Penniman, Maui No Ka Oi
Anthony Pignataro, Maui Time

** Working group co-chair contributors

Table of Contents

Title Page	1
Executive Summary	3
Foreword	4
Acknowledgements	6
Chapter 1 Introduction	10
Chapter 2 Stakeholders	15
Chapter 3 Barriers to EV Readiness	21
Chapter 4 Benefits and Incentives	28
Chapter 5 EV Deployment	35
Chapter 6 Deploying Charging Infrastructure	51
Chapter 7 The Utility Grid	63
Chapter 8 Local Ordinances	75
Chapter 9 Outreach and Education	83
Chapter 10 Recommendations	89
Glossary	95
References	98
Attachment	103

Chapter 1

Introduction

1.1 EVs IN PARADISE: A VISION

By 2030, plug-in hybrid and electric vehicles (PHEV, PEV, a.k.a. EV) will be regularly seen on the roads of Maui County. Visitors will be able to book EV rentals online. There will be EV accommodation packages available for environmentally conscious travelers. The charging of EVs during off-peak periods at night will allow Maui Electric Company to absorb more renewable energy onto its utility grid, especially from wind farms. Solar carports with EV charging stations will be commonplace, and new forms of charging (e.g., wireless) may be available.

Every major tourist destination, including hotels and condominiums, golf courses, parks and restaurants will offer access to charging stations. Local residents will be able to charge at home and at local schools, churches and shopping malls, as well as their workplaces. Buying and renting an EV will be as simple as buying and renting a traditional gas-powered vehicle today. Large corporate and government fleets will rely on a mix of electric-powered cars, trucks, and vans. Everything one needs to know about EVs—driving, parking, charging—will be available at one’s fingertips. There will also be enforceable laws to prevent gas-powered cars from parking in EV parking stalls. Staff at hotels and businesses will know about EVs. No one will be “stranded.” We will be truly EV ready.

This vision of “EVs in paradise” represents an ambitious goal to reduce emissions, reduce reliance on imported foreign oil, and generate the majority of Maui’s energy from renewable energy sources.

1.2 ELECTRIC VEHICLES AND ENERGY INDEPENDENCE

Many people ask, “why electric vehicles?” Aside from the fact that “range anxiety” on Maui is a minor issue because of limited distances, the answer is that electric vehicles play a key role in Hawai‘i’s strategy for achieving higher levels of renewable energy.

Maui County consists of the islands of Maui, Moloka‘i, Lāna‘i (as well as the uninhabited islands of Kaho‘olawe and Molokini). It relies on fossil fuels for approximately 83% of its electrical energy, and when transportation fuel is included, fossil fuels provide 95% of the total.

The Hawai‘i Clean Energy Initiative (HCEI), a partnership between the State of Hawai‘i and the U.S. Department of Energy, aims to reduce Hawai‘i’s dependence on imported fossil fuels to reach a target of 70% clean energy by the year 2030.¹ As other chapters will explain in more detail, electric

¹ Hawai‘i is the most fuel-dependent state in the nation. (n.d.). Retrieved from <http://www.hawaii-cleanenergyinitiative.org>

vehicles will decrease the amount of petroleum needed for transportation, and at the same time, increase the amount of renewable energy—such as wind and solar—which the energy company can accommodate in its energy mix.²

EVs are more fuel-efficient vehicles, whatever the source of power. According to the Department of Energy, EVs convert about 59-62% of the electrical energy from the grid to power at the wheels, while conventional gasoline vehicles convert only about 17-21% of the energy stored in gasoline to power at the wheels. So a gallon of fuel is as much as 45% more efficient when burned by the utility and transferred to an EV than when burned in the gas tank of a conventional car. If an EV 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.³

The overall goal for the transportation sector is to reduce the consumption of petroleum in *ground* transportation by 70% or approximately 385 million gallons per year (MGY) by 2030 (this excludes the jet industry, which is also a significant user of petroleum fuels). To achieve this massive reduction, HCEI has established both short-term and mid-term goals⁴ which impact the deployment of EVs in Maui County.⁵

Short-term goals (2011-2015):

- Increase average on-road fleet efficiency to 25 mpg for cars and 18 mpg for light-duty trucks
- Reduce the amount of driving, or vehicle miles travelled (VMT) by 2% over 2010 miles traveled
- Accelerate the deployment of EVs to 10,000 on-road electric vehicles statewide

Mid-term goals (2016-2020):

- An average fleet efficiency of 30 mpg for cars and 22 mpg for light-duty trucks
- A reduction in VMT of 4% over 2010 miles traveled
- At least 40,000 EVs on Hawai'i roads

² County of Maui. (2011). *Maui County Data Book*. Retrieved from <http://hisbdc.com/BusinessResearchLibrary/MauiCountyDataBook2011.aspx>

³ Electric vehicles. (n.d.). Retrieved from <http://www.fueleconomy.gov/feg/evtech.shtml>

⁴ Hawai'i Clean Energy Initiative road map. (2011). Retrieved from http://www.hawaii-cleanenergyinitiative.org/storage/media/HCEI_RoadmapSummary_FINAL_ID-11909.pdf

⁵ HCEI targets other transportation options as well, such as hydrogen vehicles and bio-fuels, but those are not included here.

The State is promoting vehicle industry participation through partnerships with automotive manufacturers, and EV equipment and infrastructure suppliers. A detailed report on the State of Hawai'i's activities (hereafter referred to as the DBEDT report) can be found online.⁶ This report also contains recommendations and best practices that apply at the state level and to communities statewide.

1.3 EV TERMINOLOGY

There are two types of highway-ready electric vehicles: fully battery-powered models, such as the Nissan LEAF, and plug-in hybrid models, such as the Chevrolet Volt, which use a combination of battery and gasoline power, but charge their batteries through a charger. In this report, the term “electric vehicle” or “EV” is used to refer to both. The special equipment used to charge electric vehicles (aside from a grounded outlet) is referred to as a charging station, electric vehicle service equipment, or EVSE.

1.4 STRATEGY: ACHIEVING MASS DEPLOYMENT OF EVS IN MAUI COUNTY

This planning document is the result of much discussion, information gathering, and analysis by key stakeholders on Maui. It represents a snapshot of a point in time, along a line that is rapidly changing. The information that is shared here will not only help Maui County move forward by providing a coherent overview of the challenges and processes to date, but may provide perspective to other regions of the country that face similar conditions: small rural communities, isolated grids, and specialized economies.

While planning has taken place, EVs already have arrived on Maui and EV owners are struggling to understand their new vehicles and the infrastructure that is needed to support them. Many more individuals and organizations want to purchase EVs, but are not sure that the conditions are right. Both barriers and opportunities exist and, equally important, so do strategies that will help Maui County develop its infrastructure effectively and efficiently.

Next steps involve taking the recommendations provided in this report and establishing priorities and timelines, estimating cost impact, and identifying potential resources and partnerships. This phase will begin in 2013, with the release of this document.

1.5 ABOUT THIS REPORT

Each of the chapters includes a description of the issues and the history to date, information that the stakeholders thought was necessary to understand the complexity of the issues, and recommendations for what needs to happen next.

⁶ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai'i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

Chapter 2: Stakeholders

Describes the individuals and organizations that helped prepare this document, and the process they used.

Chapter 3: Barriers to EV Readiness

Describes the issues EVs present, both generally and for Maui County in particular.

Chapter 4: Benefits and Incentives

Covers both the individual and collective benefits and incentives EVs present for Maui County.

Chapter 5: EV Deployment

Looks at the history of EVs on Maui to date, estimates the number of EVs that may arrive during the next two years and beyond.

Chapter 6: Deploying Charging Infrastructure

Examines the charging station infrastructure, as well as some other aspects of preparing Maui County for EVs.

Chapter 7: The Utility Grid

Discusses how EVs will impact the grid, help integrate renewable energy, and will need new technologies to assist that integration.

Chapter 8: Local Ordinances

Looks at the challenges of the permitting system for installing charging stations, as well as other regulatory processes—including signage and parking regulations.

Chapter 9: Outreach and Education

Proposes helpful or necessary education and training for new and potential EV owners, and service providers who need to know how to handle EVs safely, from tow truck drivers and first responders to automotive technicians. Discusses benefits of continued outreach to the public through social media and the press.

Chapter 10: Recommendations

Recommendations from each chapter are included again here, organized by stakeholder.

Attachments

This report frequently refers to three published and publicly releasable documents available on their respective websites, namely the DBEDT report,⁷ the HCC report,⁸ and the Hawai'i EV Ready Guidebook.⁹ All three of these reports provide critical information about the introduction of EV technology in Hawai'i, and are relevant to deployment on Maui. Two were produced from this grant by our partners. The State of Hawai'i Department of Business, Economic Development, and Tourism (DBEDT) has prepared a report titled "Report to the Maui Electric Vehicle Alliance Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii" that is available from <http://electricvehicle.hawaii.gov>. Honolulu Clean Cities (HCC) has conducted a survey and prepared a report titled "Lessons Learned: The Early Adoption of Electric Vehicle Charging Stations from the Perspective of Oahu's Commercial Properties," available from <http://www.honolulucleancities.org>.

A list of all known publicly accessible charging stations in Maui, Level 2 and above, is included in an Attachment. Updated versions of this document will be maintained on the Maui EVA website (<http://www.mauieva.org>).

In addition, other documents that may be of interest to readers and working group members have been collected on the Maui EVA website, including:

- EVSE Vendor Options
- Hawai'i's EV laws
- Frequently Asked Questions
- Maps of existing and proposed charging stations on Maui
- Maui accommodations with 50 or more units (spreadsheet)
- Visitor's Working Group – analysis of hotel and tourism sites
- Working Group Membership list
- Working Group Task Assignments
- Workforce Training list of courses and programs

⁷ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai'i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

⁸ Honolulu Clean Cities. (2012, October). *Lessons Learned: The Early Adoption of Electric Vehicle Charging Stations from the Perspective of O'ahu's Commercial Properties*. Retrieved from <http://honolulucleancities.org>

⁹ Plug-in America. (2012, October). *Hawai'i EV Ready Guidebook for Commercial EV Charging Station Installations, Plug-in America report for Hawai'i State Energy Office*. Retrieved from <http://energy.hawaii.gov> and <http://electricvehicle.hawaii.gov>

Chapter 2

Stakeholders

This implementation plan is the work of a large number of stakeholders with an interest or significant role in developing electric vehicle (EV) charging infrastructure, drawn primarily from residents, businesses, and organizations in the County of Maui and State of Hawai'i. They represent universities, businesses, organizations, and interested individuals both nationally and internationally. The sheer number and diversity of stakeholders in this enterprise speaks to the effort and complexity of planning EV charging infrastructure.

To deliver a plan with maximum buy-in from those charged with implementing the plan and those affected by the plan, it was necessary to get wide representation as early as possible in the process, and encourage strong participation. Wide representation constituted ensuring participation from multiple levels of government agencies (federal, state, and local), companies with a vested interest (auto dealers, charging station manufacturers, renewable energy companies and installers) and groups that represent Maui's unique social milieu (visitors, residents, local business owners, and the Hawaiian host culture).

Stakeholder development was achieved in three stages:

1. Identifying initial cost-share partners to compete for the Department of Energy grant
2. Establishing working groups with primary responsibility for gathering information and analyzing community needs
3. Building community awareness and participation through public events

Upon submission of this plan, we will enter stage four:

4. Recruiting new stakeholders for implementation

2.1 STAGE ONE: INITIAL "COMMITTED PARTNERS"

Fourteen organizations initially committed a matching amount to the \$300,000 requested of the Department of Energy, including the lead organization, UH Maui College, and its two sub-awardees of the grant: State of Hawai'i Department of Business, Economic Development and Tourism, and the University of California San Diego.

The other eleven are:

- Chevron Energy Solutions
- Enterprise Rent-A-Car
- Grand Wailea Resort and Spa
- Hawai'i Auto Dealers Association (HADA)
- Hawaiian Electric Vehicle Network (HEVN)
- HNU Energy
- Honua Kai Resort and Spa
- Jim Falk Automotive Group
- Maui County Office of Economic Development
- Maui Economic Opportunity, Inc. (MEO)
- Rising Sun Solar

Several other organizations also provided written support for this undertaking, including:

- AeroVironment
- Better Place Hawai'i
- General Electric Digital Energy
- The Hertz Corporation
- Hawai'i Renewable Energy Development Venture (HREDV)
- High Technology Development Corporation—Manufacturing Extension Partner (now INNOVATE Hawai'i)
- Maui Hotel and Lodging Association (MHLA)
- National Renewable Energy Lab (NREL)
- San Diego Regional Clean Fuels Coalition
- UH Mānoa Hawai'i Natural Energy Institute (HNEI)
- UH Mānoa Hawai'i Energy Policy Forum (HEPF)

The participation of these businesses and organizations provided a core constituency from which all further planning evolved.

2.2 STAGE TWO: WORKING GROUPS

The grant was awarded in October 2011, creating the Maui Electric Vehicle Alliance (EVA) with responsibility for an implementation plan for Maui County. UH Maui College invited the initial “Committed Partners” and additional stakeholders to a kick-off meeting a month later to initiate the planning process.

The kick-off meeting was significant for also identifying a new and unanticipated set of stakeholders: members of the Japan-U.S. Smart Grid Demonstration Project, a \$37 million clean energy initiative that is part of the Hawai'i-Okinawa Partnership on Clean and Efficient Energy

Development and Deployment.¹⁰ This project was signed in June 2010 by the U.S. Department of Energy, the Ministry of Economy, Trade and Industry of Japan, the State of Hawai'i and the Prefecture of Okinawa. The New Energy and Industrial Technology Development Organization (NEDO), a Japan-based government group leading the project, was visiting Maui to meet with County Mayor Alan Arakawa, coincidentally on the same day that Maui EVA held its kick-off meeting.

Given that the multi-year demonstration project addressed the integration of renewable energy, EV, battery storage, and other technologies on Maui, a decision was made to hold the two events together. Members of NEDO expressed interest in joining Maui EVA, and their participation both elevated this plan to international interest, as well as underscored the importance of achieving mass deployment of EVs within a short time frame, for purposes of a significant study they would be conducting of the impact of EVs on an isolated energy grid.

In December 2011, Maui EVA formed five working groups to conduct planning in the various areas of concern:

1. EV Charging Infrastructure
2. Policy and Legislation
3. Visitor Industry
4. Residents and Local Businesses
5. Outreach and Education

Two co-chairs were appointed for each working group and the groups assigned a series of tasks, as set out by the Department of Energy grant requirements. Membership on the committees was voluntary, with some stakeholders asked to participate on committees for which they could provide required information and needed perspectives.

Each group was tasked with identifying barriers, gathering information, analyzing issues, and providing solutions. Some groups were tasked with estimating potential users, others with addressing Maui's unique economic, business, and geographic challenges.

The table below lists the working group members as of June 2012.

¹⁰ State of Hawai'i Department of Business, Economic Development and Tourism. (2011). *Powering up: A special report on energy in Hawai'i*. Retrieved from <http://energy.hawaii.gov/wp-content/uploads/2011/08/Powering-Up-A-Special-Report-on-Energy-in-Hawaii.pdf>

Table 2.1 Working Group Participants by Organization and Role

Stakeholder	Organizations
State government	Hawai'i State Department of Business and Economic Development and Tourism (DBEDT)
Local government	Maui County various departments: <ul style="list-style-type: none"> ● Office of the Mayor ● Office of Economic Development (Director, Energy Commissioner, Special Projects) ● Transportation ● Fire and Public Safety ● Public Works ● Planning ● Parks and Recreation
Utilities	Hawaiian Electric Company (HECO) – parent company of Maui Electric Company (MECO) – responsible for Maui, Lāna'i, Moloka'i
Visitor Industry	Maui Visitors & Convention Bureau, Native Hawaiian Chamber of Commerce Maui Lodging and Hotel Association (MLHA) Grand Wailea, Honua Kai, Aston Ka'anapali Shores, The Whaler on Ka'anapali Beach Maui Lani Golf Course, Wailea Old Blue Golf Course Castle & Cooke (Lāna'i)
Residential	Kihei Community Association (KCA), Condominium Council of Maui
Rental cars	Bio-Beetle ECO Rental Cars, Enterprise Rent-A-Car, Hawaiian Electric Vehicle Network (HEVN), Green Car Hawai'i
Fleet owners	Roberts Hawai'i (public buses, tour buses, school buses), rental cars (above) Maui Economic Opportunity, Inc. Maui County Transportation Department
Installers	International Brotherhood of Electrical Workers (IBEW), EV Structure
Charging station infrastructure	AeroVironment, Better Place, Hitachi, Charge Bliss
Auto manufacturers	Nissan, Mitsubishi
Auto dealers	Hawaiian Auto Dealers Association (HADA), Jim Falk Motors, Maui Toyota
Energy companies	Rising Sun Solar, HNU Energy, Chevron Energy Solutions, Blue Pacific Energy, Silent Indoor Generator Systems, A123
Education	University of Hawai'i Maui College (UHMC), UC San Diego, Hawai'i Natural Energy Institute (HNEI), High Tech Development Corporation (HTDC)
Community & nonprofit organizations	Maui Economic Development Board (MEDB), Maui Economic Opportunity, Inc. (MEO), Maui Tomorrow, Maui YMCA
Press	Maui No Ka Oi Magazine, Maui Weekly, California OnSite Generation
Clean Cities Coalitions	San Diego Regional Clean Fuels Coalition, Honolulu Clean Cities
International	U.S.-Japan Maui Smart Grid Demonstration Project with NEDO, Mizuho Bank, and Hitachi
Others	Individual members-at-large, consultants

Over the next nine months, new members joined and many stakeholders participated in multiple groups, as issues often crossed from one topic to another. All together, Maui EVA met five times (November and December in 2011; and January, April, and June in 2012), and the working groups met from December 2011 to May 2012, a total of 17 times.

One of the strengths Maui has for planning and implementing change is that the key stakeholders for almost any sector can be gathered around a table or, at the very most, within a conference hall. In the case of planning for the charging infrastructure for EVs, the working groups included high-

level representatives from the Mayor's Office, the local utility company, Maui Electric Company (MECO), the visitor industry (major hotels), prominent island residents and the only institution of higher education on island (UHMC).

In addition, because of its prestige as a tourist destination (consistently ranked as one of the world's best islands by Travel & Leisure Magazine, among other honors) and a place of unique beauty, Maui attracts an unusual mix of locally, nationally, and internationally known active and retired entrepreneurs, business leaders, artists, environmentalists, and visionaries.¹¹ When the DOE grant award was announced, Maui EVA received many generous offers of assistance. Because of their enthusiasm, the working groups were able to draw on leaders in the field to identify the challenges ahead, share lessons learned, and think creatively about possible solutions.

2.3 STAGE THREE: BUILDING COMMUNITY AWARENESS AND PARTICIPATION

Though the number of working group members remained relatively stable over the next nine months, the mailing list for Maui EVA grew from 45 participants at the kick-off meeting to over 300 at the time of the writing of this report.

As the working groups gathered their information and discussed the recommendations for this plan, and as Maui EVA membership grew, a significant change was taking place on Maui that pushed interest in the project and affected both the arc of the planning process and the group of people who self-identified as stakeholders on Maui: highway-ready EVs were arriving on island.

At the start of the grant, few of the designated stakeholders had driven or ridden in an EV, much less owned one. Most, in fact, had not even seen one in person. The only exceptions were those stakeholders from off-island who were employed by the auto or charging station industries.

Between then and the writing of this report, however, EVs have indeed arrived on Maui, several members of Maui EVA are owners of EVs, and charging stations have been installed throughout the island (with more being announced each month). Car rental companies have begun including EVs in their fleets, and a new independent car rental company is set to open in a few months that will be renting EVs and hybrid EVs exclusively.

This shifting dynamic added both realism and urgency to the work that the stakeholders undertook in developing this implementation plan.

In the last few months of the planning process, Maui EVA began to look actively for EV owners by ramping up its social media engine on Facebook. In August 2012, the Maui Chapter of the Electric Auto Association (Maui EAA) was formed. This group participated in the dedication of the first DC fast charging station, installed in front of the Maui County building in Wailuku, and organized the

¹¹ World's best awards. (2012). Retrieved from <http://www.travelandleisure.com/worldsbest/2012/islands>

first National Plug-in Day event, which was also sponsored by national groups Plug-in America, Sierra Club, and the Electric Auto Association.

2.4 STAGE FOUR: RECRUITING NEW STAKEHOLDERS FOR IMPLEMENTATION

Moving forward, Maui EVA will target EV owners, potential EV owners, and interested community groups to expand the diversity of stakeholders as the emphasis shifts from planning to implementation. Other stakeholders have also been identified for inclusion in further planning:

- The Public Utilities Commission (PUC)
- Traditional automobile associations, such as the American Automobile Association (AAA) and local tow-truck service businesses
- Automotive service technicians and their employers
- Property brokers, property managers, and real estate agents for compliance with the Hawai'i state EV parking and charging station law
- Other fleet owners, such as taxis, delivery vehicles
- National park personnel (without a charging station installed at one of the most visited tourist sites on the island, the public charging structure will not be complete)
- Homeowner associations and other multi-unit dwellings
- Environmental groups
- Native Hawaiian Chamber of Commerce and other relevant Native Hawaiian organizations
- Energy efficiency auditors, solar installers, other energy-related businesses and organizations (such as the local chapter of the U.S. Green Building Council)

An effort to include representatives from these groups will be made as the implementation plan moves forward. After its release, Maui EVA will focus on outreach and education, sharing information with the neighbor islands of Kaua'i and Hawai'i, Moloka'i and Lāna'i. Other members will focus on aspects of implementation, such as refining local ordinances and developing charging infrastructure at private and public properties. Chapter 9 describes recommendations for how these stakeholders and others may be involved in future deliberations and activities.

Chapter 3

Barriers to EV Readiness

Due to its geography and climate, Maui presents a unique set of challenges for electric vehicle (EV) adoption. Shipping adds to the expense of vehicles, batteries, and charging stations, and can limit availability. Addressing flood risk and other environmental factors adds to the cost of installing electric vehicle supply equipment (EVSE). While the highest gas prices in the nation can make EVs attractive, that attraction is mitigated by high electricity rates. These barriers have solutions, and the benefits to the island’s renewable energy challenges far outweigh the challenges they pose.

This chapter addresses barriers and perceived barriers to EV readiness in the following areas:

- Perceived affordability
- Currently limited selection
- Limited range
- Cost of charging equipment
- Cost of installation
- Cost of electricity
- Limited information for property owners
- Limited access and information for drivers

Recommendations that respond to these issues, where appropriate, are located in later chapters according to topic.

3.1 PERCEIVED AFFORDABILITY OF EVs

The most commonly articulated barrier is that EVs are considered “too expensive.” The initial cost of an EV is higher than comparable non-EVs, and shipping costs can represent an additional expense for island residents. Currently, there are only two dealerships offering EVs on Maui, and selection is limited to the Nissan LEAF, Chevy Volt, and 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 are expected to increase EV uptake; however, leasing costs are also higher than on the mainland.

Upfront costs for EVs are an industry-wide issue, and as with other emerging technologies, costs will come down with increased production and market share. Additional battery capacity and battery production are expected to drive down battery cost, which is responsible for much of the additional cost of an EV over a gas-powered vehicle. Market share is also expected to increase due

to the new 54.6 mpg Corporate Average Fuel Economy (CAFE) standards, just announced by the Environmental Protection Agency.¹²

Upfront costs are currently being addressed by the \$7,500 federal tax credit for EVs, as well as leasing options which allow the credit to be immediately applied. Hawai'i's state rebates of up to \$4,500, however, were offered during a period of limited vehicle availability and limited consumer awareness, and funds have already been exhausted. As long as federal tax credits remain available, it will be important to continue local efforts to increase awareness and utilization.

Awareness of the longer-term total cost of ownership also affects perceived affordability. Hawai'i has the highest gasoline prices in the nation, but even with high electricity costs, the power used by a 100% electric car is less expensive than the equivalent gasoline required per mile.¹³ With additional savings on vehicle maintenance, the total cost of ownership of an EV will be lower than a comparable vehicle with an internal combustion engine (ICE) over 125,000 miles (see DBEDT Report). Affordability will be impacted by the cost of the battery, battery replacement, market share (production levels), and even the number of miles an owner drives. Cheaper batteries and more people purchasing EVs will shift the balance of actual and perceived costs of ownership.¹⁴

3.2 LIMITED SELECTION

Maui has only had access to a subset of the electric vehicle and charging station models available on either O'ahu or the mainland. The Chevy Volt has been available for test drives on island since October 2011, and the Nissan LEAF since May 2012 (before that it could only be ordered online). The Toyota Plug-in Prius just arrived in the summer of 2012. The Mitsubishi iMiev is not available because there is no Mitsubishi dealership on island. Maui residents can ship an iMiev from Honolulu, but must return it for servicing—a strong disincentive.

Currently there are no EV-equivalents for choices popular in the tropics: convertibles, SUVs, and affordable pick-up trucks. Features like sufficient trunk space for luggage and four-wheel drive capability for off-road access are important considerations for visitors and residents alike. On the island of Lāna'i, for example, the Four Seasons Manele Bay offers an AeroVironment Level 2 charging station, and the island's only car rental agency, Dollar Rental Cars, wants to purchase off-road four-wheel drive EVs for its fleet, but none are yet available.

¹² Regulations and standards. (n.d.). Retrieved from <http://www.epa.gov/fueleconomy/regulations.htm>

¹³ Hawai'i prices drop by 8 cents but still highest in nation. (2012). Retrieved from <http://www.bizjournals.com/pacific/news/2012/11/15/hawaii-gas-prices-drop-8-cents-but.html>

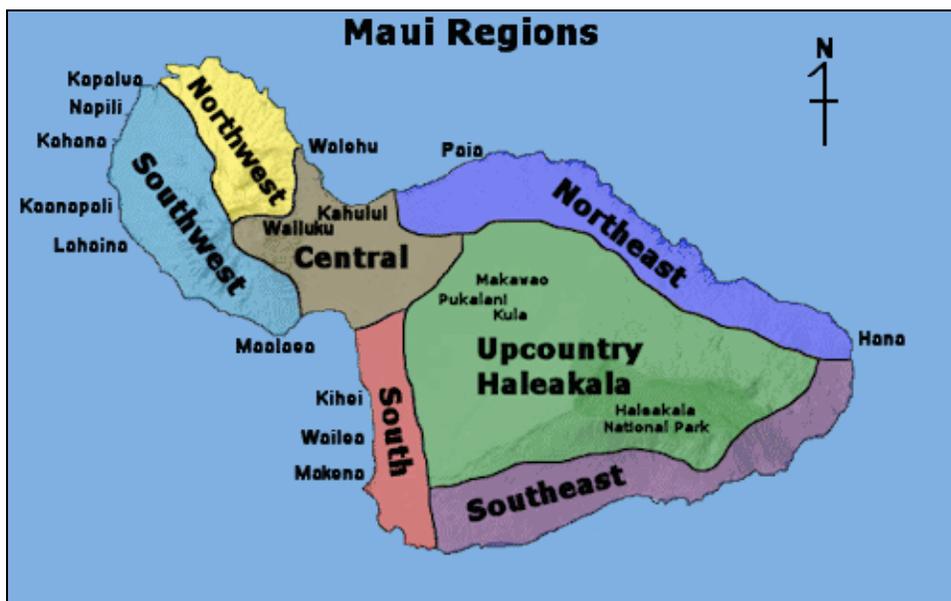
¹⁴ Evaluation of electric vehicle production and operating costs. (1999). Retrieved from <http://www.transportation.anl.gov/pdfs/HV/14.pdf>, Konrad, T. (2012, April 18). Report: electric cars cost less (but watch the assumptions). *Forbes*. Retrieved from <http://www.forbes.com/sites/tomkonrad/2012/04/18/report-electric-cars-cost-less-but-watch-the-assumptions/>

Because Hawai'i did not sign on as a California Air Resources Board (CARB) state, some auto manufacturers are faced with sending their limited production EVs to the CARB states first (California has the largest sales of EVs in the nation, estimated at one-in-four of every EV sold).¹⁵ Hawai'i Auto Dealers Association Executive Director Dave Rolf notes that Hawai'i may also face limited availability of some models because of the multiple regulators of fuel economy standards—e.g., the National Highway Traffic Safety Administration (NHTSA), Environmental Protection Agency (EPA), and CARB (D. Rolf, personal communication, November 2012).

3.3 RANGE

In the absence of a complete public charging infrastructure, many EV drivers are limited by choice of destination. The existing public charging stations on the island of Maui are dotted throughout the Central, Southwest, and South sides, but entirely absent in the Northeast, Northwest, Southeast, Upcountry, and Haleakala areas. This does not pose an issue for plug-in hybrids and extended range electric vehicles such as the Chevrolet Volt, which can travel up to 380 miles on its combined battery and gas tank, or the Tesla Model S, which can travel over 300 miles on its 85 kWh battery. However, it does limit a shorter range vehicle, such as the Nissan LEAF, which has a range of up to 73 miles on a single charge.¹⁶

Figure 3.1 Maui Island Regions



Source: Aloha Isles website, <http://www.alohaisles.com>

¹⁵ Electric vehicle geographic forecasts. (2012). Retrieved from <http://www.pikeresearch.com/research/electric-vehicle-geographic-forecasts>

¹⁶ Ranges cited here are published on manufacturer's websites, but are, of course, subject to conditions of driving, especially changes in elevation, which are significant on Maui.

3.4 COST OF CHARGING EQUIPMENT

Willingness to invest is an important consideration for both EVs and charging equipment. Even if total cost of ownership and long-term returns reveal EV-related purchases to be compelling investments, buyers have other more pressing concerns. Hotels and other property owners are reluctant to make new investments in charging infrastructure after recent recession-related cutbacks, layoffs and even bankruptcies. Businesses are especially cautious given that energy is their single largest expense after personnel. Finally, the lack of a standard for DC fast charging equipment translates into a hesitancy to invest, should standards be incompatible.

Property owners have also voiced concern that they will pay a public relations price if parking spaces reserved for EVs and EV charging are left unused, while customers with non-EVs are frustrated by parking limitations. A new ordinance, Hawai'i State Law Act 89/SB2747 (2012) requires larger property owners to designate EV parking spaces and provide access to charging stations,¹⁷ 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.

Charging equipment costs for some property owners have been addressed by nearly \$1.5 million in 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. While the ARRA funds helped subsidize some equipment and site inspection costs, installation and other costs were shared by the host site and not all who were contacted chose to participate, for a variety of reasons (B. Goldstein, personal communication, November 2012).

3.5 COST OF INSTALLATION

Charging stations cost more to install on Maui compared to the mainland; partly because materials need to be imported, and partly because labor costs are among the highest in the nation.¹⁸ 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.

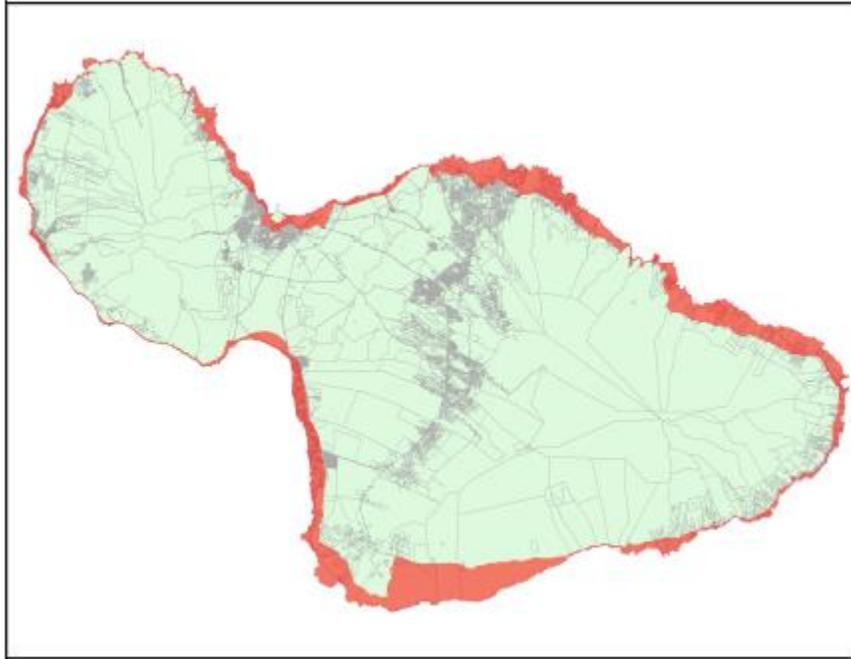
Hawai'i is a challenge for installation of charging stations because of flood control mandates and SMAs that form the coastal zone management system. Most of the properties frequented by tourists

¹⁷ State of Hawai'i. (2012). Twenty-sixth legislature, Act 89 (12) / SB 2747. Retrieved from <http://www.capitol.hawaii.gov/session2012/bills/GM1190.PDF>

¹⁸ What is the typical salary of an electrician? (n.d.). Retrieved from http://degreedirectory.org/articles/What_is_the_Typical_Salary_of_an_Electrician.html

on Maui are located in these areas, and under some conditions the charging stations must be elevated or are subject to additional requirements.

Figure 3.2 Maui Island Special Management Areas (shown in red)



Source: <http://maui.hawaii.edu/isisa2006/ConferenceProceedings.pdf>

While a charging station itself only requires an electrical permit in Maui County, adding features such as a car port with solar panels (roof construction) adds complexity. Per the Maui County Code, a building permit, if required, must be issued prior to the electrical permit. Building permits can also require initial review and consultation, followed by a public hearing before the Maui Planning Commission for sites located in an SMA.

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 EV and thus may require upgrades to their electric panels, such as new or replacement breakers. If a new transformer is needed from Maui Electric Company (MECO), the order can result in an additional delay.

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, during a site visit to the Maui YMCA, located in the Special Management Area not far from the Kahului Harbor, staff reported that everything rusts

within months of installation: “if it’s metal, it rusts!” To address this barrier, owners would need to purchase charging equipment with protective covers or anticipate higher replacement costs because of shorter lifespans for the equipment.

A final site consideration for charging stations is security in the surrounding area. User safety concerns and the risk of vandalism make remote areas, including some parks and beach parking lots, less viable. This may result in charging stations being limited to locations where there is a gatekeeper.

3.6 COST OF ELECTRICITY

Hawai‘i’s electricity rates are the highest in the country, and neighbor islands such as Maui, Moloka‘i and Lāna‘i have higher rates than O‘ahu.¹⁹ This cost must be factored into the total cost of ownership for EVs, and can pose a risk for charging station owners who are not set up to pass costs on to users.

An infrastructure designed to serve tourists 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, as well as potential changes to a business property’s rate schedule. 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.

The County of Maui, host to the first and only DC fast charging station publicly available on Maui, has estimated that a single 50 kW fast charging station, when used at the same time of day as current peak use, may add as much as \$9,800 in annual demand charges to its electricity bill (D. McLeod, personal communication, December 5, 2012). Therefore, businesses should be advised to work with MECO individually and evaluate what options are available to them.

3.7 INFORMATION FOR PROPERTY OWNERS

Information on time-of-use rates, the availability of special meters for EV usage and monitoring, and the cost to install meters is available on the MECO website, but the website may prove challenging for some customers, and more could be done to make it user-friendly.²⁰ Currently, a

¹⁹ Effective rate summaries. (2012, October 4). Retrieved from <http://www.mauielectric.com/vcmcontent/StaticFiles/FileScan/PDF/EnergyServices/Tarrifs/HECO/EFRRATESOCT2012.pdf>. Fact check — Hawai‘i has the highest electricity rates in the nation. *Civil Beat*. Retrieved from http://www.civilbeat.com/fact_checks/2011/11/07/13341-fact-check-hawaii-has-the-highest-electricity-rates-in-the-nation

²⁰ Electric vehicles. (n.d.). Retrieved from <http://www.mauielectric.com/portal/site/meco/menuitem.853d25dd64dca44973b5c410c510b1ca/?vgnextoid=df8c5aa944c22310VgnVCM10000005041aacRCRD&vgnextfmt=default>

customer must call MECO and discuss options, issues, and requirements to understand fully the impact of adding a charging station to a property.

3.8 ACCESS AND INFORMATION FOR DRIVERS

While site security is a concern for property owners, lack of guaranteed public access to charging stations is a barrier for EV drivers. Some charging stations may have limited access due to operating hours. Many of the existing Level 2 charging stations in Maui are also located on properties with a gatekeeper. Hotels, for example, may require valet parking or patronage at either their hotel or restaurant in order to access their premises, though charging stations at some, such as the Four Seasons and Sheraton Maui, are in 24-hour self-park garages. EV drivers have reported receiving conflicting and confusing information from staff regarding access to charging stations, so keeping employees informed poses a challenge. Questions have also arisen regarding the use of public funds for public charging stations with restricted access.

3.9 SUMMARY

Affordability, limited selection of vehicles and limited range of all-battery vehicles remain primary barriers to EV adoption. The limited number and location of charging stations also create concerns for potential EV buyers. For property owners, the costs and complexity of purchasing, installing, and providing electricity for charging stations are significant issues. Steps to reduce or eliminate these barriers will be explored in subsequent chapters, with recommendations summarized at the end of this document.

Chapter 4

Benefits and Incentives

This chapter will discuss the current landscape of electric vehicle-related benefits and incentives available to Maui residents and businesses, recommendations for future action, and considerations unique to Maui in the following areas:

- Intrinsic benefits of electric vehicles (EV)
- EV purchase and rental incentives
- Electric vehicle supply equipment (EVSE), charging, and renewable energy incentives
- Parking incentives
- Business incentives

Information on benefits and incentives for fleet owners can be found in Chapter 6. Because there has been a lack of public knowledge of EV consumer benefits, most of the recommendations listed at the end of this chapter are related to increasing public awareness, rather than creating new incentives.

4.1 INTRINSIC BENEFITS OF EV

In addition to the fuel efficiency benefits mentioned in Chapter 1, EVs provide their owners and other drivers with clean, quiet transportation. Fully-electric vehicles do not use energy while idling, which can decrease the frustration of being stuck in traffic. These vehicles also provide the convenience of recharging (refueling) at home, while at work, or while shopping instead of waiting in line at a gas station. Each EV comes with a plug, allowing drivers to charge whenever the vehicle is not in use and wherever a standard 110-V three-prong outlet is available and accessible. Even with a currently limited charging infrastructure, there are more places to “fill up” an EV than there are gasoline stations.

For more intrinsic benefits of EVs, including lower total cost of ownership compared to a standard, internal combustion vehicle, see Chapter 5.

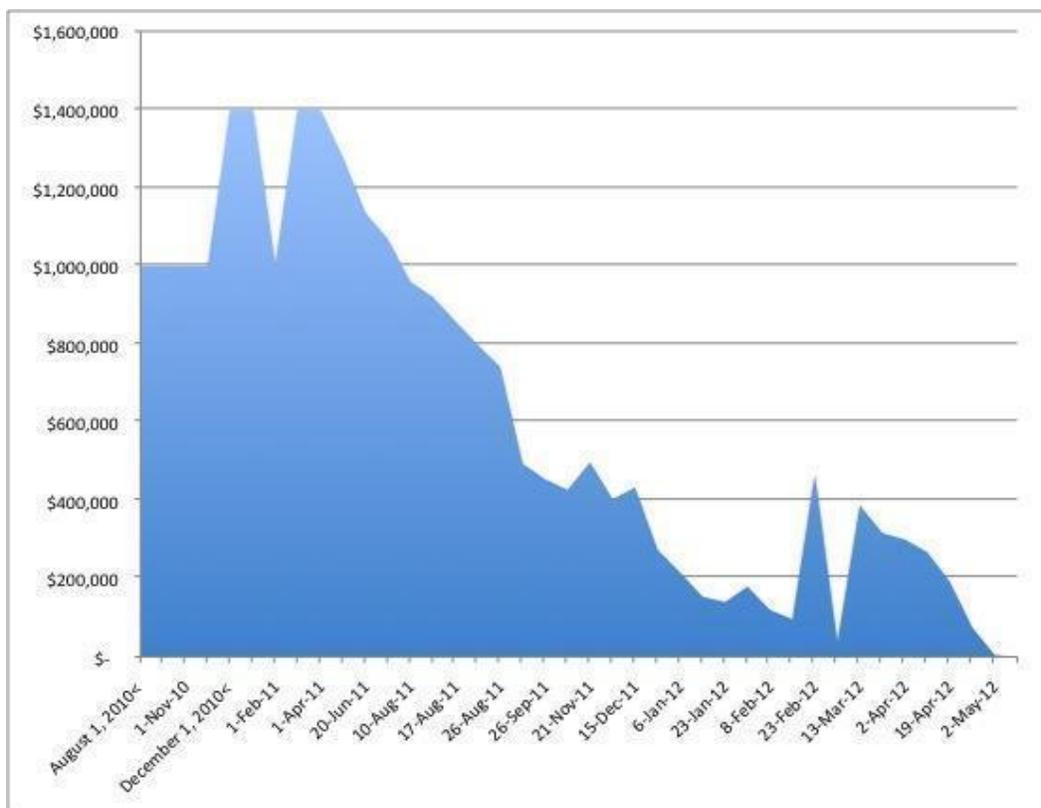
4.2 EV PURCHASE/RENTAL INCENTIVES

Hawai'i has been one of the most generous states in terms of offering EV incentives. 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 stimulus funds for transportation energy transformation, of which roughly half was given to residents and businesses in the form of tax rebates to address the high initial cost of EV investments. Through the EV Ready Rebate program,

residents who purchased EVs between August 2010 and April 2012 were eligible to claim up to \$4,500 for the purchase of a single EV on a first-come, first-served basis.²¹

The chart below shows the uptake of funds from the EV Ready Rebate program. The last distribution, in March 2012 was expected to last until November, but was completely exhausted by early May 2012. Maui residents, who constitute 11% of the state population, received 9% of these rebates, purchasing 42 vehicles.²² Because state rebate funds were exhausted just as the first Nissan LEAFs and Chevy Volts were becoming available for test drives on Maui, these funds served as incentives for the earliest of early adopters—those who were willing to purchase their vehicles off-island.

Figure 4.1 Hawai'i State EV Ready Rebate Program Fund Uptake



Source: State of Hawai'i, Department of Business, Economic Development and Tourism ²³

²¹ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai'i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

²² *ibid*

²³ Hawai'i's electric vehicle (EV) ready program. (n.d.). Retrieved from <http://energy.hawaii.gov/programs/transportation-on-the-move/ev-ready-program>

A federal tax credit of up to \$7,500 per EV has also been provided to consumers since 2008. It allows a credit for up to 200,000 EVs per manufacturer, then phases down to 50% and 25% over time.²⁴

Locally, some auto dealers are offering flexible lease arrangements that allow consumers to take advantage of the federal tax credit up-front.

Car rental agencies have provided special rates, including “kama’aina” discounts for Hawai’i residents, to encourage international, mainland and inter-island visitors to experience EVs. EV renters rushing to the airport for their return flight also enjoy the added benefit of not being required to fill their tank (or recharge) upon return.

One local car rental agency, the Hawaiian EV Network (HEVN) opening in 2013, has already committed to reselling its EV fleets in Hawai’i, thus providing a new venue for consumers to purchase EVs 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.²⁵ In response to this requirement, dealers are offering flexible lease arrangements that allow county and state agencies to work within their budget cycles.

4.3 EVSE, CHARGING AND RENEWABLE ENERGY INCENTIVES

EVSE tax rebates: The DBEDT EV Ready Rebate program also provided residents and businesses with an incentive of up to \$500 for one charging station. A total of 26 charging station rebates were issued for Maui between August 2010 and April 2012.²⁶

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 EVSE deployment. This awarded \$2.3 million in federal stimulus funds to six organizations. Two of these organizations, Better Place and AeroVironment, installed most of the charging stations in operation today on Maui.

Free charging for EV drivers: At least temporarily, early adopters have an opportunity to enjoy free charging. Free memberships are available through 2012, and will possibly be extended into 2013, for any of Better Place’s seven charging locations on Maui (though property owners may have

²⁴ Federal tax credits for electric vehicles. (n.d.). Retrieved from <http://www.fueleconomy.gov/feg/taxevb.shtml>

²⁵ Departmental guidelines for acquisition of new vehicles. (2010, January 1). Retrieved from <http://energy.hawaii.gov/wp-content/uploads/2012/08/Vehicle-Purchasing-Guide-20102.pdf>

²⁶ State of Hawai’i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai’i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

additional requirements, such as parking fees or valet parking). Free charging is also available via key fob at Maui's only DC fast charging station, the AeroVironment station at the Maui County building.

Discounted utility rates for EV charging: According to a recent report by the Northeast Group, only 6% of utilities in the United States offer special rates for EVs.²⁷ One of these is Maui Electric Company (MECO), a regulated utility which reports to its parent Hawaiian Electric Company (HECO) on O'ahu. MECO serves the islands of Maui, Lāna'i, and Moloka'i, which comprise Maui County.

MECO's special rates include time-of-use (TOU) rates for a home combined with an EV charging station, and dedicated TOU rates for EV charging through a separate meter. Special TOU tariffs for EVs are offered on a pilot basis for a maximum of 300 meters until the end of September 2013.²⁸

By the end of May 2012, about a dozen residential customers had installed some form of TOU meter for EV charging. In the subsequent five months, only three have been added, despite increased EV sales during this period. One reason for low uptake may be that TOU rates result in increased charges for all electric usage (on that meter) during peak times. Another obstacle for dedicated EV charging rates may be the installation costs for the new meter panel. More information may also be needed to make the benefits of special rates clear for customers with different projected use patterns.

Renewables: For Maui residents, the most important benefit of EVs may be the ability to charge their vehicles using solar panels at home. A recent report from California shows a considerable correlation between EV ownership and photovoltaic (PV) installations, with nearly 39% of EV owners investing in PV.²⁹ Though PV requires a significant initial investment, two Maui Nissan LEAF owners who installed PV report that they have lowered their combined monthly fuel bill, for home and vehicle, to an average of \$18.³⁰

4.4 PARKING INCENTIVES

State laws enacted between 2009 and 2012 provide EV 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

²⁷ Northeast Group. (2012). United States smart grid: Utility electric vehicle tariffs. Retrieved from http://northeast-group.com/reports/Utility_Electric_Vehicle_Tariffs_Brochure_NortheastGroupLLC.pdf

²⁸ EV pilot rates commonly asked questions. (n.d.). Retrieved from <http://www.mauielectric.com/vcmcontent/MECO/RenewableEnergy/EV%20Commonly%20Asked%20Questions.pdf>

²⁹ California plug-in electric vehicle owner survey. (2012). Retrieved from <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project/vehicle-owner-survey>

³⁰ McLeish, D. (2012, November). The path that took me to EVs. Retrieved from www.mauiuva.org/docs/mcleish.pdf
Carletta, C. (2012, July 25). Going solar is real change (Kula PV & EV). Retrieved from http://www.mauiuva.org/docs/PV_EV_experience.pdf

airport for vehicles with EV license plates.³¹ Parking spaces are also designated for exclusive EV use, with access to charging required for large public properties (over 100 parking spaces). Residents of multi-unit dwellings, such as condo owners, also have a protected right to install charging systems on or near their parking stalls.

On O'ahu, cars with EV license plates also have access to the high-occupancy vehicle lane on freeways. Though these lanes do not exist on Maui, they are a benefit to those residents who rent EVs while travelling on O'ahu.

Public awareness of these benefits is currently low, and enforcement of these protections is lacking, resulting in reports of conflicts between EV users and parking lot managers. This issue is addressed further in Chapter 9, as well as in the recommendations below.

4.5 BUSINESS INCENTIVES

Benefits of installing a charging station at a business property can include increased customer traffic and increased shopping time. Proximity to a public charging station can influence EV drivers' choice of shops and restaurants, resulting in increased business.³²

While this phenomenon seems intuitive, local businesses, including large hotels, need facts on which to base their investment decisions. As the executive director of the Maui Hotel and Lodging Association notes, hotels need to know how many visitors with EVs are coming in order to plan accordingly (L. Paulson, personal communication, November 14, 2012).

The introduction of electric vehicles also presents business opportunities for the provision of services and support for EVs and EV-related infrastructure. Included is professional training to upgrade and enhance the skills of auto mechanics, electricians, and electrical inspectors, as well as to equip charging station host staff with the language and skills needed to serve EV customers.

4.6 OTHER BENEFITS AND INCENTIVES

Additional information on programs, benefits, and incentives from other regions, states and organizations can be found online. Here are a few:

- Hawai'i:
 - <http://energy.hawaii.gov/programs/transportation-on-the-move/ev-ready-program>
- Oregon:

³¹ State of Hawai'i. (2012). Twenty-sixth legislature, Act 168 / SB 2746. Retrieved from http://www.capitol.hawaii.gov/session2012/bills/GM1271_PDF

³² Woody, T. (2012, June 18). Automakers, tech companies mining electric car big data to plot industry's future. *Forbes*. Retrieved from <http://www.forbes.com/sites/toddwoody/2012/06/18/automakers-tech-companies-mining-electric-car-big-data-to-plot-industrys-future/>

- <http://chargeportland.com/benefits.asp>
http://www.portlandgeneral.com/community_environment/initiatives/electric_vehicles/get_plugin_ready/business_government.aspx
- California:
 - http://www.driveclean.ca.gov/Do_Your_Research/Benefits_and_Incentives.php
- Washington:
 - <http://www.electricdrive.wa.gov/consumers.htm>
- Ecotality:
 - <http://www.theevproject.com/index.php>
- Plug-In America:
 - <http://www.pluginamerica.org/>

4.7 RECOMMENDATIONS

At the State and County Levels:

- Consider reinstating state tax rebates. Match the timing of any future EV purchase incentives to vehicle availability
- Amend the existing EV parking laws to include provisions for enforcement, penalties for noncompliance, and additional coverage of office buildings and shopping complexes
- Actively enforce EV parking laws and notify parking lot owners and staff of legal requirements
- Create a consumer-awareness campaign to inform multi-unit dwelling residents of their rights to EV charging access

For Maui Electric Company (MECO)/Hawaiian Electric Company (HECO):

- Analyze existing rate incentives to see if they are working as intended, and address obstacles to encourage greater use of off-peak charging
- Provide user-friendly online cost comparisons or cost calculator for different types of charging stations, including the DC fast charging station, and different projected usage levels

For Solar Companies:

- Provide solar installers, solar customers, EVSE installers and EV car dealers with real-life stories of cost savings and other benefits of combined EV and PV ownership

For Auto Dealers:

- Provide adequate training and proper staffing of service people and mechanics for EVs

- Promote and resell on island the affordable, pre-owned EVS made available when leaseholders return three-year old vehicles at the end of their leases
- Provide consumer information on charging, incentives, EV laws, and other information at point of sale

For EV Manufacturers and Car Rental Companies:

- Allow the local resale of EVs in island fleets
- Provide projections of the number of visitors who will be renting EVs to local hotels and the Maui Hotel and Lodging Association

Chapter 5

EV Deployment

Maui is working towards the Hawai'i Clean Energy Initiative goal of meeting 70% of its energy needs by 2030 through energy efficiency and renewable energy. One of the strategies to achieve this goal is to embrace hybrid and electric vehicles.³³

The General Plan of Maui County also includes several policies for which EVs play a key role:³⁴

- Promote programs and incentives that decrease greenhouse-gas emissions and improve environmental stewardship (p. 48)
- Support the renewable-energy industry (p. 63)
- Provide an efficient, affordable, and convenient ground-transportation system that is environmentally sustainable (p. 66)
- Support the development of carbon-emission standards and an incentive program aimed at achieving County carbon-emission goals (p. 66)
- Encourage energy-efficient modes of transportation (p. 67)
- Encourage the use of sustainable energy to power vehicles (p. 71)
- Reduce Maui County's dependence on fossil fuels and energy imports (p. 72)
- Promote and support environmentally friendly practices in all energy sectors (p. 72)

In addition, the State of Hawai'i has a signed agreement with the Japanese consortium led by New Energy and Industrial Technology Development Organization (NEDO), to participate in the Japan-U.S. Smart Grid Demonstration Project, an international collaboration to install and test clean technology on an island utility grid.³⁵ This, too, requires the introduction of a significant number of EVs (a target of 200) to support the overall objectives of the demonstration.

These state, local, and project-specific goals, require a strategic plan for EV deployment. This chapter will outline issues and opportunities and provide information necessary for future EV planning. These include:

³³ Hawai'i Clean Energy Initiative road map. (2011). Retrieved from http://www.hawaiicleanenergyinitiative.org/storage/media/HCEI%20RoadMap_2011_40pgs.pdf

³⁴ General plan 2030. (n.d.). Retrieved from <http://www.co.maui.hi.us/index.aspx?nid=421>

³⁵ Governor Abercrombie signs memorandum of understanding for Japan-U.S. smart grid demonstration project. (2011, November 22). Retrieved from http://hawaii.gov/dbedt/main/news_releases/2011/news-release-1126

- Tracking existing EV ownership accurately and in a timely way
- Identifying key factors that will influence EV purchases for private use
- Identifying key factors that will influence EV purchases for fleets
- Analyzing usage patterns of vehicles

The sections below will discuss these topics, in terms of residential ownership, rental car fleets, car sharing programs, and corporate/government fleets. Information for the final category—analyzing usage patterns of vehicles—was not available during the period of this report, but research on consumer behavior is currently being undertaken at University of California San Diego, which is in the process of installing 51 Level 2 charging outlets and three DC fast chargers, and the technology for that analysis will be made available to Maui to apply locally once the initial project is complete. The most comprehensive study on plug-in electric vehicle owners is by the California Center for Sustainable Energy and the California Environmental Protection Agency, and is referred to elsewhere in this report.³⁶

Based on current information, the adoption rate for privately owned EVs on Maui is expected to dramatically increase, and deployment by car rental fleets is likely to double the total number of EVs on the island within the next year. In addition, alternatives to private ownership or traditional car rentals—such as car sharing operations—may appear within the next one to two years.

5.1 TRACKING EXISTING EV OWNERSHIP

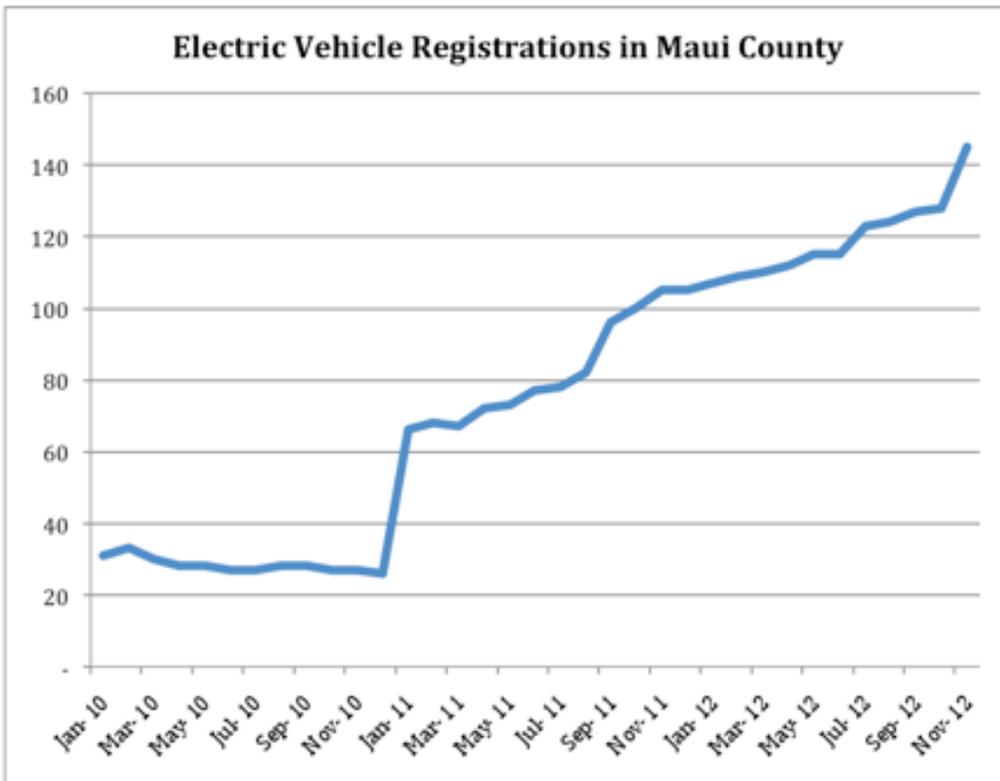
The first challenge for planning is in tracking the number of EVs that have been registered in Maui County since highway-ready EV passenger cars entered the market in significant numbers in 2011.

The State Energy office updates a monthly spreadsheet of vehicle registrations for each county by several broad categories: electric vehicles, diesel, gasoline, and hybrid. However, tracking is a challenge is because the DMV does not distinguish between “neighborhood electric vehicles” (NEVs), which the DMV defines as four-wheel electric vehicles that do not travel above a speed of 25 miles per hour, and highway-ready passenger cars, which are capable of travelling at highway speeds. Golf carts are considered NEVs, and are included in the number that DMV has historically reported. However, if 2011 is used as a starting point, when passenger-ready EVs first became available, the number prior to that can be assumed to consist primarily of NEVs (a few may have been owner-installed conversion kits or cars ordered from other countries that had earlier EV models available). At the end of 2010, there were 26 of these registered on Maui. This will be the baseline.

³⁶ California plug-in electric vehicle owner survey. (2012). Retrieved from <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project/vehicle-owner-survey>

In December 2010, both the Chevrolet Volt and the Nissan LEAF were introduced in the United States. The number of EVs in Maui County jumped the following month to 66 and then climbed slowly but steadily from the beginning of 2011 to the present, September 2012. Altogether, over 100 EVs have been added, or roughly 50 per year for two years, as seen in Figure 5.1 below:

Figure 5.1 EV Registrations in Maui County, January 2010 - November 2012



Source: State of Hawai'i Department of Business, Economic Development and Tourism³⁷

Because this increase coincides with the introduction of highway-ready passenger EVs, this report assumes that the change in number, which had been steady in prior years, primarily reflects the purchase of the new highway-ready EVs.

Despite the impressive growth of EV registrations, the supply of EVs to Maui has been a limiting factor in uptake. The adoption rate of EVs on Maui initially lagged that of O'ahu because of issues of availability, but that is now changing. Several details help explain the slower pace:

³⁷ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, November). *Monthly Energy Trends*. Retrieved from http://hawaii.gov/dbedt/main/whats_new/info/economic/data_reports/energy-trends

- Maui EV buyers could only purchase the Nissan LEAF online, and the Volt from mainland or O'ahu dealerships
- Availability of the LEAF and Volt for test drive and purchase were not consistent at island dealer Jim Falk Motors until May 2012, long after they appeared on O'ahu
- The Toyota Prius Plug-in Hybrid (Prius PHV) became available in the United States in February 2012, but the first one did not arrive on Maui until months later
- The Mitsubishi iMiev, a fourth option, and the least expensive one of the group, is still only available on O'ahu
- Luxury models such as those by Tesla and Fisker also must be purchased on the mainland and shipped by the owner at additional expense
- The Hawai'i EV Ready Rebate program funds, created to incentivize EV purchases, were depleted in May 2012, just as the first test vehicles arrived on Maui, and the funds have not been renewed

Despite the difficulty of obtaining EVs on Maui, and the reduced availability of buyer incentives, the number is obviously on the rise. In late 2013 and 2014, many more manufacturers will be introducing one or more EV models, updating existing models of the LEAF, Volt, and Mitsubishi *i*, as well as launching new vehicle types, such as minivans and SUVs. Equally important, a number of these manufacturers have local dealerships. These models may include:

- BMW i3 (formerly "Megacity", hatchback)
- Chevy Spark (2014 release, sedan)
- Ford Focus Electric (economy car)
- Ford Fusion Energi (minivan)
- Ford C-Max Energi (minivan)
- Ford Transit Connect Electric (commercial van)
- Honda Fit EV (hatchback)
- Honda Accord Plug-In (2014 release, sedan)
- Infiniti LE (2014 release, luxury sedan)
- Nissan eNV200 (commercial van)
- Toyota Prius Plug-in (sedan)
- Toyota RAV4 EV (SUV)

Other models that may be of interest, but do not have local dealers:

- Fisker Karma (luxury sedan)
- Smart ED (economy car)
- Tesla Model S and Model X (luxury sedans)

Figure 5.2 EV Options are Expanding: Honda Fit EV Hatchback, Tesla Model S Sedan, Toyota RAV4 EV SUV, Ford C-MAX Energi Minivan



Sources: (see below)³⁸

These vehicles will have extended range and faster charging capabilities than the early LEAFs and Volts, and with the greater selection of vehicle types, Maui can expect to see an even greater rate of increase in EV ownership, among both private individuals and commercial fleets.

The Hawai'i Auto Dealer Association (HADA) reports that 16 models of EVs are anticipated for 2013, growing to 61 by 2016 (based on a J.D. Powers report), and that most models will be available in Hawai'i. HADA also predicts that 356 EVs will be available to Hawai'i from manufacturers in 2013, and 797 in 2014 (D. Rolf, personal communication, November 2012). These include inventory from General Motors, Ford, Nissan, Toyota, Fiat, and BMW. HADA has accurately predicted EV sales for 2012, in part because they are in contact with manufacturers regarding availability and national distribution plans, but there is no Maui breakout of data.

For specific planning efforts, trustworthy information will be critical. The Department of Motor Vehicles needs to separate NEVs from the category of highway-ready passenger EVs, and have the numbers broken out by county and island. The Vehicle Specialist at the State of Hawai'i Department

³⁸ Retrieved from <http://gogreenautocenters.wordpress.com/2012/07/06/honda-announces-lease-for-fit-ev-electric-car/>, http://www.teslamotors.com/sites/default/files/imagecache/galleriffic_slide_960x640/model-s-signed-front3qtr_960x640_0.jpg, <http://money.cnn.com/2012/05/07/autos/tesla-toyota-electric-rav4/index.htm>, <http://www.ford.com/cars/cmax/trim/energi/>

of Business, Economic Development and Tourism (DBEDT) has taken on this task, but no long-term resolution exists at the time of this report.

5.2 RESIDENTIAL DEPLOYMENT

In addition to the expected increase in variety and type of vehicles available, especially at local Maui dealerships, there is an array of factors that will shape the rate of adoption by individual residential households. These include, in no particular order of priority:

- The cost of gasoline
- The cost of electricity
- Cost differential between EVs and gasoline-powered vehicles
- Purchase incentives, such as state and federal rebates
- Access to off-grid or net-metered renewable energy (such as solar panels)
- Degree of remoteness, local geography of individual owners
- The saturation level of renewable energy systems in the owner's area
- Ease of installation of home charging systems for private residential use
- Availability and ease of installation of charging systems for multi-unit dwellings
- Availability of public charging stations
- Availability of service and maintenance options
- Federal rates and requirements for average miles per gallon
- Technology rate of obsolescence, or perceived rate of obsolescence
- The health of the economy and strength of consumer optimism
- Other unforeseen factors

Even with all these factors in play, it is likely that an increasing number of households will purchase EVs. The lack of familiarity with EVs will lessen as they grow in number and people see them in their neighborhoods and know people who own them. The long economic recession means that more households are likely to have aging vehicles that need replacing. Most importantly, the cost of gasoline is likely to stay high.

Another factor that may have significant impact is the recent move by the federal government to increase the average miles per gallon that the U.S. market must meet for 2025 to 54.5 mpg, double the current average.³⁹ This will force auto manufacturers to produce and sell hundreds of thousands of EVs in the U.S. market.⁴⁰ Another source of EVs which will become available in the

³⁹ U.S. Environmental Protection Agency. (2012). EPA and NHTSA set standards to reduce greenhouse gases and improve fuel economy for model years 2017-2025 cars and light trucks. Retrieved from <http://www.epa.gov/oms/climate/documents/420f12051.pdf>

⁴⁰ Electric vehicle information technology systems. (2012). Retrieved from <http://www.pikeresearch.com/research/electric-vehicle-information-technology-systems>

next two years, but are not available currently, are pre-owned vehicles. This will expand the number of consumers able to afford an EV. The first source will be leaseholders who choose not to pay the balance at the end of the lease but return a three-year old EV back to the dealership. Though tax credits do not apply, the purchase price will be lower and warranties are still valid for several years. Secondly, some car rental fleet owners, who typically send older vehicles to the mainland for resale, have pledged to make them available on island first.

EV 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 Maui Electric Company’s (MECO’s) net-metering program. With Hawai’i having the highest electricity rates in the nation, the payback period for both solar and EV purchases is relatively quick compared to other regions of the country. MECO estimates that 5% of their customers now have photovoltaics (PVs), and the number is growing rapidly.⁴¹ Studies in California have shown that a high correlation between solar PV ownership and EV ownership exists; nearly 39% of EV owners had invested in PV installations.⁴²

In other words, what the most predictable factors suggest is that sales are likely to increase at a much faster rate than over the last two years, as the various factors align in favor of EV ownership. If new EV ownership continues to grow at the same rate, then the number of individually-owned EVs will only increase by 50 each year, and within two years there will be 200 owners. If sales double each year—a more likely scenario given the factors noted above—then by the beginning of 2014, there will be over 400 individually owned EVs on island (rental cars and fleets will be looked at separately). However, both of these rates are significantly below what O’ahu experienced this year to date (a 178% increase), and also below predictions in a recent report by Pike Research, which suggests that Hawai’i will have the highest penetration of plug-in EVs of any area of the country, or 12.3% of total vehicle sales by 2020.⁴³

Table 5.3 Potential Ownership Numbers for Individually-Owned EVs in Maui County

Rate of Increase in Sales	Current # of EVs	2013	2014	Total # of EVs by end of 2014
Same as 2011/2012	100+	50	50	200
Double rate of 2011/2012	100+	100	200	400

⁴¹ State electricity profiles. (2012, January 30). Retrieved from <http://www.eia.gov/electricity/state>

⁴² California plug-in electric vehicle owner survey. (2012). Retrieved from <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project/vehicle-owner-survey>

⁴³ Electric vehicle geographic forecasts. (2012). Retrieved from <http://www.pikeresearch.com/research/electric-vehicle-geographic-forecasts>

Obviously many of the factors that will encourage individual residents to purchase EVs are beyond the control of any organization or agency. But accurate information and an effective outreach effort that helps local car purchasers better understand the benefits of EVs will support increased sales.

To increase consumer adoption of EVs, local dealerships, MECO, the County, and others need to simplify the information needed to help make buying an EV as simple as buying a gas car today. There are many advantages to EV ownership, discussed in Chapter 4, that are not public knowledge. There can also be obstacles, such as the learning curve for using charging stations or the challenge of installing charging equipment at home, discussed in Chapter 8, which serve as disincentives and need to be addressed proactively.

5.3 AGENCY/CORPORATE FLEET DEPLOYMENT

To accelerate deployment of EVs in Maui County it will be critical for the owners of both agency/corporate fleets and car rental fleets to participate. Car rental fleets will be discussed in the following section.

Currently, no agency/corporate fleet in Maui has adopted EVs, with the exception of “test” vehicles. According to fleet owners, the primary reasons include: 1) equivalent EV models to replace existing fleet vehicles do not yet exist; 2) existing EV options are not affordable, i.e., it’s cheaper to replace with existing non-EV models; 3) there is no current need for replacement or the fleet is not growing. Owners of the largest fleets include:

- State of Hawai‘i
- County of Maui
- Maui Economic Opportunity, Inc. (MEO), a nonprofit agency
- Maui Electric Company (MECO)

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. As EV options are not available in these categories currently, they were not included as identified stakeholders for the first stage of planning. But the commercial market is poised to offer EVs soon, and the next round of stakeholders may be willing to plan for this change.

State of Hawai‘i: 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 EVs into its fleet on O‘ahu, where the charging infrastructure is further developed.

County of Maui: Maui County, one of the largest employers in Maui, has 2,400 employees and 1,200 vehicles in its fleet. Approximately 300 of these are light-duty passenger vehicles, and therefore possible candidates for EV replacement, given current vehicle options. Since July 2012, the County has been collecting data to identify vehicles to “shelve” in order to reduce costs, the largest of these being fuel costs. There is no plan to increase the size of the fleet. Rather, natural attrition is expected. The plan is multi-fold: reduce the fleet size through attrition, utilize the

existing fleet more efficiently, encourage employees to use personal vehicles (and claim mileage), and move to more fuel-efficient vehicles. The County has no EV in its fleet except a retrofit plug-in Prius from 2009, which uses a 110V plug for charging.

Other issues that will impact the County's adoption of EV options for future fleet purchases include:

- Availability of general funding for fleet upgrades
- Availability of special incentive programs (e.g., a "green vehicle" purchasing program)
- Timing of fiscal budgets (new contracts will be rebid for the 2014 fiscal year)
- Subcontracting of fleet to external vendors, who manage their own vehicle selection and fuel expense
- Availability of trained service technicians (currently, County technicians do not possess training for EV or hybrid vehicles)

Changes are beginning. The County has installed its first DC fast charging station at the Maui County Building in Wailuku in September 2012 and the Energy Commissioner intends to issue a Request for Proposals in 2013 to include EVs in the fleet.

Maui Economic Opportunity, Inc. (MEO): Organized as a Community Action Agency, chartered in 1965, under the Economic Opportunity Act of 1964, MEO has an annual operating budget of \$17 million, largely funded through the County. MEO provides outreach and information, and administers human service programs to low-income persons, the youth, elderly, immigrants, ex-offenders, persons with disabilities and medical needs, and other disadvantaged individuals and families on the islands of Maui, Moloka'i, and Lāna'i.

MEO has a fleet of 89 vehicles, with more than one million vehicle miles travelled per year, primarily to transport clients to community services on all three islands. The agency spends an average of \$52,000 per month on fuel. Though it makes bulk purchases of gasoline, MEO rides the fuel curve and is sensitive to increases in price.

Currently, MEO has no EVs in its fleet nor plans to adopt EVs, primarily due to their limited mileage range, limited model selection, and lengthy charging duration. The agency's decision criteria are heavily weighted by community needs and availability of funding. Currently, the County does not stipulate clean energy directives as part of funding or procurement guidelines. Community needs dictate the heavy use of paratransit vehicles with wheelchair positions, so the fleet is predominantly made up of small wheelchair buses, small and large school buses, and passenger busses, vans and minivans.

Only the two sedans in the fleet would have a current EV option available. Minivans will become available next year, but may not have wheelchair options. Mileage range and elevation change challenges will still be an issue.

As a nonprofit organization, EV tax credit incentives (such as the federal \$7,500 tax credit) are not applicable. The investment costs for EV options, even when appropriate options are available,

cannot be justified against other costs the organization must prioritize. The MEO Director of Transportation notes (G. Reioux, personal communication, August 7, 2012):

Our vehicles need extended range, ability to carry varied loads, often in hilly areas (Upcountry, Wailuku Heights) which seriously degrade range. The light duty EVs such as the LEAF may be useful with our ambulatory dialysis clients who live in hard to reach (with our standard vehicles) places. However, we typically run them over 100 miles a day, over mixed terrain, so range could be a problem, unless we devise 'flatland' schedules.

Microvast's Ultra-fast Charging Station⁴⁴ would help, but again there is initial investment that would be needed (unless partnership with other agencies, when speaking of fleet activities). Ultrafast would be useful for the medium duty type electric vehicles, also.

Maui Electric Company (MECO): In late October 2012, MECO purchased two Nissan LEAFs for its fleet, which already includes a 2009 retrofit plug-in Prius from Idaho National Lab. It has two charging stations in the back of its headquarters for employees and two for customers and others in the front near the customer entrance. Most of its fleet consists of utility service vehicles, and no EV options are currently available for these.

Based on interviews with the government agencies and other fleet owners listed above, a significant number of EVs in these fleets seems unlikely over the next two years, if each replaces just a few passenger vehicles with EVs. However, numerous other companies with small fleets may add one or two vehicles as they rotate their fleet inventory, and this may have a larger impact on the total number of vehicles than the purchases by the larger, better known fleets.

5.4 CAR RENTAL FLEET DEPLOYMENT

Car rental companies in Maui County include several national chains, such as Hertz and Enterprise Rent-A-Car, and independent local companies, such as Bio-Beetle ECO Rental Cars, and Kihei Rent A Car. In addition, a new independent car rental company is in development, Hawaiian Electric Vehicle Network (HEVN).

More than other regions of the country, car rental fleets make up a significant portion of Maui's vehicle population. Though the DMV 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 to 20%, based on the resident population,

⁴⁴ The Ultra-fast Charging Station is in production in China, has 6,400 kWh charging ports, and reportedly recharges a bus-sized battery in 5-10 minutes. Green Car Congress (2012, June 28) The Ultra-fast Charging Station is in production in China. Retrieved from <http://www.greencarcongress.com/2012/06/microvast-ultrafast-charge-station-for-electric-buses-begins-operation-in-chongqing.html>

visitor population, and percent of visitors who use rental cars as their primary form of transportation.⁴⁵

Currently, only two companies offer EV options in their car rental fleets: Enterprise Rent-A-Car and Bio-Beetle. Bio-Beetle was the first to offer EVs on Maui; a Nissan LEAF and later, a Chevrolet Volt. Enterprise Rent-A-Car has one Volt, a couple of Nissan LEAFs, and has also placed two Nissan LEAFs at hotel-based branches—one at the Sheraton in Ka’anapali and one at the Grand Wailea in South Maui. The Four Seasons resort on Lāna’i has 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 EVs to its fleet. Larry Ellison, the new majority owner of Lāna’i, said in an interview that one of his goals is to bring electric vehicles to the island, along with renewable energy, to make the island a “little laboratory” for sustainability.⁴⁶ Change may happen quickly on Lāna’i because Ellison is an “early adopter” and has a business interest with a sustainability focus.

Other rental car companies, such as Maui Condo and Car and Kihei Rent A Car, have expressed interest in purchasing second-hand EVs, when those become available on the market, but do not offer EV options currently.

The biggest impact on car rental fleet EV penetration for Maui will occur in 2013, when Hawaiian Electric Vehicle Network (HEVN) opens. This company has been in development for several years, and has now secured both its fleet and its site. A new Maui-based Renewable Energy Services Company, and Hawai‘i’s first Sustainable Business Corporation,⁴⁷ HEVN will be deploying an island-wide EV charging network and opening a large renewable energy-sourced rental facility. HEVN’s fleet will initially consist of over several hundred EVs, including passenger vehicles, minivans, luxury sedans and sports cars from a variety of manufacturers. HEVN will also be a Project Partner for the Japan-U.S. Smart Grid Demonstration Project.

Car rental companies work closely with the hotel and lodging industry, and have been in talks to determine whether charging infrastructure will be readily available for their customers. Obviously, they are strong advocates for the installation of charging stations at major hotels and tourist destinations, since their ability to successfully deploy greater numbers of EVs in their fleets is dependent on the availability of suitable charging stations where their customers lodge and visit. As a group, they are bringing pressure on the visitor industry to comply with state regulations and address customer needs.

⁴⁵ County of Maui. (2011). *Maui County Data Book*. Retrieved from <http://hisbdc.com/BusinessResearchLibrary/MauiCountyDataBook2011.aspx>

⁴⁶ Interview with Larry Ellison. (2012, October 2). Retrieved from <http://www.cnbc.com>

⁴⁷ 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).

Two examples demonstrate how serious this issue is for car rental companies. HEVN is proactively installing charging stations at major hotels as part of its business plan. The owner of Bio-Beetle personally calls the specific accommodation where a customer who wishes to rent an EV is staying, to ensure that charging options are available. Both HEVN and Bio-Beetle have been lobbying local tourist destination sites to develop onsite charging stations.

The car rental business is highly competitive, but companies have a common cause in promoting EV charging station infrastructure.⁴⁸ Though actual numbers are hard to obtain, collectively they will have the biggest impact on EV penetration on Maui in the next two years. Because their fleets disperse across the island from a home base, and recharge elsewhere, they also have the greatest ability to influence the charging station infrastructure across all sectors.

5.5 CAR SHARING FLEET DEPLOYMENT

Car sharing is a special case of car renting, one that is based on renting cars at hourly or by-the-minute rates instead of daily or weekly rates. Car sharing is designed for shorter periods of use and greater flexibility and convenience of reservation and access. Car sharing companies have been successfully operated out of hotels and at universities and colleges, and in major urban areas such as San Francisco, Washington D.C., New York City, and Honolulu. Zipcar, the leading car share company, uses hybrid not plug-in electric vehicles. Traditional car rental companies, such as Hertz, also have entered the car share market, some with electric car options.

The first car share company to operate in Hawai'i, GreenCar 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 several major hotels, including Hilton and Doubletree. It was on track to have six locations on Kaua'i and O'ahu by mid-2012, but has not yet opened any locations on Maui.⁴⁹

In November 2012, GreenCar announced a partnership with Roberts Hawai'i, a provider of bus and shuttle service. The partnership will give visitors a "sustainable, full-circle transportation solution with an express shuttle to and from the airport and car-sharing at the hotel."⁵⁰ Given that Roberts Hawai'i is the state's largest tour and transportation company, it is likely that this partnership will spread and benefit visitors on other islands if the initial market investment proves profitable.

The Enterprise Rent-A-Car car sharing program, WeCar, was launched at the University of Hawai'i Mānoa campus in September 2012. It is unknown whether they are intending to open branches at other campuses or on other islands.

⁴⁸ A complete list of car rental companies on Maui is available at <http://www.mauileisureguide.com/maui-car-rentals.htm>

⁴⁹ Electric car rental firm expands to O'ahu. (2011, December 3). Retrieved from <http://www.hawaiienergyinitiative.org>

⁵⁰ Roberts Hawai'i and GreenCar partner to take cars off the road. (2012, November 19). Retrieved from <http://www.cnn.com/id/49883245/>

In addition to tourists who want convenient use of a rental car without having to bear the cost of renting for their entire visit, car sharing can benefit residents who take public transit to work or school, but need a car periodically. Car sharing can be cheaper than renting a car because the renter only pays for time used (typically \$12-\$20/hour). In some cases, the rental is paid for by an employer as part of transportation incentives. Because the car sharing fee usually covers insurance, mileage, and charging, car sharing could offer a viable option to car ownership, especially for students and others living on a limited income.

Car sharing could also be part of a multi-modal solution for Maui’s public transportation system, helping to solve the “last mile” issue by extending range beyond bus routes. Ridership on the public Maui Bus fleet, operated by the County of Maui, now exceeds 2.7 million passenger boardings per year—a dramatic increase since 2007. However, the bus system still does not serve some areas.⁵¹ If car sharing is implemented on Maui by Green Car or one of its competitors, it has the potential to reach underserved areas, and to add EVs and charging stations to the island’s inventory.

Finally, as mentioned elsewhere, the Japan-U.S. Smart Grid Demonstration Project includes an EV impact study which will require a target of 200 participating EV volunteers (private and fleet owners), and is scheduled to begin in 2014. To ensure that adequate numbers of EVs are enrolled in the study, NEDO partner Hitachi is exploring possible leasing and/or car sharing projects to make EVs available to a cross-section of stakeholders. Three Nissan LEAFs have already been leased in September 2012 for the purpose of EV promotion.

Table 5.4 below shows a predicted increase in EVs for Maui County, based on available information from local car rental companies, the likely addition of a car sharing company, and the addition of Smart Grid demonstration vehicles. Though these are moving targets, they provide some sense of how EV deployment may unfold.

Table 5.4 Potential Cars for Rent/Lease by Car Rental, Car Sharing, and Smart Grid Demo. Project

Source	Current # of EVs	2013	2014	Total # of EVs by end of 2014
Car rental	6+	420*	220*	646
Car sharing	0	5	20	25
Smart Grid	0	15*	0	15
Total	6	440	240	686

*Estimates based on interviews conducted by Maui EVA

⁵¹ Federal grant helps Maui Bus meet ridership demands. (2012, July 20). Retrieved from <http://mauinow.com/2012/07/20/federal-grant-helps-maui-bus-meet-ridership-demands/>

5.6 EV TOTAL PROJECTION FOR 2013-2014

As this discussion has shown, estimating increases in EV ownership, even for a short-term two-year period is difficult. But if likely scenarios are addressed, it is possible that Maui will have anywhere from:

- 200 (an unlikely conservative scenario, driven primarily by slow growth in the personal ownership category and no growth in fleets), to
- 1,000 or more EVs (a more likely and optimistic estimate, based on increased rate of growth in personal ownership and the addition of an EV car rental business, EVs for Smart Grid demonstration project, and a possible car sharing fleet franchise) by the end of 2014

The car rental categories are likely to overtake individual EV ownership, though that relies heavily on the planned opening of one car rental company. Other companies and fleets were not yet willing to commit to or share information about planned use of EVs, but off-the-record conversations suggests that plans are under serious discussion. In a small rural environment such as Maui, the actions of a single company or agency can dramatically impact the penetration rate.

Corporate/agency fleets, because they include utility and specialized vehicles that are not yet in production with EV options, are likely to lag for the foreseeable future, but that will change as soon as trucks, vans, and ultrafast charging become available.

This scenario suggests that planning for Maui County should continue to focus on developing charging infrastructure that benefits the visitor industry, as a strategy to rapidly achieve mass deployment of EVs and EV charging infrastructure. Hotel and lodging accommodations and the numerous tourist destinations, especially sites that are fully publicly accessible, serve both visitor and resident needs. The visitor industry is better organized and networked than other sectors in Maui County, and has a financial incentive to innovate. Residential ownership and workplace fleets should not be ignored, however, as they will eventually overtake and outnumber rental fleets.

5.7 RECOMMENDATIONS

The following recommendations have been developed with the goal of encouraging rapid deployment of EVs in Maui County. They will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning.

At the Federal and State Levels:

- Update the DMV tracking system so highway-ready EVs are tracked separately from other EVs and by County and island (Maui, Moloka'i, and Lāna'i). Make this information up-to-date and publicly-accessible to encourage and assist planning efforts

- Provide other incentives for government agencies and non-profit organizations to purchase EV fleet vehicles and provide charging stations for employees
- Require or establish preferences for EV purchases under contracts, subcontracts, and grant funding

At the County Level:

- Identify County fleet vehicles that could be replaced with EVs

For EV Manufacturers:

- Develop an increasingly broad array of EV models, with greater attention to utility and specialized vehicles
- Continue to identify Hawai'i as an early introduction site for new models and provide distribution in line with demand

For Fleet Owners:

- Investigate fuel use, maintenance costs, and other lifetime asset costs to better understand benefits of EVs vs. traditional combustion engine vehicles
- Identify fleet vehicles that could be replaced with EVs
- Install charging stations for fleet vehicles, customers, clients, and employees

For the Visitor Industry and Other Businesses:

- Develop and market eco-tourism programs that highlight EV use
- Encourage members to install charging stations, especially at (and on the way to) visitor destinations on the East side: Upcountry, Hana, and Haleakala
- Encourage members to add EVs to hotel and business fleets
- Advertise the availability of charging stations and offer specials for EV drivers
- Encourage EV car share companies to open local branches

For Auto Dealers:

- Work with manufacturers to stock adequate inventory for sales and demonstration
- Provide attractive purchase and leasing terms to encourage first-time EV ownership
- Promote the affordable, pre-owned EVs made available when leaseholders return three-year old vehicles at the end of their leases
- Provide consumers with information on EV benefits and incentives, including:
 - Total cost of ownership

- Tax rebates or credits
- Special utility rates and incentives
- Combined EV and PV ownership
- EV parking laws
- Provide consumers with information on charging station models, public charging station locations, Better Place memberships and Electric Auto Association memberships at the point of sale
- Continue to expand the visibility of EVs by providing demonstration vehicles and test drives at community events

For Car Rental Companies:

- Work with accommodation providers, professional associations, and visitor destinations to help increase charging station infrastructure by:
 - Providing updated EV fleet numbers
 - Facilitating charging station installations

Chapter 6

Deploying Charging Infrastructure

To achieve mass deployment of electric vehicles in Maui County, the needs of two very different groups must be met: residents and visitors. The latter is significant, as on any given day approximately 25% of Maui County’s population are visitors—over two million annually.⁵²

Residential EV owners are likely to have access to charging at home, which for many drivers will be sufficient for their daily driving needs, especially if they live and work in Central or South Maui and drive less than 40 miles to and from work. For these residents, a robust public charging infrastructure is a benefit, but not a requirement. Those residents who live “upcountry” or in more remote areas from Central Maui, and cope with elevations and longer distances in their daily commutes, will need at least minimal access to public charging stations in key areas to manage.

For visitors renting an EV, however, a robust public charging infrastructure is a requirement. Visitors should be able to charge their vehicles while at their place of lodging (primarily hotels and condominiums), and recharge at various tourist and public destinations when out touring. They should not be inconvenienced or made anxious by distant or difficult to locate charging sites. And, as they are unfamiliar with Maui, they should have readily accessible information about charging station facilities, consistent and uniform signage to help them locate the stations while driving, and understandable directions for individual charging station use. In addition, there needs to be adequate charging infrastructure to prevent waiting once they arrive at a charging station facility. All of this requires careful planning, coordination among various Maui stakeholders, public outreach and education, and a willingness by property owners to invest.

Maui faces several unique regional issues specific to its economy and geography. This chapter will discuss these issues and make recommendations, based both on what is needed and known to date, including:

- Electric Vehicle Supply Equipment (EVSE) manufacturers and models available currently, and those planned for the near future
- Publicly-accessible information for tracking charging station installation
- Stages of EVSE deployment
- Public charging stations, existing and proposed
- Workplace charging stations, existing and proposed

⁵² 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. County of Maui. (2011). *Maui County Data Book*. Retrieved from <http://hisbdc.com/BusinessResearchLibrary/MauiCountyDataBook2011.aspx>

- Residential charging
- New business models to accelerate EVSE deployment

A list of recommendations for EVSE deployment are included at the conclusion of the chapter.

6.1 EVSEs AVAILABLE CURRENTLY AND IN THE NEAR FUTURE

The National Electric Code specifies the three levels of chargers. Level 1 is a standard, grounded 110/120 volt outlet, and most but not all EVs use Level 1 charging. This provides the slowest level of charging to EV owners with private access at home, and to drivers at other venues where safe access to an external electrical outlet is available. Charging times for Level 1 range from 8 to 20 hours for a full battery recharge, depending on the battery size and type. Level 2 uses 240 volts, providing a quicker charge in 4 to 8 hours. Most commercial and publicly-accessible charging will be via Level 2. Much quicker than Level 2, DC fast chargers use direct current and 480 volts, and in some cases provide a charge in as little as 15 minutes. Levels 1 and 2 are preferable for routine charging, and fast charging is best used while driving, when extra charging is needed to ensure return to the home port.

At present, eight different manufacturers and models of Level 2 charging stations operate in Maui County: Better Place, AeroVironment, Eaton, Schneider Electric, Coulomb, Pep Station, Blink, and GE. Hitachi's quad port fast charging stations are expected to be introduced in 2013. The CHAdeMO plug specification is used in several Japanese cars, including the Nissan LEAF. A different configuration, approved by the Society of Automotive Engineers, is used by European and American-made vehicles.⁵³

Figure 6.1 Charging Station Designs by GE WattStation (in two colors), AeroVironment, Coulomb ChargePoint, and Better Place



⁵³ Thomason, M. (2012). EV charging station levels. Retrieved from <http://www.pluginrecharge.com/2009/08/charging-station-levels.html>

Ideally an EV driver should be able to access a charging station, and charge his or her EV without much more effort than filling up at a gas station. But with the diversity of EVSE companies and models come challenges, particularly for visitors. For example, each company uses a different access scheme and billing process. Better Place charging stations use a key fob obtainable through a Better Place membership.⁵⁴ AeroVironment also uses key fobs, but the key fobs can only be used for a charging station at a particular location; they are not interchangeable. Eaton and Coulomb both have credit card 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 for EV drivers, especially visitors who may be driving and charging an EV for the first time, or may not be familiar with locally-installed charging stations, even if they have familiarity with EVs at home.

This lack of standardization will become an issue as more charging stations, from an even greater variety of manufacturers, are installed. An adequate public charging infrastructure also will require clear guidelines for the right to access, the right to use, and payment procedures.

6.2 TRACKING SYSTEM

The deployment of EVSE charging infrastructure requires an effective and efficient way for the public, planning and regulatory agencies, and various information services (such as web-based applications) to track new charging stations as they become available. Currently there is a delay in learning about newly-commissioned charging stations as the national database of the Department of Energy's alternative Fuel Station Locator (<http://www.afdc.energy.gov/locator/stations/>) relies on charging hosts to self-report and aggregators to submit data. At present, there is no incentive or requirement for hosts to report or make available this information. As such, charging station access information is not complete.

Until a universal system is available (such as the one in development with National Renewable Energy Lab and Google),⁵⁵ a local solution is needed. The Maui County permitting process requires electrical permits for the installation of any charging station, Level 2 and above, and this information is available through the KIVA permit system, which is a publicly-accessible database (also see Chapter 8 for more information about the permitting process).⁵⁶ The KIVA system is not designed for use by drivers, and would require a mediating interface to be useful—however, it does provide a one-point source for information that is not dependent on individual input by property

⁵⁴ 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. O'Connor, M. C. (2008). RFID is the key to electric vehicle recharging stations. *RFID Journal*. Retrieved from <http://www.rfidjournal.com/article/articleview/4464/1/1/>

⁵⁵ Google Maps adds electric vehicle charging stations. (2011, March 13). Retrieved from <http://green.autoblog.com/2011/03/13/google-maps-electric-vehicle-charging-stations/>

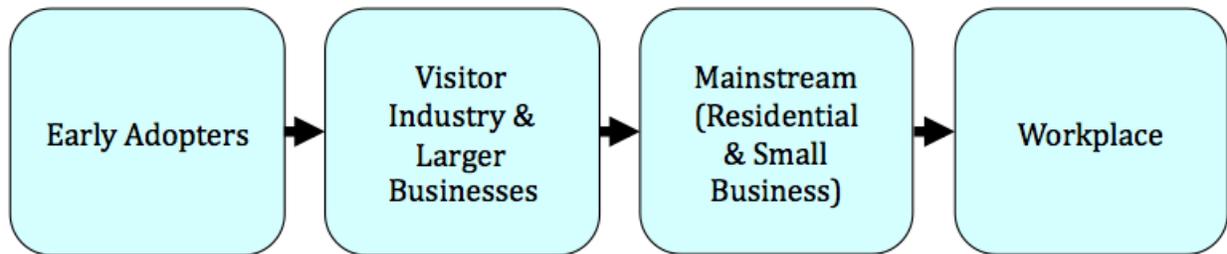
⁵⁶ The KIVA permit search engine for Maui County can be found at <http://kivanet10g.co.maui.hi.us/kivanet/2/>

owners. At the time of this report, there have been 47 permits issued charging stations in Maui County.

6.3 STAGES OF EVSE DEPLOYMENT

EVSE deployment on Maui will likely take place in several stages, similar to the early adopter model for EVs:

Figure 6.2 Predicted Adoption Sequence on Maui by Sector



Source: Maui EVA

Stage 1: Early Adopters. The earliest adopters will be “green-minded” individuals with higher incomes and those who will install charging stations in support of their business or organizational goals, such as auto dealerships and pioneering car rental companies. Others may include government agencies with energy-related programs that receive support for installation, such as utility companies, educational institutions, and county governments. Businesses which have access to subsidized installations from manufacturers and government grants also fall into this category. These installations will provide valuable information and lessons learned, but will serve a small portion of the public need. This stage has already occurred on Maui.

Stage 2: Visitor Industry and Larger Businesses. Once initial government subsidies are depleted, EV ordinances—such as Hawai‘i’s law requiring one EV parking space with access to charging for each 100 parking lot spaces—will serve as the primary motivation for larger companies and organizations to bear the cost of installation. State, county, and other public agencies and institutions will be particularly compelled to comply with such ordinances.

Stage 2 will also include larger businesses that see a competitive advantage or profit potential. On Maui this will be true of visitor industry companies such as large hotels, tourist attractions, golf courses, rental car companies which did not participate in Stage 1, and other businesses that serve early adopters or work with other businesses that have an interest in EV adoption. Even retail stores may see a benefit to providing charging: Forbes Magazine has reported that “drivers who

plug in at big box stores that offer free charging spend twice as long shopping as the average customer.”⁵⁷

Private residential installations will also increase, especially in more affluent neighborhoods where EVs are likely to be purchased first. Maui is currently in Stage 2.

Stage 3: Mainstream. As charging stations become more visible in the transportation landscape, and EV drivers more numerous, additional businesses and organizations will voluntarily install charging stations. Enforcement of EV parking laws will force others to add charging stations, similar to the manner in which ADA parking spaces became universally adopted. This will include multi-unit dwellings, as property owners in townhouses and multi-unit dwellings cannot be prevented from installing charging stations for their parking stalls by HOA regulations, covenants, or bylaws (Hawai'i Act 186 HRS 196-7.5, 2010). Larger businesses and organizations will begin to add EVs to fleets, which will also require charging stations. EVs will become widely adopted by private owners. Maui may reach Stage 3 as early as 2015, depending on the rate of increase by the visitor industry in Stage 2.

Stage 4: Workplace. Finally, mass adoption of EVs, more competitive pricing of charging systems, and cheaper, more efficient technologies will allow more individuals and organizations to install charging stations, including in situations where compliance is not required. Charging at workplaces, churches, schools, and other sites where profit motive is not a strong incentive will become widely available, as employers and property owners are willing to embrace what by then will be accepted basic facilities, and because smart grid technologies may be part of a building's energy system.

Maui County has moved successfully through Stage 1. Success in Stage 2 will depend on 1) enforcement of EV ordinances, 2) education and outreach to businesses regarding benefits of installing EV charging stations, and 3) streamlining the permitting processes to facilitate installation by residents and small business owners who have an interest in adopting and promoting EVs.

6.4 PUBLIC CHARGING STATIONS ON MAUI, EXISTING AND PROPOSED

During the preparation of this report, the charging infrastructure on Maui has more than tripled: from six Level 2 charging stations (at Maui Electric Company, at local auto dealership Jim Falk Motors, and at Alamo/Enterprise Rent-A-Car) to over 20 publicly accessible stations. Many more are in process. Recent installations include:⁵⁸

⁵⁷ Woody, T. (2012, June 18). Automakers, tech companies mining electric car big data to plot industry's future. *Forbes*. Retrieved from <http://www.forbes.com/sites/toddwoody/2012/06/18/automakers-tech-companies-mining-electric-car-big-data-to-plot-industrys-future/>

⁵⁸ Charging Stations on Maui. (n.d.). Retrieved from <http://mauieva.org/docs/ChargingStationsonMaui.pdf>

- AAAAA Rent-a-Space
- County of Maui
- Elleair Golf Course
- Four Seasons Resort
- Hyatt Regency Maui
- Kahana Gateway
- Kihei Town Center
- Manele Bay Hotel
- Ritz Carlton Kapalua
- Maui Memorial Medical Center
- Maui Ocean Club
- Sheraton Maui
- Walmart
- Westin Maui

This list of businesses follows the stages described above. The first wave belonged to the auto industry and involved government agencies and energy companies. The second wave has come primarily from businesses taking advantage of the State of Hawai'i's EV Ready Program (ARRA funds), which provided free on-site consultations by Better Place and AeroVironment to early adopters. Many of these businesses, such as the hotels, golf courses, and malls see a competitive advantage in offering charging services to visitors.

6.5 RECOMMENDED CRITERIA AND LOCATIONS FOR CHARGING LOCATIONS

As part of this planning process, the Maui Hotel and Lodging Association, in coordination with the Maui EVA Visitors Working Group, developed a list of criteria to guide the selection of sites for the installation of publicly-accessible charging stations on Maui. The criteria include:

- Are free public parking lots with easy access to stalls (no paid parking lots)
- Have access to electrical power
- Are strategically positioned at various locations across Maui
- Are sites where there is something for people to do while waiting to charge the EV
- Include some kind of security patrol
- Are not over-crowded lots
- Are not isolated areas, so as to reduce the risk of vandalism

The group identified 166 tourist destinations as locations that need to provide at least one charging station per 100-parking spaces, in compliance with the EV parking law (Act 89/SB2747, 2012, Section 291-71, Hawai'i Revised Statutes). These include:

- 31 Hotels/Resorts/Timeshares (does not include condos)
- 10 Public Golf Courses
- 15 Shopping Centers & Attractions
- 8 State Parks
- 103 County Parks

However, many of these sites had issues according to the identified selection criteria, for example, they lacked access to electric power or were vulnerable to vandalism.

The group also identified criteria and locations for DC fast charging stations on Maui. The criteria included, in addition to the general criteria for charging stations:

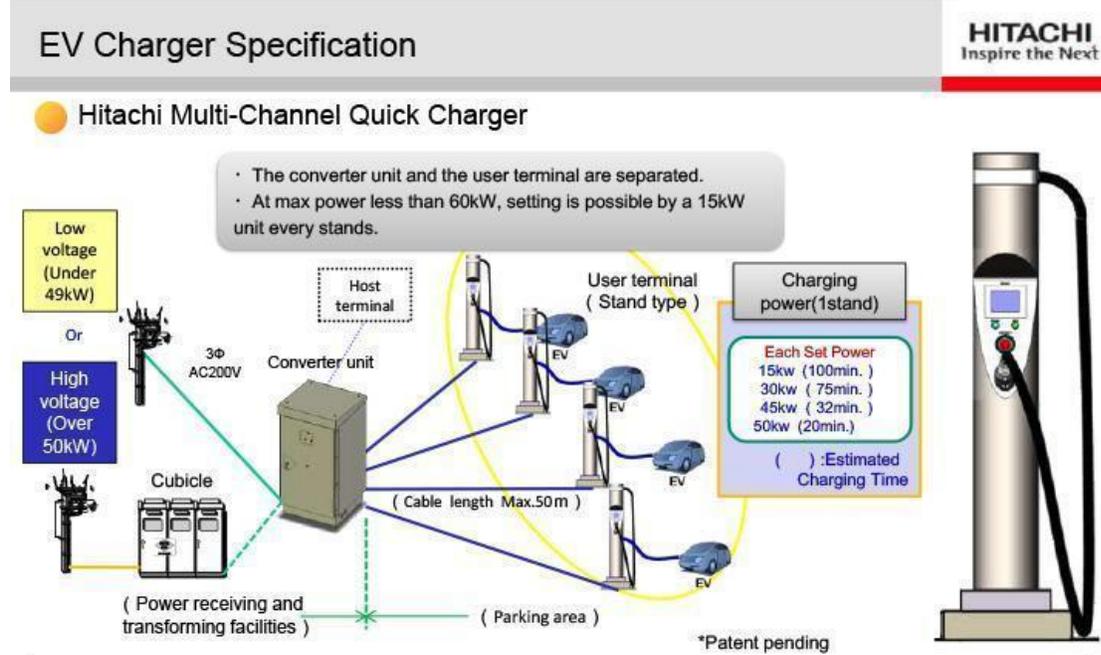
- Serves a highly populated area
- Does not duplicate coverage (no more than one location in any given community)
- Does not present special issues of safety and security (e.g., near a school or playground, in an isolated location)

Based on these criteria, the Maui EVA Visitor Industry Group critiqued and ranked potential sites and then reduced them to a list of sites best suited to support DC fast charging stations:

- Area A: Central Area (Kahului, Wailuku, Maalaea)
 - Walmart
 - Kaahumanu Shopping Center
- Area B: West Side (Lahaina, Napili, Ka'anapali)
 - Lahaina Cannery Mall
 - Old Lahaina Center
- Area C: South Maui (Kihei, Wailea, Makena)
 - The Shops at Wailea
 - Kihei Piilani Shopping Center
- Area D: Upcountry (Pukalani, Kula, Makawao)
 - Pukalani Terrace Shopping Center
 - Longs Drug Store
- Area E: East Side (Hana)
 - Hana Community Health Center (near airport)
- Area F: North Shore (Paia, Haiku)
 - Paia Community Center
 - Haiku Community Center

This information will be useful for companies and other agencies wishing to install fast charging systems on Maui. For example, as this report was being prepared, Hitachi received Underwriter's Laboratory (UL) certification of its multi-channel DC fast charging station. These "quad-port" (four-way) charging systems will be appropriate for heavy-use, publicly-accessible sites. The figure below shows how the multi-channel charging station is configured:

Figure 6.3 Hitachi Quick Charging Station Specification



Source: Hitachi 2012

DC fast charging stations placed strategically throughout Maui County will be needed as the demand for charging infrastructure increases in the years ahead. They will serve residents and visitors alike, and will accelerate mass adoption of EVs.

6.6 WORKPLACE CHARGING

Workplace and multi-unit dwelling charging of electric vehicles are still in their infancy in Maui County. No government agency, large corporation, or nonprofit organization has yet adopted an EV fleet. Without fleet purchases, workplace charging will be driven primarily by employee ownership, and the numbers of EVs on Maui are still too low to drive demand for Level 2 charging at the workplace. Some workplaces may offer Level 1 charging as an interim solution.

There are two notable workplace installations, however: one complete and one in process. Maui County and UH Maui College are two of the largest employers on Maui. The County recently installed a DC fast charging station, which is available to the public as well as employees. UH Maui College will also be installing four dual-port charging stations in its 800-space parking lot, and a self-standing, solar-powered carport in Spring 2013. These will be publicly-accessible, and are anticipated to be heavily used, given the campus size of over 4,000 students, and 500 faculty and staff. The ARRA-funded Better Place Level 2 dual-port charging station at the University of Hawai'i Mānoa (on O'ahu) is the one of the most used of all 154 Better Place charging ports currently in the state of Hawai'i.

Providing employees an opportunity to charge EVs at the workplace will require further study as EVs become more prevalent on Maui. However, employer-provided charging access is expected to encourage employee EV purchases, improve retention of employees who drive EVs to work, and attract new employees with EVs—that is, charging access will become an employer amenity. In the foreseeable future, the primary motivator for workplace charging may be Hawai'i State Law SB2747/HD2, requiring one EV parking space for properties with at least 100 parking spots.

6.7 RESIDENTIAL CHARGING

The majority of EV owners have thus far opted for Level 1 charging at their homes. Upcoming changes in technology and accompanying cost reductions are likely to increase the installation of Level 2 charging stations by residential customers. Level 2 charging stations are now available at Lowes, Home Depot and other retail outlets, and even online, for under \$1,000. The development of mobile charging stations, which are just now hitting the market, may introduce new opportunities as well as new issues.

Maui Electric Company (MECO) offers two kinds of time-of-use tariffs to residential customers. The TOU EV rate uses a single “whole house” meter and does not require the customer to purchase additional electrical infrastructure for a second meter. The other TOU rate requires the installation of a second meter. Very few residential customers have taken advantage of these pilot time-of-use incentives (see Chapter 7 for a more thorough discussion). Under these rates, electricity usage during off-peak periods is much cheaper, but usage during peak periods is charged at higher than standard rates. Though MECO provides the second meter, the expense of hiring an electrical contractor to install it, and the paperwork required for the permit, may be significant enough obstacles to dissuade most residents.

6.8 NEW BUSINESS MODELS FOR EVSE DEPLOYMENT

The current method for deploying charging station infrastructure is piecemeal, fragmented, and slow. The lack of standardization between different manufacturers and models is confusing for the user, and acknowledged within the industry as an obstacle to faster adoption. As discussed in other chapters, there are also issues of initial expense, difficulty with permitting, concerns about rapid obsolescence, and site-specific challenges of zoning and installation. Each of these issues will require attention at the federal, state, and local levels, as well as by manufacturers of EVs, outreach and education by educational institutions and agencies, and attention by local media. Some of these issues will require case-by-case solutions, but whenever possible, broader streamlined solutions are preferable.

Listed below are business models that have worked elsewhere and should be investigated for applicability in Maui County:

Table 6.4 New Business Models to Accelerate and Simplify EVSE Deployment

Business model or method	Description	Benefits	Considerations
Request for Proposals (RFP) for charging station vendors	The Office of Sustainability of the County of Los Angeles made a Request for Proposals (RFP) to charging station vendors on behalf of all public agencies installing workplace, fleet, and/or public EVSEs.	Standardization. Transparency. Everyone benefits. [Current piecemeal method takes too long, pricing is confidential.]	Who will initiate an RFP? Who will liaise, coordinate, and administer?
Sponsors pay for advertising on charging stations	<u>Volta Industries</u> in O’ahu has introduced a successful business model for Level 2 charging stations at shopping malls by getting advertisers to pay.	A third party (the installer) initiates and bears the cost of installation, equipment, operation, and maintenance, all or part of which is funded by advertising.	Acceptable locations for advertising. Charging station as billboard-size and display type.
Build, own, operate	<u>Charge Bliss</u> builds, owns, and operates fast charging stations, so that property owners pay a subscription fee which they can choose to pass through to customers (EV users).	Minimization of work and responsibility for property owners.	Installation costs vary (depending on location, panel load, access to power, etc).
Third party as integrator: Hitachi Smart City	Hitachi’s AEC subsidiary has installed all varieties of fast charging stations on Okinawa and gets its revenue from usage.	One access method is used for all charging stations. Billing at end of the month. Property owners get benefit of EV driver patronage.	Requires broad coordination of multiple sites.

The Hawai'i EV Ready Guidebook provides additional information for commercial EV charging station installations.⁵⁹ Also see the Honolulu Clean Cities report on lessons learned from O'ahu.⁶⁰

6.9 RECOMMENDATIONS

The following recommendations have been developed with the goal of encouraging rapid deployment of EVSEs in Maui County, especially Level 2 and higher charging stations. They will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning.

For Manufacturers and the Society of Automotive Engineers:

- Collaborate on uniform charging standards that apply to all EVs and EVSEs
- Develop intuitive, easy-to-use interfaces across platforms

At the Federal and State Level:

- Provide additional incentives to government agencies, businesses, and nonprofit organizations to add charging stations for employees, customers, and fleet purchases
- Disseminate information on available charging station locators, including mobile applications, directories and guidebooks

At the County Level:

- Transmit information on the location of new public charging stations at county facilities to the State Energy's charging station locator database (or other recognized information providers) so consumers and mobile applications have access to the most current information
- Explore ways for property owners to share key information on charging station locations, including:
 - Guidance on and downloadable forms for permits needed, including application forms and checklists of required documentation and information for:
 - Maui Electric Company (MECO) "New Service" request
 - Electrical permits
 - Building permits
 - Ability to upload maps, photos, and design/construction documents (as required for the permitting process)

⁵⁹ Hawai'i EV Ready guidebook for commercial EV charging station installations. (2012). Retrieved from http://energy.hawaii.gov/wp-content/uploads/2011/09/EV-Guidebook_FINAL_Oct_3_12.pdf

⁶⁰ Honolulu Clean Cities. (2012, October). *Lessons Learned: The Early Adoption of Electric Vehicle Charging Stations from the Perspective of O'ahu's Commercial Properties*. Retrieved from <http://honolulucleancities.org>

- Guidance on and downloadable forms for permits needed for any required special permits
 - Flood Zone
 - Special Management Area permits
- Guidance (by the State or other agency) on appropriate signage, parking stall markings, and illumination.
- Link to ADA regulations
- Other federal, state, county, or other agencies with information useful for EV owners and property owners
- Link to certified electrician resource or referral service (State)
- Link to an updatable map of publicly-accessible charging stations
- Information for new commercial charging station owners regarding registering and publicizing their stations with federal, state, and independent databases
- Send representatives to state and other local meetings to discuss best practices and changing challenges of EV charging infrastructure

For Educational Institutions and Organizations:

- Develop an “EVSE 101” course for property owners, fleet owners, business owners, and others covering the benefits, incentives, and processes for installing charging stations and transitioning to EV fleets
- Conduct site visits or surveys for businesses regarding EV benefits and charging station options, to raise awareness

For the Visitor Industry and Other Businesses:

- Investigate the competitive advantage of offering EVSE as an amenity to guests and the public
- Encourage multi-site permits by installers
- Encourage online applications or use of “permit runners” to speed up permitting processes at County

Chapter 7

The Utility Grid

Maui Electric Company (MECO) is Maui County’s only electric utility company, a regulated investor-owned utility with parent Hawaiian Electric Company (HECO). MECO serves all of Maui County which includes the islands of Maui, Lāna‘i, and Moloka‘i.

At the core of any utility company’s service is the ability to deliver energy to customers when they need it at whatever amount they need. Customers assume, when they flip a light switch or plug in an electrical device, that the energy will be there. But there is a complex infrastructure and a system for predicting what those needs will be that is invisible to most consumers. When a system lacks sufficient energy to meet demand, unintentional brownouts can result in a sag or drop in voltage. Too much demand can also overload circuits and cause a complete shutdown, or blackout. Because neither brownout nor blackout is desirable, utilities monitor demand carefully to establish the load curve that occurs during a 24-hour cycle, and establish targets for the production they need to generate in order to meet potential demand.

Compared to states with more distinct seasons, the mild climate of Hawai‘i results in a fairly consistent load curve throughout the year. The challenge faced by utility companies that service Maui and other islands is their isolation. Most utility companies on the mainland can connect with other energy sources, even across state lines, and share excess energy when production exceeds demand or purchase energy when demand exceeds production. With an isolated grid, MECO needs to have sufficient reserves and flexibility to meet the island’s demand independently, through the full load curve. It has no backup.

Even in isolation, MECO currently has more than adequate capacity to meet demand, and welcomes the addition of electric vehicles (EV). Plans for system upgrades are focused not on increased capacity, but on a rapid shift from fossil fuel to wind and solar—both variable sources of energy. While the mass deployment of EV will increase demand for energy, EV batteries also have the potential to provide back-up storage that will allow Maui’s isolated grid to absorb more renewable energy without disruption in service. This is a win-win situation for Maui and MECO in the effort to become less dependent on imported fossil fuel.

This chapter examines the following:

- Existing utility generation and the potential for renewables
- Challenges posed by renewable energy sources
- The impact of EV
- Incentives for off-peak charging
- The role of smart grid technology

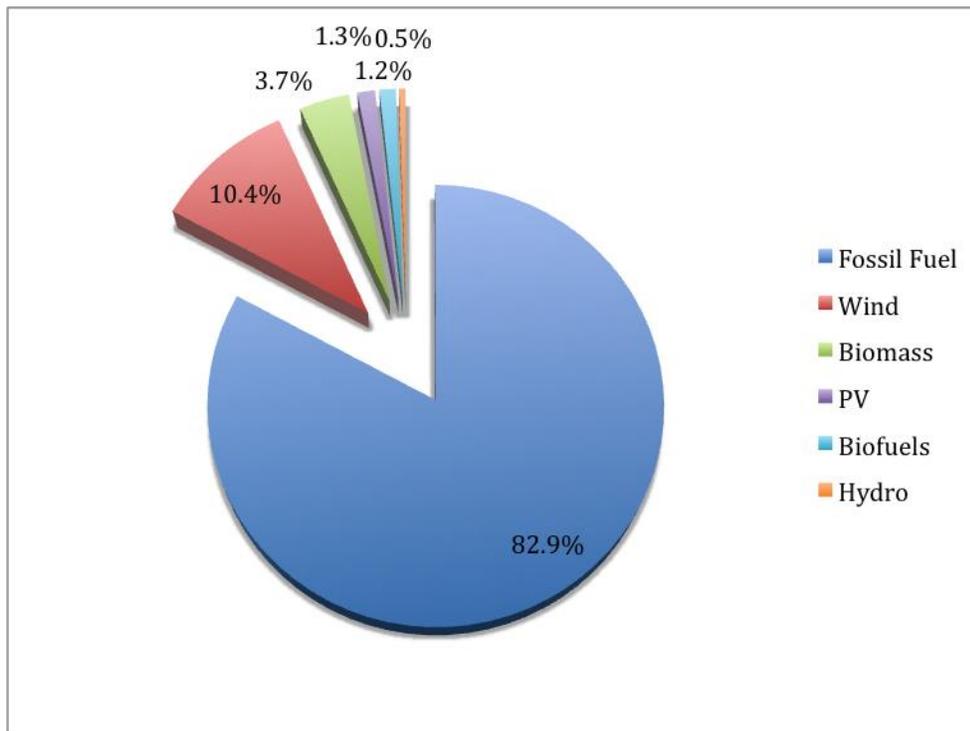
Recommendations are listed at the end of this chapter.

7.1 EXISTING UTILITY GENERATION AND THE POTENTIAL FOR RENEWABLES

The cost of electricity in Hawai'i is directly related to the high cost of importing fuel. Despite an abundance of renewable resources, Hawai'i imports 86% of its energy in the form of fossil fuels. Of the total energy needed, 36% is used for power generation, 15% for industrial use, and the remainder in transportation.⁶¹

Only a small percentage of Maui's electricity comes from renewable sources. These include wind, solar, biofuels, biomass from the burning of sugarcane "bagasse," and hydro from a small "run of the river" turbine-generator plant built at least 75 years ago for plantation mills. Figure 7.1 below shows relative contributions from each source.

Figure 7.1 MECO Energy Mix Based on Total Sales = 1,181,026 mWh for 2011



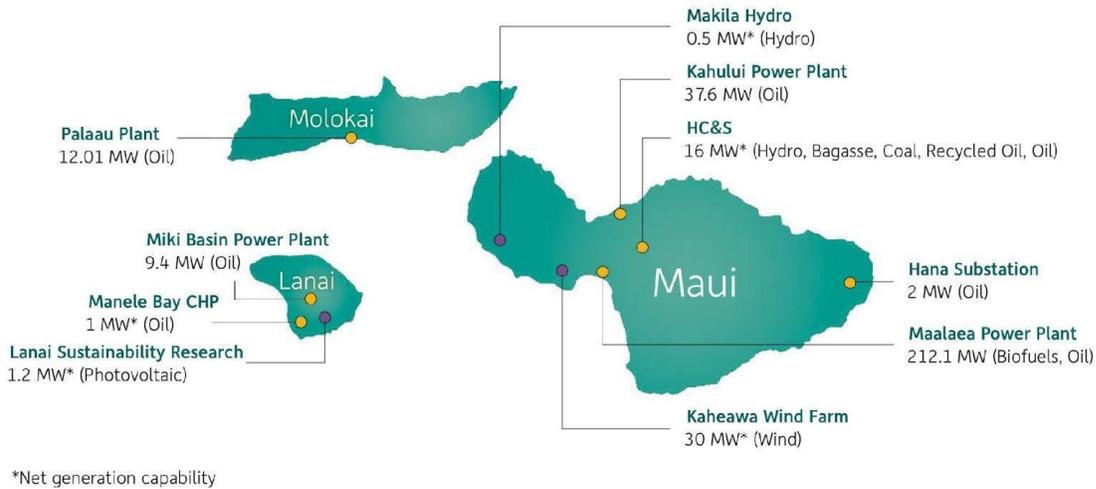
Source: HECO (2011). Renewable Portfolio Standard Status Report⁶²

⁶¹ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, November). *Monthly Energy Trends*. Retrieved from http://hawaii.gov/dbedt/main/whats_new/info/economic/data_reports/energy-trends

⁶² Hawai'i Electric Company. (2011). 2011 Renewable Portfolio Standard Status Report. Retrieved from http://www.heco.com/vcmcontent/StaticFiles/pdf/2012-05-04_RPS%20Report_2011.pdf

Energy from these sources is produced in a variety of geographic locations across Maui County, and tied into MECO's grid system, as seen on the map below, which includes power plant locations for Moloka'i and Lāna'i.

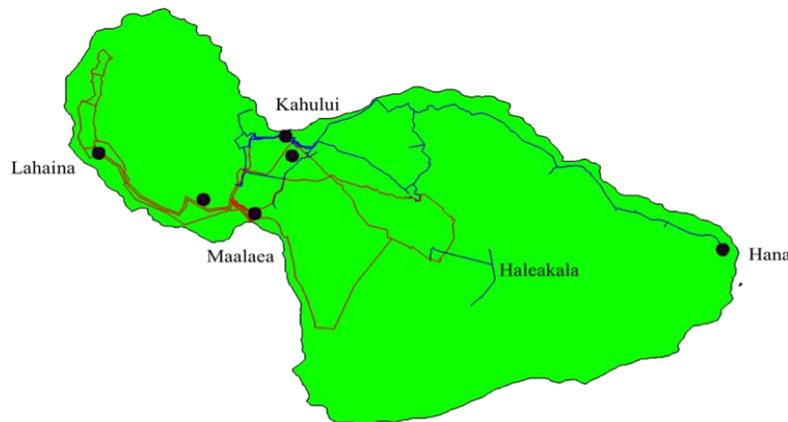
Figure 7.2 MECO Generation Mix



Source: 8th episode of Maui EVA TV, November 2012, with Mat McNeff, MECO

On the island of Maui, the delivery of electricity is available from MECO to most of the more populated areas. Where distribution is not available, residents must live off the grid, such as on the southern slope of Haleakala and in north Maui. There are also residents who choose to live off the grid even where distribution is available. Transmission lines are shown in the map below.

Figure 7.3 Maui Transmission Facilities



69kV & 23kV Transmission Lines = approx. 240 miles. Distribution Lines = approx. 1,475 miles

Source: Chris Reynolds, MECO presentation, 27 April 2012 Plug-in Maui: Challenges and Opportunities, one day conference at UHMC

According to National Renewable Energy Labs (NREL), Maui also has multiple proposed renewable generation projects, including 42 megawatts of wind energy, 6 megawatts of biomass power, and 10 megawatts of geothermal.⁶³ In addition, HCEI, identifies further resource potential as follows:

- Wind energy—67 megawatts
- Biomass energy—25 megawatts
- Geothermal energy—140 megawatts
- Solar thermal energy (exact capacity to be determined)

Although ocean energy technologies are not yet proven on a commercial scale, Maui is at the forefront of ocean energy research. The island is planning to help test and demonstrate a wave project off its north coast in the near future.⁶⁴ No doubt other possibilities will develop in the future, given the attention and research on alternative energy sources.

7.2 CHALLENGES POSED BY RENEWABLE ENERGY SOURCES

The greatest challenge for MECO is absorbing alternative energy into the generation mix from sources which are not “firm,” or available at all times for the production of electricity. In addition to the approximate 83% of electricity generated from fossil fuels, three of the other current existing sources are considered firm: biomass, biofuel, and hydro. Together, these account for a total of 88% of Maui’s energy.

Wind and solar, which together account for almost 12% of MECO’s sales in 2011, are considered “variable,” meaning that the energy may be intermittent. Both exist in abundance on Maui and the other islands of Hawai’i. However, variable energy sources challenge a utility grid because they introduce issues of unpredictability into the energy mix. If a cloud passes over a set of solar panels, their production dramatically drops. If the wind changes speed, wind turbines will produce more or less energy in response. Neither of these changes is predictable with current technologies.

MECO has to continuously balance supply and demand to maintain a stable frequency of 60 cycles per second or hertz. To accomplish this in the presence of variable sources, MECO needs other energy sources that can increase or decrease (i.e. ramp up or ramp down) their output. Today, MECO primarily does this by maintaining sufficient reserve capacity in generators that are online or can be started quickly. In the future, demand response can also be called on to help maintain this balance. This is another one of the functions that will be tested in the smart grid projects on Maui.

MECO confronts an additional challenge in adding variable renewable energy, because its primary source—wind—is more productive at night, when demand is at its lowest point and the grid least

⁶³ Arent, D., Barnett, J., Mosey, G., & Wise, A. (2009). The potential of renewable energy to reduce the dependence of the State of Hawai’i on oil; Proceedings of the 42nd Hawai’i international conference on system sciences. Retrieved from http://www.hawaii-clean-energy-initiative.org/storage/potential_of_renewable_energy.pdf

⁶⁴ Electric Power Research Institute. (2012). Mapping and assessment of the United States ocean wave energy resource. Retrieved from <http://www1.eere.energy.gov/water/pdfs/mappingandassessment.pdf>

able to absorb it into the mix. Though the most recent wind turbine installations have some storage capacity built into them (e.g., Kaheawa's Wind Farm Stage 2 turbines), they still capture only a fraction of what the turbines are able to produce.⁶⁵

Rule 14 governs the interconnection of distributed generation.⁶⁶ This rule refers to a State of Hawai'i PUC rule, based on a similar Rule 21 in California, requiring a study be conducted of the impact of new distributed generation systems on a utility grid system, if the proposed system fails a series of prescribed screens. This is a challenge for MECO because some Maui neighborhoods have already 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. In fact, according to MECO, the Net Energy Metering (NEM) program in 2011 exceeded the capacity installed in the previous 10 years combined. This is the program in which customers can tie their (mostly) PV installations into the grid and then pay only for the net amount of energy they use beyond what their system produces. In 2012, which is not concluded at the time of this report, the NEM capacity already exceeded that installed in all of 2011.

Though the saturation issue has been a point of contention for some of MECO's customers, MECO is absorbing renewable energy sources at a fast pace compared to other utilities across the nation. In 2012, the Solar Electric Power Association (SEPA) recognized MECO as the nation's top performer in Cumulative Solar installations. Since the start of its solar program in 2001, MECO has added 29.3 solar systems for every 1,000 customers. With 209.3 watts installed per customer, MECO is also ranked second in the nation in terms of cumulative solar watts per customer. SEPA's Utility Solar Rankings survey identifies the most active utilities in the country, based on the new solar power added to systems relative to the number of customers served.⁶⁷

Though increasing renewable energy resources in Maui County is critical, MECO is constrained under current conditions. It either needs to manage energy production to better fit demand, store energy produced when it is not needed to be used later when it is, or find ways to make variable energy behave more like firm energy sources. Existing technologies for storage are both limited and expensive.⁶⁸ However, the addition of EVs to the grid system provides a possible solution.

⁶⁵ First Wind. (2012, July 5). First Wind announces completion of Kaheawa Wind II Project and start of commercial operations. Retrieved from http://www.firstwind.com/sites/default/files/KWP%20II%20COD_FINAL_070512.pdf

⁶⁶ See the latest update/amendment to Rule 14 at <http://puc.hawaii.gov/news/pressreleases/2011/2011-11-29%20PUC%20Press%20Release%20HECO%20Rule%2014h%20Approval.pdf/?searchterm=interconnection>

⁶⁷ Solar Electric Power Association. (2011). 2011 SEPA utilities top solar rankings. Retrieved from <http://www.solarelectricpower.org/sepa-utility-solar-rankings.aspx>

⁶⁸ International Renewable Energy Association. (2012). Electricity storage and renewables for island power: A guide for decision makers. Retrieved from <http://www.irena.org/DocumentDownloads/Publications/Electricity%20Storage%20and%20RE%20for%20Island%20Power.pdf>

7.3 THE IMPACT OF EV

How much energy does it take to charge an EV? The fully-electric Nissan LEAF takes a charge of 24 kWh, while a hybrid plug-in Chevy Volt requires 10 kWh. Daily charging needs will depend on the size and efficiency of the battery system, the weight of the vehicle, the miles driven, the type of terrain driven, and other variables. To provide some sense of scale, the soon to be released BMW ActiveE demonstration vehicle, which takes a 28 kWh charge, will use approximately the same amount of power in a 15,000 mile year as five 100-watt light bulbs left on continuously for that same year.⁶⁹

On the island of Maui, MECO currently has the capacity to generate 264 megawatts of firm electricity. Peak demand on the system in 2012 (to date) has only reached 194.1 megawatts. According to MECO, this means that there is adequate capacity to meet the demand generated when consumers replace conventional vehicles with plug-in electric vehicles. Indeed, MECO has indicated that it welcomes additional sales, as the slowdown in construction during the economic recession from 2008 to 2012 flattened its market of new customers (E. Reinhardt, personal communication, July 2011).

MECO and Hawaiian Electric Company (HECO) studies of the potential impact of EV charging on Maui's grid include individual projects with Better Place and Hawai'i Renewable Energy Development Venture (HREDV), AeroVironment, General Electric, and the National Renewable Energy Lab (NREL). For example, NREL performed an analysis of possible EV impacts to distribution transformers, utilizing National Highway Transportation & Safety (NHTS) driving statistics for Hawai'i. Scenarios were analyzed for different types of transformers in Hawai'i's climate based upon different household power consumption profiles, EV penetration, charging rates, time-of-use rate adoption, and influence of public charging. While fast charging, especially during weekday priority peak hours or in concentrated geographic areas, puts a greater demand on the system, "HECO does not envision issues" with EVs "even at the highest forecasted adoption rate."⁷⁰

7.4 INCENTIVES FOR OFF-PEAK CHARGING

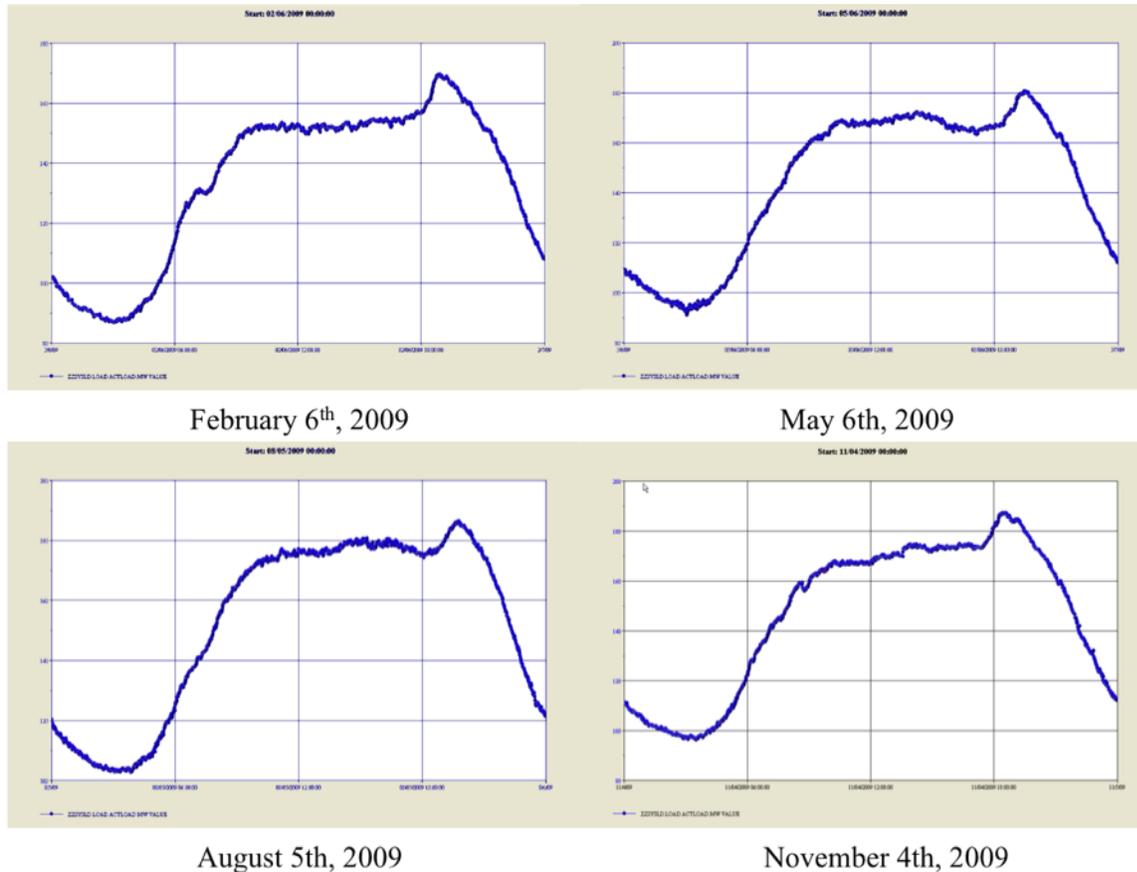
Demand on MECO's utility grid is consistent from weekday to weekend, and Maui's mild temperatures translate into little variation in load profiles throughout the year. However, demand does shift throughout a 24-hour cycle, as activity picks up during the day, peaks at around seven in the evening when people return home from work, and then drops off after most people go to sleep.

⁶⁹ How much electricity does an EV use? (2012). Retrieved from <http://activeemobility.blogspot.com/2012/05/how-much-electric-does-ev-use.html>

⁷⁰ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai'i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

As the figures below show, demand for electricity drops precipitously during the nighttime hours. This is when both residential and commercial EV owners are more likely to charge their vehicles.

Figure 7.4 Seasonal Daily Load Curves (12 am – 11:59 pm)



Source: MECO

In addition to welcoming additional sales, MECO welcomes the addition of EVs to its grid because increased demand during the nighttime has two effects: 1) it stabilizes the balance between demand and production during a 24-hour cycle; and 2) it allows MECO to absorb more wind power, which typically increases at night.

If EVs primarily charge at night, it will help smooth the load curve, and thereby increase efficiency for MECO. In the case of Maui and other Hawaiian islands, it also increases the ability of the local utility system to absorb renewable energy that is currently available, but curtailed or “dumped” because nighttime demand is insufficient. Dumping is necessary because a utility company typically cannot store the electricity it produces and use it strategically. What is not used is lost. EVs have the potential to change that because they can be charged at off-peak times.

7.5 TIME OF USE RATE INCENTIVES

Time-of-use rate incentives for EVs encourage load balancing by rewarding customers for charging their vehicles at night, during periods of low demand. According to a national report, only 6% of utilities in the U.S. offer special rates for EVs, and MECO is one of these few.⁷¹ Special residential rates include dedicated EV rates as well as time-of-use and time-of-use on separate EV meters. Special commercial rates include dedicated EV rates with and without demand charges, as well as time-of-use. Current and detailed information on rate incentives is available on the MECO website.⁷²

By May 2012, only a handful of Maui residential customers had installed some form of time-of-use meter for EV charging, all at Level 2, except one at Level 1. At the writing of this report, five months later, only one more has been added, despite the number of EVs estimated sold during this same time period (estimated at approximately 50 vehicles). No commercial customers have signed up at all. On O‘ahu, 127 customers have signed up for EV pilot rates (J. Yao, personal communication, November 2012). This raises a question as to why more customers are not taking advantage of what are significant rate incentives.

A major obstacle for customers signing up for the EV rate is the cost of installing a new meter panel. Though MECO provides the second meter, the customer must hire a licensed electrician to install it, pay for permitting, and pay for any additional work needed to ensure that the electrical line for the charging station is adequate for the new demand. Time-of-use metering also penalizes customers who charge during peak times. Customers may be opting to install PV instead, which handles the extra charging without affecting peak charging rates.

A final obstacle may be the lack of information about the cost of the various incentive options. Cost comparisons are needed for different types of charging stations and their levels of usage, such as a residential installations, and commercial installations at hotels, shopping malls, golf courses, and other publicly accessible sites. Only with this level of information can a customer evaluate the cost of installation against the lifetime savings generated by the cheaper electricity rates.

7.6 THE ROLE OF SMART GRID TECHNOLOGY

As described above, electric vehicles can serve as storage devices which can stabilize the delivery and use of renewable energy, especially wind. In the near future, use of vehicle-to-home and vehicle-to-grid systems, better known as “smart grid” technologies, may provide the communication needed between EVs and utility grid to balance the load more effectively.

Smart grid systems are currently unproven at a large scale, and when first asked about smart grid technologies, a team of MECO engineers and administrators admitted that it was unlikely they

⁷¹ Northeast Group. (2012). United States smart grid: Utility electric vehicle tariffs. Retrieved from http://northeast-group.com/reports/Utility_Electric_Vehicle_Tariffs_Brochure_NortheastGroupLLC.pdf

⁷² Retrieved from <http://www.mauielectric.com>

would be investing in this technology any time soon, as the cost to customers would be exorbitant and not enough was known about how effective such technologies might be (E. Reinhardt, personal communication, July 2011).

However, in 2011, a new development came about with the potential to change the timeline. The New Energy and Industrial Technology Organization (NEDO) of Japan signed an agreement with the State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT) for collaboration and implementation of a smart grid demonstration project on Maui.⁷³ The project was supported by HECO, MECO, the Hawai'i Natural Energy Institute (HNEI), the County of Maui, and the Maui Economic Development Board (MEDB). National laboratories and entities also joined the collaborative efforts for implementation of the project, which was named the "Japan-U.S. Smart Grid Demonstration Project." NEDO committed to investing \$37 million over a period of several years.

Maui was selected as an ideal site for a demonstration both because it suffers from the highest energy costs in the nation and because it is experiencing rapid growth of variable renewable energy. The Japan-U.S. collaboration offered MECO a unique opportunity to pilot smart grid technologies which could enhance grid stability, balance demand, and integrate the anticipated growth of EVs.

The goals for the Japan-U.S. collaboration include demonstrating smart grid technology "without any impact on the daily life of Maui residents;" demonstrating an island-wide EV management system allowing for increased use of renewables; enabling Maui to become an even more energy efficient and renewable energy friendly island; and creating a business model that can be applied to other islands and future power grids around the world (K. Takada, personal communication, November 2012).

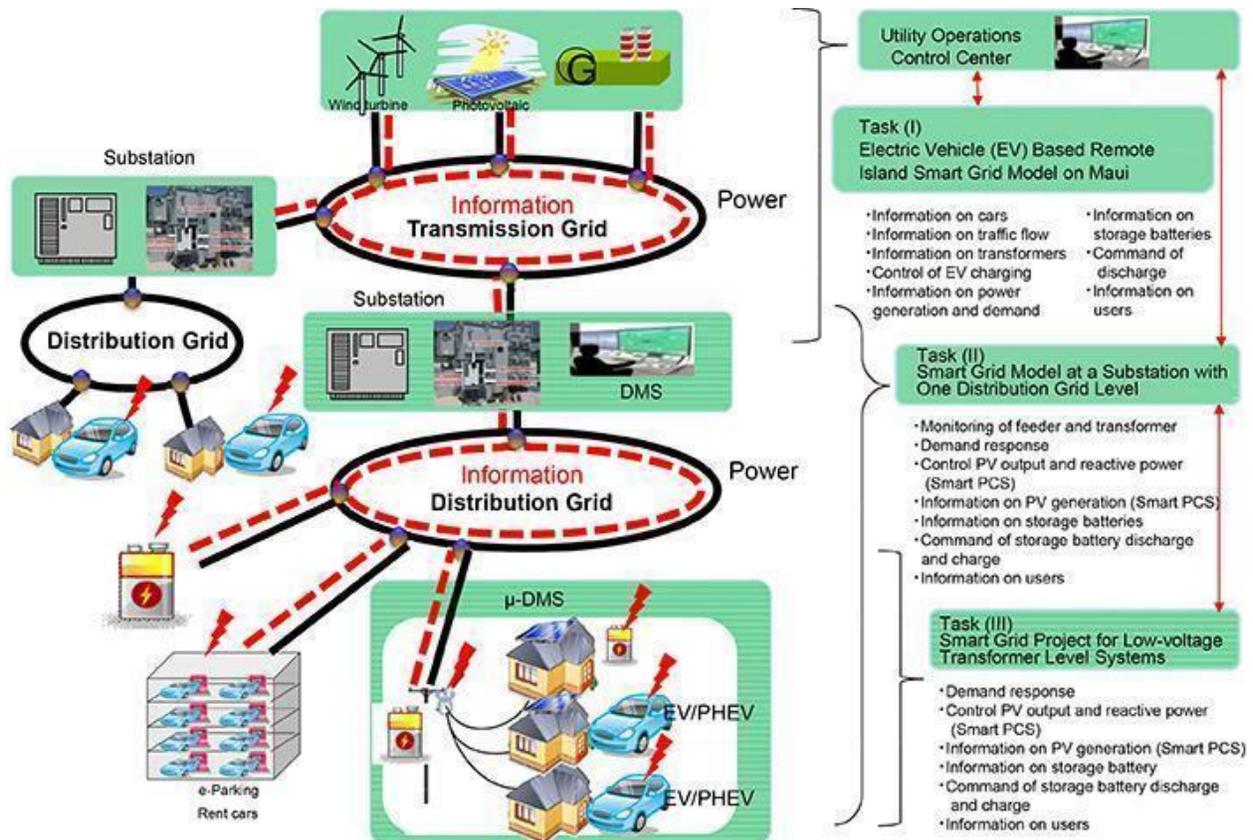
The key difference between a traditional grid system—which Maui has now—and a smart grid system, which the demonstration project will install between 2013 and 2015, is that a smart grid system communicates power demand and power resources back to the grid, so that the two can be managed. A traditional system generates power and transmits it to the user, but does not know simultaneously what the user is using. That is, a traditional system provides only one-way communication, while a smart grid system offers two-way communication that will provide MECO the ability to better manage production and demand.

The proposed EV-based remote island smart grid model on Maui will potentially mitigate adverse effects on power grids, including the impact of significant changes in power frequencies caused by the fluctuating output of renewable energy (e.g., if a cloud passes over a neighborhood causing production in the area to drop momentarily). An EV management system (EVMS) using information communication technologies will be established to control EV charging and storage batteries for power grids that serve as a substitute for storage batteries for EVs. The EVs become part of the power grid storage system, helping to even out the production and demand of energy locally.

⁷³ Governor Abercrombie signs memorandum of understanding for Japan-U.S. smart grid demonstration project. (2011, November 22). Retrieved from http://hawaii.gov/dbedt/main/news_releases/2011/news-release-1126

Finally, the EVMS will reduce effects (low-voltage transformers' overload and voltage violation) on the distribution system by charging EVs. The process is detailed in the figure below:

Figure 7.5 Maui Demonstration Smart Grid Project Overview (NEDO)



Source: Japan - United States clean energy collaboration: Smart grid demonstration project on Maui⁷⁴

The demonstration project will also be gathering information on vehicles, traffic flow, transformers, EV charging, power generation and demand, storage batteries, users, and command of discharge. Researchers want to know the impact EVs have on the grid, as devices that both use power and have the capability of storing it for future use.

A key requirement for the study is the recruitment of 200 EV volunteers willing to have their use of an EV and residence or business monitored by smart meters. Recruitment is scheduled to take place through 2012 and well into 2013. The demonstration will start in mid-2013, once enough volunteers have been signed up to provide significant data.

⁷⁴ Matsuura, M. (2011, November 1). Japan - United States clean energy collaboration: Smart grid demonstration project on Maui. Retrieved from <http://mauienva.org>

Other chapters in this report discuss the potential impact of the Japan-U.S. Smart Grid Demonstration Project on EVs and tourism, installation of charging infrastructure, and EV deployment in general. But within the context of the impact on Maui's utility grid system, the project brings critical resources, information, and potential partnerships that will allow MECO and the County of Maui to rapidly implement a mass deployment of EVs, which in turn provide a missing link in the challenge that variable renewable energy creates for an isolated utility grid. Together, EVs and a smart grid system will accelerate Maui's transformation to a less fossil-fuel dependent, more secure region.

This convergence of national and international energy-focused businesses and organizations on Maui will generate further interest in using Maui's isolated grid as a test bed for future pilot projects, but also necessitates that utilities, and the various government agencies and organizations involved with these projects, keep businesses and residents aware of, and educated about, the transformation that is taking place.

7.7 RECOMMENDATIONS

It is to the advantage of MECO to encourage EV adoption. Because the utility company works in concert with the Public Utilities Commission and various government agencies and programs, the recommendations address multiple parties.

The following recommendations have been developed with the goal of encouraging more effective use of utility resources, including off-peak charging to support greater use of renewable energy, increase public awareness of tariff incentives, and support research on integration of smart grid technology. They will be taken up by stakeholder working groups early in 2013, for further refinement and detailed implementation planning.

At the Federal and State levels:

- Provide adequate support and information regarding anticipated and actual sales of EVs to island-based utility providers and other agencies, organizations, and projects that have an interest in planning and testing local energy grids
- Consider partnering with Hawai'i Energy to subsidize or provide free home and office energy audits

At the County Level:

- Consider partnering with Hawai'i Energy to subsidize or provide free home and office energy audits

For the PUC and Hawaiian Electric Company/Maui Electric Company:

- Analyze existing rate incentives to see if they are working as intended, and address obstacles to encourage greater use of night-time charging
- Working in collaboration with auto dealers and property owners, identify new EV owners that may not have installed second electricity meters and ensure that they are aware of rate incentive programs
- Continue to provide property owners, EV dealers and potential EV owners with user-friendly information on installing charging stations, charging costs, metering and time-of-use options. Ensure that this information is accessible and available at strategic communication points (in newsletters, at point-of-purchase of vehicles, etc.)
- Offer free or discounted home and commercial energy audits through Hawai'i Energy to ensure that customers are aware of benefits and incentives of owning EVs [PUC]

For Others:

- For auto dealers, communicate issues of sales, inventory, and other factors that encourage or obstruct adoption of EVs to the utility company, PUC, NEDO, and other stakeholders with an interest in mass deployment of EVs
- For auto dealers, the County, and other initial points of contact with potential and new EV owners, provide information about incentives and processes for accessing special rates for EV charging
- For installers of individual residential and commercial energy systems, provide information and guidance to customers regarding including EV charging needs in their system configurations (thus reducing the need for multiple installations and saving installation costs up front for customers who are interested in adding EVs later)

Chapter 8

Local Ordinances

One of the key challenges for implementing both private and public electric vehicle (EV) charging infrastructure is the complexity of installing and permitting charging stations, including the local ordinances that impact everything from site location and equipment installation to signage and parking enforcement, especially in public areas.

Level 1 charging, which uses a standard 110/120V grounded outlet, is simple. Every plug-in vehicle (EV or hybrid) comes with a plug that fits standard outlets found on the exterior of most buildings, as well as in the garages of most single and multi-residential homes. Permits are not required unless a new outlet is needed, or an existing outlet needs to be relocated.

Faster Level 2 charging using EV servicing equipment (EVSE), also known as a charging station, is another matter entirely. For higher voltage charging stations, including the DC fast charging station, an *electrical permit* is required. If the installation requires new or renovated construction to support the charging station equipment, then a *building permit* is also required. Finally, if the installation takes place within a flood zone or a special management area (SMA), then *special zoning permits and approvals* are required.

This chapter examines:

- The current process of securing these permits and approvals
- The potential for updates and process improvements such as online permitting
- Other regulatory issues such as signage, parking enforcement, and safety

Recommendations for updates and process improvements are listed at the end of the chapter.

8.1 CURRENT PERMITTING PROCESS

In Maui County, all permitting processes must be handled in person, by the appropriate individual.

Electrical Permits: A County electrical permit is required for any new or relocated outlet, and for installation of any residential or commercial electric vehicle charging station. There is no electrical code restriction on where outlets can be installed outdoors. Depending on location, outlets may need to be provided with the proper type of covers when exposed to the weather, or wet/damp locations, and the circuit or outlet will need ground-fault circuit-interrupter (GFCI) protection.

Permit processing time for residential dwellings is currently seven to ten days, and permits are applied for by, and issued to, a licensed electrical contractor—not the property owner.

The process requires:

- A complete County Department of Public Works permit application
- A check or money order for applicable fees (\$30.00 for a permit with 1 charging station, \$40.00 for a permit with 2 charging stations)
- Depending on the size of the installation, project drawings stamped and signed by a licensed electrical engineer. Plans are usually not required for residential dwellings, unless the system is unusually large (e.g. the Tesla Charging Station) which may require upgrading the dwelling electrical service.⁷⁵ The County does recommend that drawings be submitted for commercial installations to show where the stations are located and how they will be powered

Building Permits: While building permit requirements are not new, charging stations are new technology and appropriate permitting requirements can be confusing to owners, contractors, and government employees. Currently, each county in the State of Hawai'i has individual requirements for EV charging infrastructure because each county has different planning and building requirements. In contrast to the City and County of Honolulu, which requires a building permit for charging station installation, Maui County requires an electrical permit, but will generally require a building permit only if the station includes structural additions or alterations.

On March 19, 2012 the County of Maui adopted the 2006 International Building Code and 2006 International Residential Code. There is no language in this adopted ordinance that specifically addresses EV charging infrastructure. County staff determines if a building permit is required based on factors that include type of equipment, location, and whether the building structure is affected. A charging station powered by a solar carport, for instance, requires a building permit because the carport has a roof construction.

EV charging installations *are* specifically addressed under regulations provided by the International Energy Conservation Code (IECC), which issues a new set of guidelines every three years. The IECC establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses. However, the focus of the IECC is conservation, while the County is focused more generally on structural concerns of the building and electrical systems. In addition, the County Electrical Code and the National Electrical Code both require electrical equipment to be listed by a qualified electrical testing laboratory, such as UL, to ensure safety.

⁷⁵ This is a case where the variety in charging station equipment poses additional challenges for homeowners. For more information, see: Hawai'i EV Ready guidebook for commercial EV charging station installations. (2012). Retrieved from http://energy.hawaii.gov/wp-content/uploads/2011/09/EV-Guidebook_FINAL_Oct_3_12.pdf

As with building codes, each county may use different editions of the IECC at a given time. O‘ahu and Maui adopted IECC 2006 in 2010. IECC 2009, as amended, was approved by the State of Hawai‘i Building Code Council in Feb. 2012. Maui and O‘ahu are moving through the code adoption process currently.

Special Zoning Requirements: Much of the inhabited area of Maui County is a coastal environment, within special management areas (SMA) and designated flood zones. These pose unique problems for EV charging stations and may require additional permitting, inspections, and construction or installation requirements.

Figure 8.1 Special Management Areas in Maui County



SMA are based on a state law which is an extension of the Federal Coastal Zone Management Law that applies to all coastal states. Flood zones are federal and are designated by the Federal Emergency Management Agency (FEMA). Detailed SMA and flood zone maps can be viewed online.⁷⁶

If a property is in an SMA area, then an SMA assessment is required. The assessment will result in either an exemption or minor permit.

If a property is in a flood hazard area, then a flood development permit is required. Ideally, an assessment will find a “no rise” situation, which means that improvements will not add to flood

⁷⁶ For more information, use the land permit map viewer at <http://www.mauicounty.gov>, or the flood hazard assessment tool at <http://gis.hawaiiinfip.org/fhat/>.

inundation levels. For example, ground-level parking spaces typically do not make inundation levels rise, but above-ground improvements can. It may be that a charging station needs to be elevated or other changes made to the project area to compensate for the rise. Assuming that the charging station platform is relatively small, such as a post, no impact on inundation would be anticipated.

The County electrical code also has federally-mandated installation requirements within flood zones. It is best to locate the charging stations above the base flood elevation on flood zone parcels. If that cannot be done, Ground-Fault Circuit-Interruption (GFCI) protection must be provided.

Other Considerations:

- In terms of zoning, an EV charging station would ordinarily be considered an accessory use to the other (residential, commercial, etc.) uses already established on the property
- Under the County's existing off-street parking ordinance, different commercial (and residential) uses have specific requirements to provide a certain number of parking stalls. If any of these stalls are designated exclusively for electric cars, then it could result in deficient parking for non-electric cars

Property owners need to allow additional time for special zoning permits, from one to several weeks, depending on the complexity of the situation and application. Zoning permits are available from the Maui County Planning Department. Property owners can inquire with planning staff about SMA areas and flood zones or check the flood zone maps. The process requires:

- A one-page form to confirm zoning and flood designations for a particular location. This form requires knowing the Tax Map Key (TMK) for the property
- The fee for an SMA assessment application or for a flood development permit is currently \$55

8.2 POTENTIAL PROCESS IMPROVEMENTS

Currently in Maui County, all permit applications (electric, building, SMA, flood zone) have to be submitted in person. The applicant must obtain the forms from the appropriate permit office, fill them out by hand, get the forms signed by the owner and contractor, and provide other documentation such as technical drawings. The County permit office staff then enters the information into their system. This labor-intensive process is a source of interpretation and potential input error, staff may need to call an applicant to check spelling and other details, and inadequate staffing levels can create backlogs. In addition, only checks or money order are accepted. Once entered into the system, however, permits can be tracked online, as this is considered public information.⁷⁷

⁷⁷ For more information on permits, visit Maui County's website at <http://www.mauicounty.gov/index.aspx?nid=1205>. To check permit status, visit the KIVA system at <http://kivanet10g.co.maui.hi.us/kivanet/2/permit/index.cfm>

A fully online permitting system, with information entered directly by the applicant could minimize operator errors and speed up the application process. The City and County of Honolulu recently implemented an online process for their residential EV charging station installation permits. The system can be used as long as an EV product has an approved product code. According to the Department of Business, Economic Development and Tourism, online permitting has significantly improved the EV charging station installation process for property owners.⁷⁸ No other counties have yet followed suit. However, as Maui County's current operating system is no longer supported by the company that bought the system, it is possible that this may occur soon as part of an overall upgrade.

8.3 OTHER REGULATORY ISSUES

Signage: The first charging station in Maui County was installed in 2011. Since then, several stations have been added. Each one has unique signage in terms of colors, forms, and content. This is the result of a lack of guidance or mandated requirements, and as new stations increase in number in the coming years, it will be a source of confusion for both drivers and property owners. Standardization of signage is clearly needed.

The newly published Hawai'i State Guidebook for Commercial Charging Station Installations outlines three kinds of EV-related signage: General, Regulatory, and Special. These are summarized in Table 8.2 on the following page.

EV parking spaces also should be stenciled and painted with additional color indicators and content to distinguish them from regular parking stalls. The Guidebook provides minimal information about parking stenciling. Green and white are the most commonly used colors.

Parking areas: Installation of charging infrastructure and changes in parking lots may trigger additional issues of access and safety, and therefore be the subject of other regulations or local ordinances.

For example, because charging equipment may be located in a space that can be damaged by vehicles, and because the equipment itself may create a hazard to pedestrians, cyclists, and landscape maintenance personnel, guidance on placement and protective devices (such as bollards) may be useful. The Hawai'i Guidebook provides some discussion of these issues.

As charging equipment differs in its operation according to the manufacturer, type of payment system, and local installation, night-time illumination for both equipment and signage is important both for ease of use and safety. Currently, no guidance is provided either in the existing building codes or in EV handbooks, including the new guidebook on signage from the State of Hawai'i. This will need to be addressed by either the County or the State.

⁷⁸ State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). *Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawai'i*. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

Table 8.2 Guidelines for EV Signage

Type	General	Regulatory	Special
Purpose	Way-finding; to help drivers find the EV charging station and/or parking space	Required to enforce the time duration and days that electric vehicles are permitted to charge or park, or to restrict internal combustion engine vehicles from occupying the space. [no requirements yet in federal MUTCD]	Provide additional information to the driver; used by the private sector to assist in guiding motorists to their destinations or to identify features or supported programs at a facility.
Colors	Blue and white	Permissive: green and white; Prohibitive: red and white	Distinct colors, images, artwork, and themes
Examples		 	

Source: Hawai'i EV Ready Guidebook for Commercial EV Charging Station Installations.⁷⁹

⁷⁹ Hawai'i EV Ready guidebook for commercial EV charging station installations. (2012). Retrieved from http://energy.hawaii.gov/wp-content/uploads/2011/09/EV-Guidebook_FINAL_Oct_3_12.pdf, Davids, D. (2012, October 11). Promoting best practices for electric vehicle signage. Retrieved from http://www1.eere.energy.gov/cleancities/toolbox/training_archives.html

If property owners add new parking spaces to a property as part of developing charging infrastructure, they may also trigger tree requirements. New parking installations for most non-residential properties require one shade tree for every five parking spaces. Off-street parking requirements are found in chapter 19.36A of the Maui County Code.⁸⁰

Maui County does not regulate or enforce American's Disability Act (ADA) and the existing regulations do not specifically address charging stations. However, ADA access is a federal requirement. Guidance on general ADA regulations is available from the State Disability and Communication Access Board at <http://hawaii.gov/health/dcab/home/> and the Hawai'i Guidebook has identified several key recommendations to help property owners demonstrate good faith compliance when installing charging stations.

8.4 RECOMMENDATIONS

For a new owner of a plug-in electric vehicle, or a property manager with responsibility for providing charging infrastructure for tenants or visitors, the process for installing EV charging infrastructure can be both confusing and complex. The following recommendations have been developed with the goal of streamlining the process required for installing Level 2 and higher charging stations, encouraging earlier installations at multi-residential and commercial properties and workplaces, and removing obstacles to the mass deployment of EVs in Maui County. These recommendations will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning.

At the Federal and State Levels:

- Until a standard is set, provide guidance and best practices for EV charging station and parking signage, stenciling and illumination

At the State Level:

- Require certification for charging station installers, and provide consumers with an online, updatable list of certified installers
- Convene a regular meeting of appropriate county and state representatives from each of the islands to discuss best practices and changing challenges of EV charging infrastructure

At the County Level:

- Explore ways for property owners to share key information on charging station locations, including:

⁸⁰ Maui County Code. (n.d.). Retrieved from <http://library.municode.com/index.aspx?clientId=16289&stateId=11&stateName=Hawaii>

- Guidance on and downloadable forms for permits needed, including application forms and checklists of required documentation and information for:
 - Maui Electric Company (MECO) “New Service” request
 - Electrical permits
 - Building permits
- Ability to upload maps, photos, and design/construction documents (as required for the permitting process)
- Guidance on and downloadable forms for permits needed for any required special permits
 - Flood Zone
 - Special Management Area permits
- Guidance (by the State or other agency) on appropriate signage, parking stall markings, and illumination.
- Link to ADA regulations
- Other federal, state, county, or other agencies with information useful for EV owners and property owners
- Link to certified electrician resource or referral service (State)
- Link to an updatable map of publicly-accessible charging stations
- Information for new commercial charging station owners regarding registering and publicizing their stations with federal, state, and independent databases
- Send representatives to state and other local meetings to discuss best practices and changing challenges of EV charging infrastructure
- Consider upgrading the permitting process to an online system, starting with downloadable forms, with appropriate staffing at all levels to prevent backlog
- Monitor upgrades of the Building Code to be aware of best practices related to EV charging stations

Chapter 9

Outreach and Education

Increasing availability of electric vehicle (EV) car models locally, creating easier methods for permitting charging stations, extending incentives for purchasing cars and installing charging stations—all of these actions will help accelerate EV deployment in Maui County. But the single most important way to transition our conventional car culture to EVs is through outreach and education.

This chapter discusses outreach efforts conducted by Maui Electric Vehicle Alliance (Maui EVA) to date, and some of the insights gained from those activities. It also describes the specialized training and education needed for safe installation, maintenance and operation of EV and EVSE, focusing on consumer and workforce populations.

The Department of Energy (DOE) encourages communities to include the needs of users, first responders, public safety officers, EVSE installers, inspectors, and permitting officers in their plans. For Maui, consumers include both residents and visitors using rental vehicles, and the workforce includes visitor industry staff as well as automotive technicians and electricians.

Recommendations are included for both:

- Outreach to the public, including EV owners and property owners
- Training and education for consumer and workforce populations

9.1 OUTREACH TO THE PUBLIC

Over the last year, Maui EVA has laid a foundation of outreach and public education designed to increase awareness, generate interest, increase the visibility of EVs, and prompt action among stakeholders. Efforts to-date have addressed public acceptance of new technology and provided feedback for future outreach efforts.

Maui EVA outreach has included publicity for new charging stations, a Mayoral proclamation of Plug-in Day, and speakers for professional organization and community association meetings. Maui EVA has also hosted informational booths and exhibits at community-wide events which draw a wide audience, one not limited to those already interested in EVs. These have included the county fair and parade, swap meet, film festival, and Earth Day. Event-related media, materials and follow-up have included press releases, public service announcements, posters, and surveys. Displays of EVs with ride/drive opportunities, and drawings for free EV weekend rentals have provided hands-on experiences for potential users.

Maui EVA both collected and developed educational content as part of this process, including answers to frequently-asked questions, brochures, lists and maps of charging stations, and personal stories from owners and renters about their EV experience. Social media, a website, an e-mail list, a monthly e-newsletter, and a Maui EVA cable TV program and corresponding YouTube channel have all served to build community and create a digital archive for local information. Maui EVA TV, in particular, has become a medium to engage with stakeholders through live and studio interviews, talk shows, and individual presentations. Contributors have included business owners, fleet owners, Maui Electric Company, and academics and experts from other states with successful EV implementation. Episodes have presented perspectives and lessons learned from early adopters of both EVs and EVSE, including those using photovoltaic systems. They have shared new user and renter experiences with specific vehicles and destinations, as well as information on renewable energy and EVs, charging costs and options, and online resources.

Maui EVA online presence:

- <http://www.facebook.com/mauieva>
- <http://www.twitter.com/mauieva>
- <http://www.mauieva.org>
- <http://www.youtube.com/user/mauievatv>

As various events have been picked up by the local media, in numerous front-page articles, public awareness of EVs on Maui has grown extensively in the past year. This has coincided with the first EVs to arrive on Maui, and early adopters have also served to increase public awareness and EV sales. As a salesman at Jim Falk Motors puts it, “For every Nissan LEAF that gets sold, we get five more inquiries—from the buyer’s neighbors, friends, and colleagues.”

9.2 RECOMMENDATIONS FOR OUTREACH

The following recommendations have been developed with the goal of encouraging greater public understanding of EVs and EVSE infrastructure. They will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning.

For Educational Institutions and Organizations:

- Continue to engage stakeholders and train outreach volunteers, and serve as a clearinghouse for information and communications. Seek additional support from stakeholders to sustain these efforts
- Produce multimedia presentations (television, radio, webinars) on identified topics, including total cost of ownership, return on investment, and EV workforce training
- Partner with local sustainability organizations and share EV information via their mailing lists

At the State and County Levels:

- Utilize information on new public charging stations to create a list of owners and encourage publicity, information sharing, and communication of policies and procedures for public access
- Transmit information on the location of new charging stations at county locations to the State Energy Office's charging station locator database (or other recognized information providers) so consumers and mobile applications have access to the most current information

9.3 TRAINING AND EDUCATION FOR CONSUMER, PROPERTY OWNER, AND WORKFORCE POPULATIONS

There are currently no EV workforce training or EV-related courses offered on Maui. Consumers, property owners, and employers must seek out information on their own, refer to owner's manuals, rely on dealership, rental agency or EVSE host staff, attend classes on O'ahu or the mainland, or pay to have trainers travel to Maui.

Consumers: Safety and other user information for EV owners and renters is currently available directly from manufacturers, dealers, rental car outlets, and online from numerous sources, but no classes or workshops are offered locally, especially for potential EV purchasers.

Fleet owners: Fleet owners need to know about EVs, policy incentives, home/work charging, total cost of ownership, EV models, electricity tariffs, maintenance, legislation, financial analysis, and charging stations.

Property Owners: Property owners may also be EV or EV fleet owners, or members of the visitor industry, but as a class, are concerned primarily with installation of charging stations. In addition to information directly available from manufacturers and installers, property owners need information about legislation, incentives, financial analysis (how much to charge, total cost of ownership, return on investment), permitting, liability, manufacturers, installers, billing, training of operators for customer service, special zoning requirements, signage, ordinances, safety and security. A local class or workshop would be able to address these issues and more, and could address concerns that inhibit property owners from taking advantages of existing incentives.

Visitor industry: Education is needed for hotel staff and other charging station hosts regarding how to best serve customers who use the charging stations on their properties. Without consistent training, EV owners and renters receive potentially conflicting information from front desk staff, operators, concierge, bell captains, valets, housekeeping, and other staff they encounter. These staff members need to know answers to basic EV questions, including business specific information, such as whether and how charging stations bill the consumer for electricity consumed, where

stations are located on a property, and where additional charging stations are located at or near other tourist destinations.

First responders: There are approximately 350 police officers, 300 fire department personnel, 90 ambulance and emergency medical staff, and 60 state crash personnel currently in Maui County. Training for these safety personnel is available from the National Fire Protection Association (NFPA). Three safety personnel on Maui have achieved NFPA train-the-trainer status on EV safety for first responders. Once established, each trainer will have the capacity to teach a hands-on best practices class for 20-30 people over one full day. It will take a minimum of six months to train all safety personnel on Maui given the current NFPA training program capacity.

Additional concerns documented by Maui EVA workgroups relate to the current training content, which is generic or covers a single vehicle type. Specific safety information is available from the NFPA, however this information must be merged with the existing training content for it to be effective. This will be required as each new EV type is introduced into Maui County.

Material Safety Data Sheet (MSDS) information for chemicals in EV batteries and other components is also not standardized and is currently not a part of the NFPA training. The information is available from the manufacturer but would need to be standardized and incorporated into the training program.

Installers: There are five electrical inspectors and approximately 280 union electricians in Maui County (R. Shimabuku, personal communication, December 4, 2012). The Electric Vehicle Infrastructure Training Program (EVITP) developed by the DOE's Office of Energy Efficiency and Renewable Energy (EERE) provides training and certification for those who install and maintain charging stations. EVITP classes are offered by the Hawai'i Electrician's Training Fund on O'ahu. At time of this report, only five IBEW members on O'ahu have received EVITP Phase 1 certification in the state. The 30-hour course has not yet been offered in Maui (R. Aquino, personal communication, December 3, 2012).⁸¹

Automotive Technicians: Though established EV curricula exist elsewhere, there are few automotive training opportunities currently available in Hawai'i—and a looming shortage of automotive technicians is likely to occur as the number of EVs increase.⁸² Technicians also need to be available on each island, so that owners need not ship their cars elsewhere, even for routine maintenance. Currently there is just one qualified technician at Jim Falk Motors for all Nissan LEAFs on Maui and the Big Island.

⁸¹ For more information, see <http://www.hawaiielectricianstraining.org> and <http://www1.eere.energy.gov/cleancities/evitp.html>

⁸² Hayden, T. (2012). Shortage of qualified auto mechanics as cars get more high-tech. Retrieved from <http://www.myfoxphoenix.com/story/19432644/2012/08/31/shortage-of-qualified-auto-mechanics-as-cars-get-more-high-tech>

Train-the-trainer programs are offered on the mainland,⁸³ and the UHMC Automotive Program has sent two faculty members to these trainings. Barriers to creating a training program on Maui include the high cost of tools, safety equipment, and diagnostic equipment. Larger facilities are also needed, including space to house a mock-up vehicle and a safe location above the flood plain.

Providing automotive training will also help to increase EV ownership in fleets. Currently, one of the barriers cited by the County of Maui for purchase of EVs for its fleet is that the County has no EV-trained technicians.

9.4 RECOMMENDATIONS FOR TRAINING AND EDUCATION

The following recommendations have been developed with the goal of encouraging the critical training needed for first responders, installers, automotive technicians and other service providers. They will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning.

For Educational Institutions and Organizations:

- Utilize information gathered on EV-related training programs, local training needs, and expert contributors to develop new materials and improve existing materials
- Offer an “EV 101” class that will include an introduction to the issues surrounding EV ownership, charging station installation and maintenance, renewable energy options, and discussion of key EV safety issues
- Develop an “EVSE 101” course for property owners, fleet owners, business owners, and others covering the benefits, incentives, processes and other issues for installing charging stations and transitioning to EV fleets
- Develop, in collaboration with the visitor industry, training for hotel staff and tourist business employees, including best practices of hotels that excel in EV-related customer service
- Support the development of automotive training programs, with materials, EVs and EV-related classroom equipment, and appropriate facility space
- Where appropriate and working through industry and union groups, offer EV and EVSE training courses for first responders, tow truck drivers, charging station installers, general and electrical contractors, building inspectors and other personnel who impact EV deployment and infrastructure

At the State and County Level:

- Ensure that up-to-date information about EVSE installations, EV laws, and other ordinances is available and readily accessible to the public, and that County permitting representatives receive training to provide consistent and accurate information

⁸³ For more information, see <http://www.electricvehicletechnicalinstitute.com>

For Maui Electric Company (MECO)/Hawaiian Electric Company (HECO):

- Continue to sponsor advertising campaigns designed to encourage purchase of EVs, with answers to basic questions, basic information about Level 1 charging, and an emphasis on the connection to renewable energy^{84,85}

⁸⁴ According to the Hawai'i Auto Dealers Association, "heavy messaging" in a HECO/MECO sponsored campaign could dramatically increase EV adoption, by as many as 500 vehicles statewide.

⁸⁵ In Maui EVA's one-page EV Readiness survey administered at the National Plug-in Day (N = 44), and at the Maui Fair (N=408), 36.4% and 55.7% (respectively) answered NO to the question: Did you know that you can charge an electric car in a standard three-prong outlet?

Chapter 10

Recommendations

Achieving mass deployment of EVs, with all the attendant benefits, will require the participation and collaboration of the stakeholders that are identified here, and more. Rather than make broad statements, the recommendations below address specific issues that were identified by the working groups, EV experts who were consulted on this project, and national reports developed to help communities achieve EV readiness.

As the information and lessons learned present a moving target for planning and implementation, some of these recommendations may soon be obsolete or superseded by better solutions and new information. But as we have learned during the last year, the details have enormous impact. These recommendations will be taken up by stakeholder working groups, early in 2013, for further refinement and detailed implementation planning, including strategic goals, timelines, and estimated costs of implementation. The goal of this chapter is to present the best thoughts about how to move forward given what we know now.

Recommendations are organized by individual groups and stakeholders:

At the Federal and State Levels:

- Extend tax rebates or credits to reduce the cost of initial EV investments for businesses and consumers
- Provide other incentives for government agencies and non-profit organizations to purchase EV fleet vehicles and provide charging stations for employees
- Require or establish preferences for EV purchases under contracts, subcontracts, and grant funding
- Update the DMV tracking system so highway-ready EVs are tracked separately from other EVs and by county and island (Maui, Moloka'i, and Lāna'i). Make this information up-to-date and publicly-accessible to encourage and assist planning efforts
- Provide adequate support and information regarding anticipated and actual sales of EVs to island-based utility providers and other agencies, organizations, and projects that have an interest in planning and testing local energy grids
- Amend the existing Hawai'i EV parking laws to include provisions for enforcement, penalties for noncompliance, and additional coverage of office buildings and shopping complexes
- Actively enforce EV parking laws and notify parking lot owners and staff of legal requirements
- Create a consumer-awareness campaign to inform multi-unit dwelling residents of their rights to EV charging access

- Create statewide standards for EV charging station and parking signage, stenciling and illumination
- Until a standard is set, provide guidance and best practices for EV charging station and parking signage, stenciling and illumination
- Disseminate information on available charging station locators, including mobile applications, directories and guidebooks
- Ensure that up-to-date information about EVSE installations, EV laws, and other ordinances is available and readily accessible to the public, and that County permitting representatives receive training to provide consistent and accurate information
- Require certification for charging station installers, and provide consumers with an online, updatable list of certified installers
- Convene a regular meeting of appropriate county and state representatives from each of the islands to discuss best practices and changing challenges of EV charging infrastructure
- Consider partnering with Hawai'i Energy to subsidize or provide free home and office energy audits
- Utilize information on new public charging stations to create a list of owners and encourage publicity, information sharing, and communication of policies and procedures for public access

At the County Level:

- Identify County fleet vehicles that could be replaced with EVs
- Monitor upgrades of the Building Code to be aware of best practices related to EV charging stations
- Explore ways for property owners to share key information on charging station locations
- Consider upgrading the permitting process to an online system, starting with downloadable forms, with appropriate staffing at all levels to prevent backlog
- Transmit information on the location of new charging stations at county facilities to the State Energy Office's charging station locator database (or other recognized information providers) so consumers and mobile applications have access to the most current information
- Send representatives to state and other local meetings to discuss best practices and changing challenges of EV charging infrastructure
- Discuss EV parking laws with Maui County Police Department
- Consider partnering with Hawai'i Energy to subsidize or provide free home and office energy audits

For the PUC and Maui Electric Company (MECO)/Hawaiian Electric Company (HECO):

- Offer free or discounted home and commercial energy audits through Hawai'i Energy to ensure that customers are aware of the benefits and incentives of owning EVs [PUC]
- Continue to provide property owners, EV dealers and potential EV owners with user-friendly information on installing charging stations, charging costs, metering and time-of-use options. Ensure that this information is accessible and available at strategic communication points (in newsletters, at point-of-purchase of vehicles, etc.)
- Provide user-friendly online cost comparisons or cost calculator for different types of charging stations, including the DC fast charging station, and different projected usage levels
- Working in collaboration with auto dealers and property owners, identify new EV owners who may not have installed second electricity meters and ensure that they are aware of rate incentive programs
- Analyze existing rate incentives to see if they are working as intended, and address obstacles to encourage greater use of off-peak charging
- Consider the removal or reduction of demand charge for DC fast charging stations
- Explore ways to simplify existing tariffs
- Continue to sponsor advertising campaigns designed to encourage purchase of EVs, with answers to basic questions, basic information about Level 1 charging, and an emphasis on the connection to renewable energy

For Solar Companies:

- Provide information and guidance on including EV charging in all photovoltaic (PV) system configurations, including information on costs avoided by installing both PV and EV at the same time
- Include or bundle EV charging stations in the permitting and installation of PV
- Provide solar installers, solar customers, EVSE installers and EV car dealers with real-life stories of cost savings and other benefits of combined EV and PV ownership

For EV Manufacturers:

- Develop an increasingly broad array of EV models, with greater attention to utility and specialized vehicles
 - Continue to identify Hawai'i as an early introduction site for new models
 - Allow the local resale of EVs in island fleets
 - Sponsor public outreach events to familiarize individuals and businesses with EVs and EV benefits
 - Provide attractive purchase and leasing terms to encourage first-time EV ownership
-

- Collaborate on uniform charging standards that apply to all EV and EV charging stations

For EVSE Manufacturers and Charging Station Networks:

- Collaborate on uniform charging standards that apply to all EV and EV charging stations
- Develop intuitive, easy-to-use interfaces across platforms
- Provide charging station models at car dealerships and EV outreach events
- Provide bulk discounts for hotel and restaurant chains, condo associations and others

For Auto Dealers:

- Work with manufacturers to stock adequate inventory for sales and demonstration
- Communicate issues of sales, inventory, and other factors that encourage or obstruct adoption of EVs to the State, County, MECO, the PUC, NEDO, and other stakeholders with an interest in mass deployment of EVs
- Provide attractive purchase and leasing terms to encourage first-time EV ownership
- Promote the affordable, pre-owned EVs made available when leaseholders return three-year old vehicles at the end of their leases
- Provide consumers with information on EV benefits and incentives, including:
 - Total cost of ownership
 - Tax rebates or credits
 - Special utility rates and incentives
 - Combined EV and PV ownership
 - EV parking laws
- Provide consumers with information on charging station models, public charging station locations, Better Place memberships and Electric Auto Association memberships at the point of sale
- Continue to expand the visibility of EVs by providing demonstration vehicles and test drives at community events
- Provide adequate training and proper staffing of service people and mechanics for EVs

For Car Rental Companies:

- Work with accommodation providers, professional associations, and visitor destinations to help increase charging station infrastructure by:
 - Providing updated EV fleet numbers
 - Facilitating charging station installations
 - Work with accommodation providers, professional associations, and visitor destinations to provide discounts and other special offers, such as eco-tourism packages, to encourage residents and visitors to try EVs
 - Sponsor outreach events
-

- Provide complete “how-to” information (including charging station locations) for EV renters
- Allow the local resale of EVs in island fleets

For Fleet Owners:

- Investigate fuel use, maintenance costs, and other lifetime asset costs to better understand the benefits of EVs vs. traditional combustion engine vehicles
- Identify fleet vehicles that could be replaced with EVs
- Install charging stations for fleet vehicles, customers, clients, and employees

For the Visitor Industry and Other Businesses:

- Develop and market eco-tourism programs that highlight EV use
- Encourage members to install charging stations, especially at (and on the way to) visitor destinations on the East side: Upcountry, Hana, and Haleakala
- Encourage members to add EVs to hotel and business fleets
- Educate staff to better serve EV drivers and meet their charging, parking, and safety needs
- Comply with EV parking laws
- Advertise the availability of charging stations and offer specials for EV drivers
- Encourage EV car share companies to open local branches

For Educational Institutions and Organizations:

- Continue to engage stakeholders, train outreach volunteers, and serve as a clearinghouse for information and communications. Seek additional support from stakeholders to sustain these efforts
- Utilize information gathered on EV-related training programs, local training needs, and expert contributors to develop new materials and improve existing materials
- Develop, in collaboration with the visitor industry, training for hotel staff and tourist business employees, including best practices of hotels that excel in EV-related customer service
- Offer an “EV 101” class that will include an introduction to the issues surrounding EV ownership, charging station installation and maintenance, renewable energy options, and discussion of key EV safety issues
- Develop an “EVSE 101” course for property owners, fleet owners, business owners, and others covering the benefits, incentives, and processes for installing charging stations and transitioning to EV fleets
- Support the development of automotive training programs, with materials, EVs and EV-related classroom equipment, and appropriate facility space
- Where appropriate and working through industry and union groups, offer EV and EVSE training courses for first responders, tow truck drivers, charging station installers, general

and electrical contractors, building inspectors and other personnel who impact EV deployment and infrastructure

- Produce multimedia presentations (television, radio, webinars) on identified topics, including total cost of ownership, return on investment, and EV workforce training
- Partner with local sustainability organizations and share EV information via their mailing lists
- Conduct site visits or surveys for businesses regarding EV benefits and charging station options, to raise awareness

For Community Members:

- Test drive EVs at dealerships, rental agencies and outreach events
- Attend seminars and classes; get informed on EV and charging station issues, and on EV laws and regulations
- Invite EV experts to speak about or demonstrate EVs at community events
- Join EV associations
- Volunteer for the Smart Grid demonstration project
- Share EV information and experiences with family, friends and neighbors
- Advocate for more charging station locations
- Configure home electric panels to have room for charging stations in the future

Glossary of Terms and Acronyms

AC	Alternating Current
ADA	Americans with Disabilities Act of 1990
ADAAG	Americans with Disabilities Accessibility Guidelines
ALS	Advance Life Support
ANSI	American National Standards Institute
AOAO	Association of Apartment Owners
ARRA	American Recovery & Reinvestment Act of 2009
BEV	Battery Electric Vehicle
CAFE	Corporate Average Fuel Economy
CARB	California Air Resources Board
CHAdcMo	“Charge de Move” Japanese DC fast charger standard
CNG	Compressed Natural Gas
CZM	Coastal Zone Management
DBEDT	Department of Business, Economic Development, and Tourism
DC	Direct Current
DG	Distributed Generation
DMV	Department of Motor Vehicles
EERE	Department of Energy’s Energy Efficiency and Renewable Energy
EMS	Emergency Medical Service, which includes Advance Life Support (ALS), medication administering and transporting to our Medical Center
EREV	Extended Range Electric Vehicle, e.g. Chevy Volt
EV	Electric Vehicle; in this report, it refers to any plug-in hybrid or 100% electric vehicle
EVA	Electric Vehicle Alliance
EVSE	Electric Vehicle Supply Equipment (charging stations)
EVITP	Electric Vehicle Infrastructure Training Program
EVMS	Electric Vehicle Management System
FEMA	Federal Emergency Management Agency
FIT	Feed in Tariff
FY	Financial Year
GEM	Global Electric Motorcars
GFCI	Ground Fault Circuit Interrupter
HCC	Honolulu Clean Cities
HCEI	Hawai’i Clean Energy Initiative
HECO	Hawaiian Electric Company, Inc.
HEI	Hawaiian Electric Industries
HELCO	Hawai’i Electric Light Company
HEPF	University of Hawai’i at Mānoa Hawai’i Energy Policy Forum
HEV	Hybrid Electric Vehicle
HEVN	Hawaiian Electric Vehicle Network
HNEI	Hawai’i Natural Energy Institute
HOA	Home Owners Association

HOV	High Occupancy Vehicle lanes
HREDV	Hawai'i Renewable Energy Development Venture
HVAC	Heating, Ventilation, and Air Conditioning
IBEW	International Brotherhood of Electrical Workers
ICC	International Code Council
ICE	Internal Combustion Engine
ICEd	when a non-EV parks in an EV parking spot
IECC	International Energy Conservation Code
IPP	Independent Power Producer
IRBC	International Residential Building Code
JTB	Japan Travel Bureau
kama'aina	A Hawaiian word meaning "local" or "resident"
keyfob	See RFID
kW	Kilowatt
kWh	Kilowatt hour
LEED	Leadership in Energy and Environmental Design certification
mahalo	A Hawaiian word meaning "thank you"
Maui EVA	Maui Electric Vehicle Alliance
MECO	Maui Electric Company
MEDB	Maui Economic Development Board
MEO	Maui Economic Opportunity Inc
MGY	Million gallons per year
MHLA	Maui Hotel & Lodging Association
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mpg	Miles per gallon
MUD	Multi-Unit Dwelling
MW	Megawatt
MWh	Megawatt hours
n.d.	No date (as appearing in footnotes)
NEC	National Electricity Code
NECA	National Electrical Contractors Association
NEDO	New Energy and Industrial Technology Organization
NEM	Net Energy Metering
NEV	Neighborhood Electric Vehicle
NFPA	National Fire Protection Association
NHTSA	National Highway Traffic Safety Administration
NREL	National Renewable Energy Laboratory
OEM	Original equipment manufacturer
OSHA	U.S. Occupational Safety & Health Administration
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PPA	Power Purchase Agreement
PUC	Public Utilities Commission
PV	Photo Voltaic (solar panel)
QC	Quick Charger (i.e. DC Fast Charger)
RFID	Radio Frequency Identification, also known as keyfob

RMI/PGR	Rocky Mountain Institute / Project Get Ready
SEPA	Solar Electric Power Association
SMA	Special Management Area
SUV	Sports Utility Vehicle
TOU	Time of Use (meter)
TMK	Tax Map Key system
TV	Time of use rate with electric Vehicle charger (MECO, HECO terms)
TVN	TV (above) + Net energy metering (MECO, HECO terms)
TVR	TV (above) with separate Residential meter (MECO, HECO terms)
UCSD	University of California at San Diego
UHMC	University of Hawai'i Maui College
UL	Underwriters Laboratories
USDOT	United States Department of Transportation
V2G	Vehicle to Grid
V2H	Vehicle to Home
VMT	Vehicle Miles Travelled

References

- Arent, D., Barnett, J., Mosey, G., & Wise, A. (2009). The potential of renewable energy to reduce the dependence of the State of l on oil; Proceedings of the 42nd Hawai'i international conference on system sciences. Retrieved from http://www.hawaiienergyinitiative.org/storage/potential_of_renewable_energy.pdf
- Carletta, C. (2012, July 25). Going solar is real change (Kula PV & EV). Retrieved from http://www.mauieva.org/docs/PV_EV_experience.pdf
- Charging Stations on Maui. (n.d.). Retrieved from <http://mauieva.org/docs/ChargingStationsonMaui.pdf>
- California plug-in electric vehicle owner survey. (2012). Retrieved from <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project/vehicle-owner-survey>
- County of Maui. (2011). Maui County Data Book. Retrieved from <http://hisbdc.com/BusinessResearchLibrary/MauiCountyDataBook2011.aspx>
- Davids, D. (2012, October 11). Promoting best practices for electric vehicle signage. Retrieved from http://www1.eere.energy.gov/cleancities/toolbox/training_archives.html
- Departmental guidelines for acquisition of new vehicles. (2010, January 1). Retrieved from <http://energy.hawaii.gov/wp-content/uploads/2012/08/Vehicle-Purchasing-Guide-20102.pdf>
- Effective rate summaries. (2012, October 4). Retrieved from <http://www.mauielectric.com/vcmcontent/StaticFiles/FileScan/PDF/EnergyServices/Tarrifs/HECO/EFFRATESOCT2012.pdf>
- Electric car rental firm expands to O'ahu. (2011, December 3). Retrieved from <http://www.hawaiienergyinitiative.org>
- Electric Power Research Institute. (2012). Mapping and assessment of the United States ocean wave energy resource. Retrieved from <http://www1.eere.energy.gov/water/pdfs/mappingandassessment.pdf>
- Electric vehicle geographic forecasts. (2012). Retrieved from <http://www.pikeresearch.com/research/electric-vehicle-geographic-forecasts>
- Electric vehicle information technology systems. (2012). Retrieved from <http://www.pikeresearch.com/research/electric-vehicle-information-technology-systems>
-

Electric vehicles. (n.d.). Retrieved from <http://www.fueleconomy.gov/feg/evtech.shtml>

Electric vehicles. (n.d.). Retrieved from <http://www.mauielectric.com/portal/site/meco/menuitem.853d25dd64dca44973b5c410c510b1ca/?vgnextoid=df8c5aa944c22310VgnVCM10000005041aacRCRD&vgnnextfmt=default>

EV pilot rates commonly asked questions. (n.d.). Retrieved from <http://www.mauielectric.com/vcmcontent/MECO/RenewableEnergy/EV%20Commonly%20Asked%20Questions.pdf>

Evaluation of electric vehicle production and operating costs. (1999). Retrieved from <http://www.transportation.anl.gov/pdfs/HV/14.pdf>

Fact check — Hawai'i has the highest electricity rates in the nation. Civil Beat. Retrieved from http://www.civilbeat.com/fact_checks/2011/11/07/13341-fact-check-hawaii-has-the-highest-electricity-rates-in-the-nation

Federal grant helps Maui Bus meet ridership demands. (2012, July 20). Retrieved from <http://mauinow.com/2012/07/20/federal-grant-helps-maui-bus-meet-ridership-demands/>

Federal tax credits for electric vehicles. (n.d.). Retrieved from <http://www.fueleconomy.gov/feg/taxevb.shtml>

First Wind. (2012, July 5). First Wind announces completion of Kaheawa Wind II Project and start of commercial operations. Retrieved from http://www.firstwind.com/sites/default/files/KWP%20II%20COD_FINAL_070512.pdf

General plan 2030. (n.d.). Retrieved from <http://www.co.maui.hi.us/index.aspx?nid=421>

Google Maps adds electric vehicle charging stations. (2011, March 13). Retrieved from <http://green.autoblog.com/2011/03/13/google-maps-electric-vehicle-charging-stations/>

Governor Abercrombie signs memorandum of understanding for Japan-U.S. smart grid demonstration project. (2011, November 22). Retrieved from http://hawaii.gov/dbedt/main/news_releases/2011/news-release-1126

Green Car Congress (2012, June 28) The Ultra-fast Charging Station is in production in China. Retrieved from <http://www.greencarcongress.com/2012/06/microvast-ultrafast-charge-station-for-electric-buses-begins-operation-in-chongqing.html>

Hawai'i Clean Energy Initiative road map. (2011). Retrieved from http://www.hawaii-cleanenergyinitiative.org/storage/media/HCEI_RoadmapSummary_FINAL_ID-11909.pdf

Hawai'i EV Ready guidebook for commercial EV charging station installations. (2012). Retrieved from http://energy.hawaii.gov/wp-content/uploads/2011/09/EV-Guidebook_FINAL_Oct_3_12.pdf

Hawai'i Electric Company. (2011). 2011 Renewable Portfolio Standard Status Report. Retrieved from http://www.heco.com/vcmcontent/StaticFiles/pdf/2012-05-04_RPS%20Report_2011.pdf

Hawai'i is the most fuel-dependent state in the nation. (n.d.). Retrieved from <http://www.hawaiienergyinitiative.org>

Hawai'i prices drop by 8 cents but still highest in nation. (2012). Retrieved from <http://www.bizjournals.com/pacific/news/2012/11/15/hawaii-gas-prices-drop-8-cents-but.html>

Hawaii's electric vehicle (EV) ready program. (n.d.). Retrieved from <http://energy.hawaii.gov/programs/transportation-on-the-move/ev-ready-program>

Hayden, T. (2012). Shortage of qualified auto mechanics as cars get more high-tech. Retrieved from <http://www.myfoxphoenix.com/story/19432644/2012/08/31/shortage-of-qualified-auto-mechanics-as-cars-get-more-high-tech>

Honolulu Clean Cities. (2012, October). Lessons Learned: The Early Adoption of Electric Vehicle Charging Stations from the Perspective of O'ahu's Commercial Properties. Retrieved from <http://honolulucleancities.org>

How much electricity does an EV use? (2012). Retrieved from <http://activeemobility.blogspot.com/2012/05/how-much-electric-does-ev-use.html>

International Renewable Energy Association. (2012). Electricity storage and renewables for island power: A guide for decision makers. Retrieved from <http://www.irena.org/DocumentDownloads/Publications/Electricity%20Storage%20and%20RE%20for%20Island%20Power.pdf>

Interview with Larry Ellison. (2012, October 2). Retrieved from <http://www.cnbc.com>

Konrad, T. (2012, April 18). Report: electric cars cost less (but watch the assumptions). Forbes. Retrieved from <http://www.forbes.com/sites/tomkonrad/2012/04/18/report-electric-cars-cost-less-but-watch-the-assumptions/>

Matsuura, M. (2011, November 1). Japan – United States clean energy collaboration: Smart grid demonstration project on Maui. Retrieved from <http://mauieva.org>

Maui County Code. (n.d.). Retrieved from <http://library.municode.com/index.aspx?clientId=16289&stateId=11&stateName=Hawaii>

McLeish, D. (2012, November). The path that took me to EVs. Retrieved from www.mauieva.org/docs/mcleish.pdf

Northeast Group. (2012). United States smart grid: Utility electric vehicle tariffs. Retrieved from http://northeast-group.com/reports/Utility_Electric_Vehicle_Tariffs_Brochure_NortheastGroupLLC.pdf

O'Connor, M. C. (2008). RFID is the key to electric vehicle recharging stations. RFID Journal. Retrieved from <http://www.rfidjournal.com/article/articleview/4464/1/1/>

Plug-in America. (2012, October). Hawai'i EV Ready Guidebook for Commercial EV Charging Station Installations, Plug-in America report for Hawai'i State Energy Office. Retrieved from <http://energy.hawaii.gov> and <http://electricvehicle.hawaii.gov>

Regulations and standards. (n.d.). Retrieved from <http://www.epa.gov/fueleconomy/regulations.htm>

Roberts Hawai'i and GreenCar partner to take cars off the road. (2012, November 19). Retrieved from <http://www.cnn.com/id/49883245/>

Solar Electric Power Association. (2011). 2011 SEPA utilities top solar rankings. Retrieved from <http://www.solarelectricpower.org/sepa-utility-solar-rankings.aspx>

State electricity profiles. (2012, January 30). Retrieved from <http://www.eia.gov/electricity/state>

State of Hawaii. (2012). Twenty-sixth legislature, Act 89 (12) / SB 2747. Retrieved from http://www.capitol.hawaii.gov/session2012/bills/GM1190_.PDF

State of Hawaii. (2012). Twenty-sixth legislature, Act 168 / SB 2746. Retrieved from http://www.capitol.hawaii.gov/session2012/bills/GM1271_.PDF

State of Hawai'i Department of Business, Economic Development and Tourism. (2011). Powering up: A special report on energy in Hawaii. Retrieved from <http://energy.hawaii.gov/wp-content/uploads/2011/08/Powering-Up-A-Special-Report-on-Energy-in-Hawaii.pdf>

State of Hawai'i Department of Business, Economic Development and Tourism. (2012, December). Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii. Retrieved from <http://electricvehicle.hawaii.gov> and <http://energy.hawaii.gov>

State of Hawai'i Department of Business, Economic Development and Tourism. (2012, November). Monthly Energy Trends. Retrieved from http://hawaii.gov/dbedt/main/whats_new/info/economic/data_reports/energy-trends

Thomason, M. (2012). EV charging station levels. Retrieved from <http://www.pluginrecharge.com/2009/08/charging-station-levels.html>

U.S. Environmental Protection Agency. (2012). EPA and NHTSA set standards to reduce greenhouse gases and improve fuel economy for model years 2017-2025 cars and light trucks. Retrieved from <http://www.epa.gov/oms/climate/documents/420f12051.pdf>

What is the typical salary of an electrician? (n.d.). Retrieved from http://degreedirectory.org/articles/What_is_the_Typical_Salary_of_an_Electrician.html

Woody, T. (2012, June 18). Automakers, tech companies mining electric car big data to plot industry's future. Forbes. Retrieved from <http://www.forbes.com/sites/toddwoody/2012/06/18/automakers-tech-companies-mining-electric-car-big-data-to-plot-industrys-future/>

World's best awards. (2012). Retrieved from <http://www.travelandleisure.com/worldsbest/2012/islands>

Attachment

All Known Publicly-Accessible Charging Stations on Maui

Known Level 2 Charging Stations & DC Fast Chargers in Maui County by Region

Location, Telephone	Region	Type	Number of stations (pedestals) X charge points (ports)	Access & \$ Usage Cost & Detailed Location	Operational Date (latest to earliest) *Date Completed
Walmart 101 Pakaula Street	Central: Kahului	Blink. Level 2	1 x 1	In the back by the garden center. Free. Requires blink card. 24/7	Oct 2012*
Maui Electric Company Tel: 808-871-8461	Central: Kahului	Siemens (Coulomb) Level 2 Chargepoint	2 x 1	24/7 Free for public. Either use your (free) Chargepoint RFID or call the 1-877 my Chargepoint number to get access. Located next to each other, in front of public entrance for customer service & bill payment.	New replacement of previously installed Coulomb stations Sept 2012
Jim Falk Motors of Maui 260 Hana Hwy., Kahului, HI 96732 Tel: 808-270-2600	Central: Kahului	AeroVironment Level 2	Front: 1 x 2 Back: 1 x 1	Free. Jim Falk clients; close at 7 pm, but packed with other cars already parked. If the main Nissan building is a clock with sales entrance at noon, the back charger is wall-mounted across the alley from the building at 6 o'clock. There's a park bench there.	2011 [installed as a requirement of Nissan Corp as authorized dealer]
Maui Memorial Medical Center 220 Mahalani Street, Wailuku, 96793 Brian Yanno	Central: Kahului	AeroVironment Level 2	1 x 2	Two designated EV parking spaces in the far left of the handicapped parking in the row in front of the ER entrance (facing west Maui mountains). \$15 per charge session, maximum 4 hours. AV FOB and/or credit card.	November 2012
Enterprise Car Rental 40 Hana Highway, Kahului, HI 96732 Tel: 808-871-1511	Central: Kahului	AeroVironment Level 2	1 x 1	Public during office hours M - F 7 am to 5 pm; Sat 9 am to noon. Free but subject to availability. Gate closed otherwise.	March 2012
Alamo Rent-A-Car, Kahului Airport 905 Mokuea Pl. Kahului, HI 96732 Tel: 866-979-4824	Central: Kahului	Better Place Level 2	1 x 2	Alamo discretion; inside their rental facility; not for the public. Better Place Membership, free in 2012	March 2012

Maui County Building Wailuku	Central: Wailuku	AeroVironment DC Fast Charger	1 x DC Fast Charger and 1 port Level 2	Go to County Business Office at the Maui Mall to get an Avinc keyfob by putting a \$20 deposit and registering your details. Watch the video on how to use it. The Level 2 does not require a key fob. Currently FREE until further notice.	21 Sept 2012
Kihei Town Center 1881 South Kihei Road, Kihei, HI 96753 "Kihei Foodland" Tel: 866-979-4824	South: Kihei	Better Place Level 2	1 x 2	Public 24/7; Better Place Membership, FREE 2012 in front of "Happy Nails" between Sansei and Cuatro Restaurants, near Police Station & Rainbow Attic at 24/7 Kihei Foodland	March 2012
Elleair Golf Club, 1345 Piilani Highway Kihei, HI 96753 Tel: 808-874-0777	South: Kihei	Schneider Electric Level 2 Installed by Sunetric	1 x 1	\$12 flat fee per charge session. During golfing hours 6:30 am to 6 pm M-Sun, visit the Pro Shop & attendant will give you access. Otherwise restaurant open 8 to 10 pm. Closed after 10 pm.	June 2012
Four Seasons Resort, Wailea 3900 Wailea Alanui Dr., Wailea Tel: 866-979-4824	South: Wailea	Better Place Level 2	2 x 1	Guest parking, publicly accessible. No need valet, self-park at spaces 167 and 169 (at end of row on left) in valet/self-park garage. Move the cone that's there to prevent non-EV parking. Better Place Membership, free in 2012. Hint: Valet at Hotel Wailea will drive you to/from Four Seasons garage for tip, other hotel valets may if you ask.	March 2012
Wailea Beach Marriott 3700 Wailea Alanui Dr., Wailea, Maui 96753 Tel: 808-879-1922	South: Wailea	AeroVironment Level 2	2 x 1 (one in Valet, one in self- parking)	\$30 for valet parking, waived for hotel guests or purchase on property e.g. Mala Restaurant; not Shops of Wailea or elsewhere [around the corner from one another]. EV charging is free.	Nov 2011 [first hotel on Maui to install charging station]
Ritz Carlton 1 Ritz-Carlton Dr., Kapalua, HI 96761 Tel: 808-669-6200	West Side	Pep Stations Level 2	2 x 2	Outdoor parking lot close to entrance for employees, EV station labeled, where buses and big vehicles park. Free until further notice.	Oct 2012*
Hyatt Regency 200 Nohea Kai Dr., Lahaina, HI 96761 Tel: 808-661-1234	West Side	Pep Station Level 2	1 x 2	In Lahaina parking area, take a left turn towards back area, EV station will be directly on your right. \$3.50/hour, max of 4 hours. Pay with credit card at charger 24/7	Aug/Sept 2012*
Marriott Maui Ocean Club 100 Nohea Kai Dr. Lahaina, HI 96761 Tel: 808-667-1200	West Side	Chargepoint Level 2	1 x 1	Located in the valet station. Free	July 2012*

5A Rent A Space Business Services Center 3600 Lower Honoapiilani Rd., Lahaina, HI 96761 Tel: 808-669-5200	West Side	Eaton Level 2	1 x 1	Public 24/7 outdoor access Credit card \$2/hour (just changed 10/12/2012)	April 2012
Sheraton Maui Resort & Spa 2605 Ka'anapali Parkway, Ka'anapali, HI 96761 Tel: 866-979-4824	West Side	Better Place Level 2	2 x 1	2nd floor of parking lot; Valet parking. Better Place Membership, free in 2012	March 2012
Westin Maui Resort & Spa 2365 Ka'anapali Parkway, Lahaina HI 96761 Tel: 808-667-2525	West Side	Better Place Level 2	2 x 2	Located in a secure area – registered guest parking lot; \$18 for valet parking. Fee is waived for guests of hotel and/or restaurant. Better Place Membership, free in 2012	March 2012
Kahana Gateway 4405 Honoapiilani Hwy, Lahaina, HI 96761 Tel: 866-979-4824	West Side	Better Place Level 2	2 x 2	Public 24/7; Better Place Membership, free in 2012 In rear of shopping center underneath the building close to Shell Station and down from Kahana Koin-Op.	March 2012
Alamo Rent-A-Car, Ka'anapali 30 Halawai Dr., #C Lahaina, HI 96761	West Side	Better Place Level 2	1 x 2	Alamo discretion; inside their warehouse. Not open to the public; Better Place Membership, free in 2012	March 2012
Four Seasons Hotel at Manele Bay, Lāna'i Tel: 808-565-2000	Lāna'i Island	AeroVironment Level 2	1 x 1	Valet available for hotel guests who have priority. Located in the employee parking lot. FREE parking for the public. 24/hours a day. Currently no charge.	July / August 2012

Last update: December 4, 2012

Retrieved from: <http://maui.eva.org/docs/ChargingStationsonMaui.pdf>