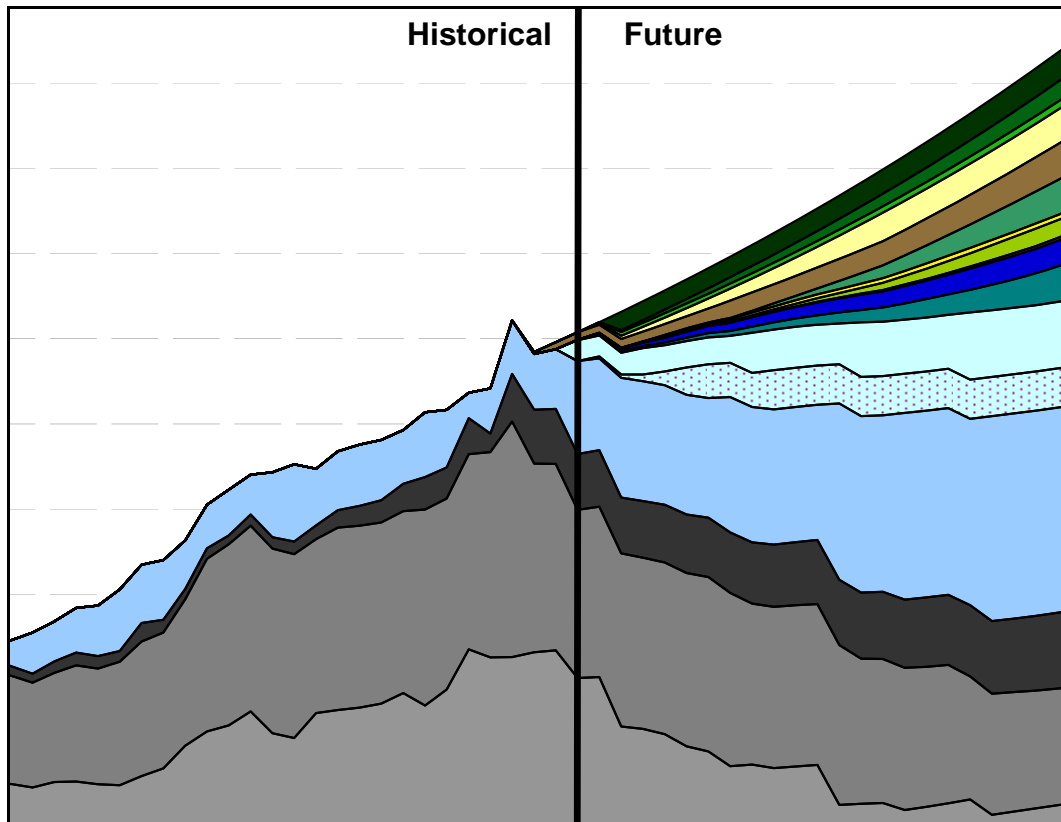


# ANALYSIS AND RECOMMENDATIONS FOR THE HAWAI‘I COUNTY ENERGY SUSTAINABILITY PLAN

OCTOBER 3, 2007

---



---

By Michael Davies, Claire Gagne, Zeke Hausfather, & Dawn Lippert  
Project Manager: Jeremiah Johnson, Ph.D.  
Faculty Advisor: Marian Chertow, Ph.D.

Yale School of Forestry and Environmental Studies

Research conducted for The Kohala Center, Kamuela, Hawai‘i and  
the Hawai‘i County Department of Research and Development  
Prepared for and Funded by the Hawai‘i County Council

# ACKNOWLEDGEMENTS

**The authors would like to extend our sincere gratitude to the many people who have helped in the creation of this report:**

---

Betsy Cole, Matthews Hamabata, Jan Stenberg, Vanessa Geisman, and Debera Crosson at **The Kohala Center**, for their continued administrative, intellectual, and advisory support

To **Noe Noe Wong-Wilson**, a founding member of The Kohala Center's Board of Directors, for her support in matters both intellectual and cultural

The **Hawai'i County Council** for the vision to launch this project, with special thanks to Chairman Peter Hoffman, and Council Members Robert Jacobson and Angel Pilago for their generous financial support

Robert Arrigoni, Jane Testa, and Diane Ley at **Hawai'i County Research and Development**, for their continued insight and support

Prof. Marian Chertow at **Yale University's School of Forestry and Environmental Studies**, for her continued guidance

The many members of the public who provided comments at the various public meetings that were held during the Spring and Summer of 2007

The research team would also like to thank the many people who offered their time and insight through interviews, tours, and emails. Inclusion in these Acknowledgements does not imply endorsement of this report or the recommendations contained herein.

**Department of Business, Economic Development & Tourism:** Steven Alber, Andrea Gill, Maurice Kaya, John Tantlinger, Howard Wiig, Elizabeth Raman, Priscilla Thompson, Maria Tome

**Edith Kanaka'ole Foundation:** Ulu Garmon

**Energy Management Solutions:** Mitchell Johnson

**Gentry Builders:** Robert Kayser, Robert "McKibbin" Mist

**Hawai'i Agriculture Research Center:** Mike Poteet

**Hawai'i County Department of Public Works:** Randy Riley

**State Department of Transportation:** David Hein, Chauncey Wong Yuen

**Hawai'i County Department of Water Supply:** Bettina Arrigoni, Earl Fukunaga, Clyde Young

**Hawai'i County Mass Transit:** Tom Brown

**Hawai'i County Planning Department:** Susan Gagorik, Brad Kurokawa

**Hawai'i Renewable Energy Alliance:** Warren Bollmeier

**HELCO:** Robbie Alm, Pat Moore

**Hawai'i Superferry:** Terry O'Halloran

**Kamehameha Schools:** Peter Simmons

**Kauai County Office of Economic Development:** Glenn Sato

**Maui County Energy Office:** Kal Kobayashi

**Pacific Biodiesel:** Kelly King

**PowerLight:** John Crouch

**Puna Geothermal Venture:** Mike Kaleikini

**Rocky Mountain Institute:** Lionel Bony, Virginia Lacy, Christina Page, Laura Schewel  
**University of Hawai‘i at Hilo:** Dean Bill Steiner  
**University of Hawai‘i at Manoa:** Makena Coffman, Sarah Goorskey, Prof. Goro Uehara  
**US Biodiesel:** Kyle Datta, Cortney Hoffman

# TABLE OF CONTENTS

<b>List of Abbreviations and Acronyms</b>	iv
<b>Executive Summary</b>	ES-1
<b>1. Public Involvement and Outreach</b>	
1.1 Sustainable Energy Plan Stakeholder and Public Meetings	1
1.2 Community Development Planning	1
Kona Community Development Planning Process	2
Puna Community Development Planning Process	3
<b>2. Personnel and Training</b>	
2.1 County Employees	4
2.2 Training for Renewable Technology Maintenance and Repair	5
<b>3. Electricity Supply – Centralized</b>	
3.1 Current Electricity Use and Future Scenarios	7
Historical Electricity Generation and Price	7
Electricity Scenarios	10
3.2 Recommendations for Future Policies	19
Time-of-Day Pricing	19
Block Pricing	21
Transmission Line Upgrades	23
Energy Storage: Pumped Storage Hydro with Wind, Batteries	25
Power Plant Retirements	28
Geothermal Power Development	31
Competitive Bidding	35
Avoided Cost	37
Utility Risk Sharing	38
Renewable Portfolio Standard	40
Net Metering	43
IRP-3	44
<b>4. Supply – Decentralized</b>	
4.1 Solar Energy	46
Photovoltaic Modules	46
Solar Water Heaters	47
Residential Solar Energy	47
Commercial Sector Solar Energy	53
Public Sector Solar Energy	54
Information Dissemination	56
<b>5. Supply – Fuels</b>	
5.1 Biofuels	58
Background and Options	58
Economic Incentives	59
Life Cycle Benefits	61
Research and Development	62
Existing Solid Biomass	68
5.2 Waste to Energy	69
Background to County Solid Waste Management Problems	70
Limited Solid Waste and Funds	71
Recycling	73

Stated Goals of Hawai‘i Legislature and the EPA	74
5.3 Hydrogen	75
What is Hydrogen Energy?	75
Hydrogen Initiatives Outside of Hawai‘i	78
Hawai‘i State and County Initiatives	78
County Implementation of Hydrogen	79
5.3 Ocean Energy	82
Ocean Thermal Energy Conversion	82
Wave Energy	87
<b>6. Demand – Building Efficiency</b>	
6.1 Residential Housing	95
Residential Building Efficiency	95
Point of Sale Incentives and Information for Efficient Appliances and Lighting	115
6.2 Commercial Buildings	123
6.3 Public Sector	128
<b>7. Demand – Department of Water Supply</b>	
7.1 Leak Detection and Repair	129
7.2 Distributed Generation with Microturbines and Photovoltaic Modules	132
7.3 Conservation Strategy	133
<b>8. Demand – Transportation</b>	
8.1 Public Sector	134
Mass Transit and Rideshare	134
Idling	138
County Vehicle Fleet	139
Transportation Lighting	143
Aviation and the Superferry	149
8.2 Private Sector	152
Plug-in Hybrid Electric Vehicles	152
Private Automobile Fuel Efficiency	157
<b>9. Potential Cumulative Effects of Recommendations</b>	165
<b>10. Future Research</b>	174
<b>Appendix</b>	
A. The Supply Side Model	A-1
B. Resources	B-1

# LIST OF ABBREVIATIONS AND ACRONYMS

AC	Air Conditioning
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
B100	100% Biodiesel
B2	2% Biodiesel Blend
B20	20% Biodiesel Blend
B90	90% Biodiesel Blend
BCAP	Building Codes Assistance Project
Boe	Barrels of Oil Equivalent
Btu	British Thermal Unit
CDP	Community Development Plan
CFL	Compact Fluorescent Light Bulb
CT	Combustion Turbine
DBEDT	Department of Business, Economic Development, and Tourism
DSM	Demand Side Management
E10	10% Ethanol Blend
E85	85% Ethanol Blend
ECAC	Energy Cost Adjustment Clause
EIA	Energy Information Administration, U.S. Department of Energy
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GWh	Gigawatt-hours (one billion watt-hours)
HCATT	Hawai'i Center for Advanced Transportation Technology
HECO	Hawai'i Electric Company (parent company of HELCO)
HELCO	Hawai'i Electric Light Company
HEP	Hamakua Energy Partners
HNEI	Hawai'i Natural Energy Institute
HPwES	Home Performance with EnergyStar
HRS	Hawai'i Revised Statutes
IECC	International Energy Conservation Code
IESNA	Illuminating Engineering Society of North America
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IRP	Integrated Resource Plan
IRP-3	HELCO's Third Integrated Resource Plan
kW	Kilowatts (one thousand watts)
kWh	Kilowatt-hour (one thousand watt-hours)
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
MEC	Model Energy Code
MECO	Maui Electric Company
MMBtu	Million British Thermal Units

Mpg	Miles per Gallon
MSFO	Medium Sulfur Fuel Oil
MW	Megawatts (one million watts)
MWh	Megawatt-hours (one million watt-hours)
NEG	Net Excess Generation
NELHA	Natural Energy Laboratory of Hawai'i Authority
NYMEX	New York Mercantile Exchange
O&M	Operations and Maintenance
OTEC	Ocean Thermal Energy Conversion
PAYS	Pay As You Save
PGV	Puna Geothermal Venture
PHEV	Plug-in Hybrid Electric Vehicle
PSH	Pumped Storage Hydro
PUC	Public Utilities Commission
PURPA	Public Utilities Regulatory Policies Act
PV	Photovoltaic
QF	Qualified facility
RESNet	Residential Energy Services Network
RPS	Renewable Portfolio Standard
RSHG	Residential Solar Heat Gain
SEER	Seasonal Energy Efficiency Ratio
SHGC	Solar Heat Gain Coefficient
SWH	Solar Water Heater
TOD	Time-of-day

# EXECUTIVE SUMMARY

Hawai‘i Island depends heavily upon imported petroleum products to meet its energy needs. Petroleum products shipped in from the mainland United States and foreign countries currently satisfy the fuel demand for approximately 70% of electricity generation and virtually all transportation needs. Growth in population, tourism, and the economy has resulted in significant and steady increases in energy demand in the commercial, transportation, and residential sectors.

High petroleum prices are a main factor driving up Hawai‘i County’s electricity price, which was more than three times the national average in 2006. Gasoline prices are among the highest in the nation. Due to this reliance on imported petroleum-based fuels, the County is vulnerable to the volatility of global oil markets and sends hundreds of millions of dollars out of the local economy each year. Fossil fuel use poses environmental problems that include oil spills, air pollution, and the release of greenhouse gases that cause global climate change.

In recognition of Hawai‘i County’s dependency on fossil fuel, the Hawai‘i County Council directed the Hawai‘i County Department of Research Development to create a plan to transition the Island from fossil fuel use for transportation energy and electric generation to a system based on greater efficiency and renewable energy. In September, 2006, the Hawai‘i County Council issued Resolution 419-06, which provided funding for the creation of an energy sustainability plan. The goals of this Resolution included:

“The identification of opportunities and incentives for Hawai‘i County to enhance and maximize energy self-sufficiency and conservation and to employ renewable and alternative power resources and the use of biofuels within County facilities and Hawai‘i Island.”

The report contained herein, *Analysis and Recommendations for the Hawai‘i County Energy Sustainability Plan*, represents the preliminary findings to support this County goal.

In 2005, The Kohala Center and Yale University’s School of Forestry and Environmental Studies launched a program to create a roadmap for sustainability, culminating in the May 2006 publication of the *Hawai‘i County Energy Baseline Analysis*.<sup>1</sup> The baseline report characterized the County’s energy supply and demand, the local, state, and federal energy regulatory structure, and the social and cultural characteristics of Hawai‘i as they relate to energy. This report also served as a key data source for the analysis contained herein to support the County Resolution.

**Energy supply** – the types and sources of energy made available to meet demand (e.g., solar, oil)

**Energy demand** – energy needed to provide the service

As part of this effort, the energy system was examined holistically, including electricity generation and transportation fuel use, with the goal of identifying lowest cost, technologically feasible opportunities that can be employed in the near term.

<sup>1</sup> Available online at: <http://learning.kohalacenter.org/resource/resmgr/pdf/hcbea.pdf>



Opportunities were identified to maximize energy efficiency and conservation as well as to develop economically viable renewable generation. To this end, sixty-six recommendations to the County were developed and are presented and discussed in this report.

***The broad focal areas of this report include energy efficiency and increased energy generation from renewable sources.*** Energy efficiency improvements include measures to improve buildings, transportation, and water use. Renewable generation categories include the use of biofuels in transportation, distributed generation solar technologies, and large scale electricity production options for the utility, Hawai'i Electric Light Company (HELCO), such as geothermal power, wind farms, and pumped storage hydropower. For each of these areas of focus, in addition to several smaller categories, recommendations were crafted to support the County's goals of maximizing efficiency and renewable generation. The group or groups capable of implementing the areas of focus were identified and the potential impacts on the energy system were characterized through 2030.

**Energy efficiency** – reduce demand from existing services without affecting the type or quality of that service

In order to compare the benefits of the different options, it is necessary to evaluate the primary energy use. For example, when discussing a reduction in electricity use caused by an efficiency measure, one should quantify the total energy extracted from nature (i.e., the primary energy) that was required to generate the electricity. Within the State of Hawai'i, each kilowatt-hour of fossil-fuel generated energy saved avoids the combustion of approximately 10,350 Btu.<sup>2</sup>

**Primary energy** – energy resources as extracted from nature

The cumulative effect of the recommendations contained in this report is expressed in Figures ES-1, ES-2, and ES-3 below. These figures compare historic energy use and future energy use under two scenarios; (1) a business as usual scenario (Figure ES-1) where energy in the future is generated and consumed in the same manner as in the past and (2) a more sustainable scenario (Figure ES-2) that implements those recommendations presented in this report. In both scenarios, energy consumption would increase due to increased individual demand, population rise, and additional tourism. However, the amount of energy increase and the manner in which the energy is generated differ dramatically. Figure ES-3 provides a breakdown of the efficiency measures and technologies implemented to provide the results shown in Figure ES-2.

Figure ES-1 shows projected energy demand through 2030 and the means of generation if Hawai'i County were to continue supplying and consuming energy the way it does today (business as usual). As shown, energy demand would continue to increase. A portion of energy generation would continue to be from renewables (mainly geothermal in addition

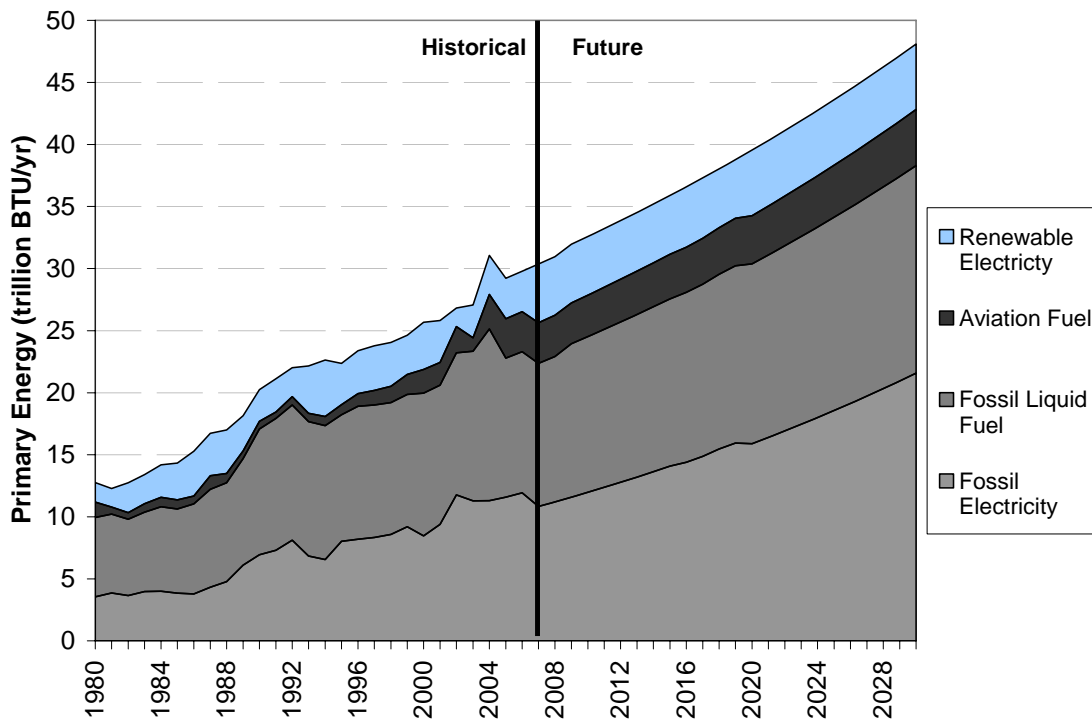
---

<sup>2</sup> For the purpose of this study, the energy content of gasoline, diesel, and the fuels used in power plants are assumed to be equal to their primary energy, despite having undergone processing after extraction; Btu calculation provided by Steven Alber, State Energy Planner, DBEDT, July 2007, calculation performed by Douglas Oshiro, DBEDT.

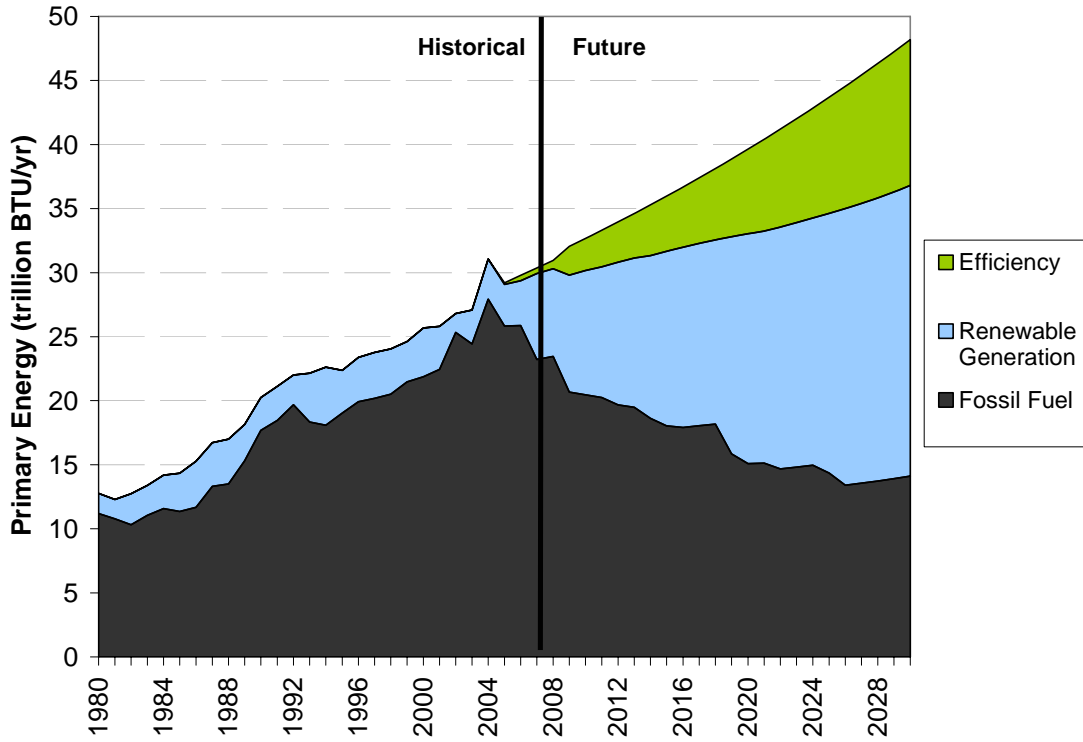
to wind); however, imported fossil fuels would remain the backbone of the energy supply.

Figure ES-2 shows the cumulative contribution of all renewable energy technology and energy saving measures presented in the report. As shown, both efficiency measures and renewable generation play an important role in increasing overall energy independence. The efficiency wedge (in green) illustrates the potential to reduce demand, while the renewable generation wedge (in blue) represents opportunities to employ alternative energy generated on Hawai‘i Island to reduce the use of imported fossil fuels. Both the green and blue wedges are made up of numerous initiatives that are presented in this report. Whereas each recommendation may contribute a modest improvement on its own, the aggregate impact of the various measures on the energy system would be tremendous. This illustrates a central conclusion of this report: energy sustainability would be achieved as the result of numerous and innovative efficiency measures and a more diversified energy portfolio that emphasizes renewable sources.

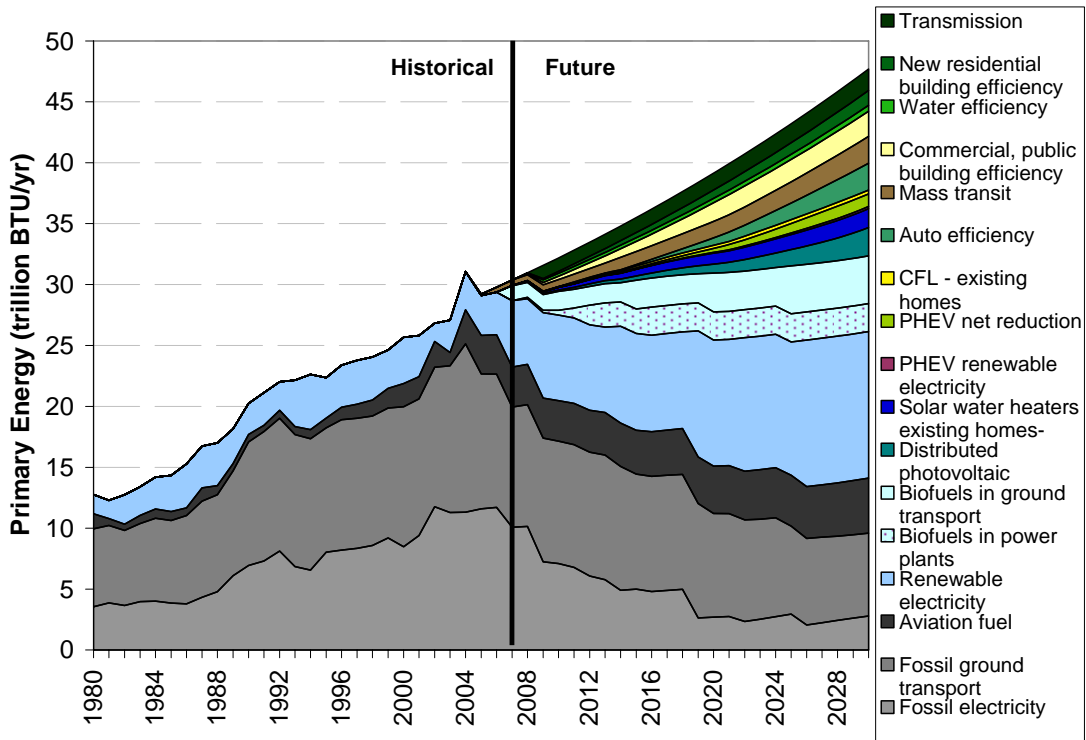
Figure ES-3 shows the contribution of each energy-saving measure and renewable generation technology, which were summarized in Figure ES-2. The efficiency measures (green wedge in Figure ES-2) are segmented into different actions, such as reducing energy losses through improved electrical transmission, improving the energy efficiency in buildings, and increasing the fuel efficiency of transportation. The renewable energy measures (blue wedge in ES-2) are broken down into options such as increased electrical generation from greater geothermal and wind, and from increased use of biofuels for vehicular transportation.



**Figure ES-1: Projected energy supply fuel sources using business as usual scenario**



**Figure ES-2: Estimated potential for all efficiency and renewable generation recommendations in the proposed Hawai'i Island Sustainable Energy Plan**



**Figure ES-3: Primary energy use in Hawai'i County with future energy efficiency and renewable energy actions**

A summary of the assumptions that support this model are provided in Table ES-1 and each contributing factor is discussed in greater detail throughout the body of the report.

**Table ES.1: Assumptions for aggressive efficiency and renewable energy scenario**

<b>Category</b>	<b>Assumptions</b>
Transmission improvements	Line losses are reduced by 1.8% of total generation.
New residential building efficiency	Each year, 1,000 new homes are constructed which utilize 240 kWh/month of electricity as compared to the current average home which utilizes 591 kWh/month.
Water use efficiency	Leaks in the Hilo water transmission and distribution system are repaired, saving approximately 5 million kWh/year in pumping energy. A water conservation strategy reduces water use by 20%. Two microturbines (0.04 MW) are added per year until 2030, which achieve 75% utilization.
Commercial & public building efficiency	Electricity use by these sectors is 36% of total demand and efficiency measures reduce demand by 1.5% per year until a 21% reduction is met.
Mass transit and rideshare	Current growth trajectories, which are very high, are reduced to annual increases of 20% through 2015, followed by 5% annual growth between 2015 and 2030, resulting in 310,000 trips in 2030.
Automobile efficiency	The average passenger vehicle efficiency is increased from 23 mpg to 30.2 mpg in 2030 using a graduated feebate strategy (i.e., CAFEplus)
CFL use in existing homes	Each year, 2,000 homes change to compact fluorescent lights, saving 65 kWh/month, increasing until 32,000 new homes have made the change.
Plug-in hybrid electric automobiles	Beginning in 2010 with a small pilot program, the sales of plug-in hybrids would grow to a green fleet of approximately 40,000 vehicles by 2030. Under time-of-day pricing, the automobiles use electric power for 74% of the miles driven and a 12 kWh charge provides 40 miles of driving.
Solar water heaters for existing homes	Of the roughly 65,000 residences, approximately 10% currently have solar water heaters. Three and a half percent of existing homes add this technology each year (2,300 units), saving 190 kWh/month. Solar water heaters on new homes are included in new building efficiency.
Distributed photovoltaic power	Starting at 1.5 MW in 2007, an additional 110% of capacity is added each year. In 2030 a total of 130 MW of photovoltaics are online with 13 MW installed in 2030 alone.
Biofuels in transportation	Biofuel use in transportation is assumed to meet the Renewable Fuel Standard with 8.5% of ground transportation fuel being met by biofuel until 2010; 10% for 2010 to 2014; 15% for 2015 to 2020; 20% for 2020 to 2025; and 25% 2025-2030. The Superferry would use biodiesel and have one trip per day starting in 2009.
Biofuels in power plants	Biodiesel is used to replace diesel and/or cellulosic ethanol is used to replace naphtha in existing power plants, increasing until reaching 2.3 trillion Btu in 2016.
Renewable electricity on grid	Geothermal capacity increases by 20 MW in 2009 and 10 MW in 2014. In 2019, 40 MW of wind coupled with 30 MW of pumped hydro storage goes online. In 2022, 10 MW of intermittent renewable generation goes online, followed by 20 MW of firm renewable in 2026.

Of the various options presented to the County, those with the most immediate impact include:

- Retiring the HELCO Shipman and Puna steam power plants, replacing them with geothermal generation, and adding pumped storage hydro coupled with wind power;
- Improving building design and performance through codes and incentives, and increasing the use of technologies such as solar water heaters and compact fluorescent light bulbs;
- Improving the fuel efficiency of vehicles;
- Increasing the use of mass transit.

Based on the aggressive scenario represented in Figure ES-3, in 2030, all efficiency measures could cover 23% of the expected primary energy use and renewable generation could cover 46%, leaving approximately 31% of primary energy demand to be met using fossil fuels. This report describes the specific actions that can be taken to achieve the County's goals, beginning with energy efficiency and followed by renewable generation. *The overarching goals are to minimize energy use to the greatest extent possible and to meet remaining demand with energy generated from locally generated renewable resources.*

### **Energy Efficiency of Buildings**

A combination of regulations and incentives for builders and residents represents the optimal strategy for improving the energy efficiency of buildings.

The current Hawai'i County **Model Energy Code** exempts energy efficient construction of **new residential homes**. The County can incorporate specific energy savings requirements into the residential code, such as minimization of roof heat gain, requirements for wall insulation, low-emissivity windows and doors, passive envelope cooling techniques (e.g., use of overhangs), and more efficient air conditioning units. Additions and alterations to existing homes should be subject to these same requirements. These Code updates would mean little in the way of additional costs to the builder but would result in a lifetime of savings to the resident. An additional code requirement should be to place any single-structure residential developments in excess of 6,000 square feet into the more stringent commercial Model Energy Code.

**Model Energy Code** – energy efficiency criteria incorporated into County building codes for new residential and commercial buildings

Beyond regulations, there are many **incentives** that can encourage builders to incorporate energy efficiency measures. In addition to existing state and federal tax credits and utility rebates, the County can promote efficiency through an environmental labeling system for homes, assist builders in paying for energy certifications, streamline the permitting process for efficient buildings, reduce the efficiency verification backlog by hiring a third-party verifier, incentivize the Hawai'i BuiltGreen and the nationally recognized LEED programs, and establish a County energy efficiency tax credit. The federal EnergyStar program provides a labeling system for energy efficiency in homes

and buildings that should be utilized by the County as a guide. A tax credit could be indexed to either the EnergyStar or BuiltGreen programs.

**Building envelope** – the “shell” of the structure (i.e., the walls, roof, doors, and windows)

While the average home in Hawai‘i County uses approximately 600 kWh of electricity per month, one successful contractor on Oahu constructs energy efficient homes that use 60% less energy with upfront construction costs often lower than

conventional home prices. These homes emphasize building envelope design to improve energy efficiency and feature such technologies as solar water heaters, compact fluorescent lighting, and cool roofs.

**If the construction efficiency measures described above are implemented, and new homes in Hawai‘i County realize this 60% reduction in energy consumption, in 2030 an estimated 1.2 trillion Btu per year of primary energy would be saved, which is the energy equivalent of 9 million gallons of diesel per year.**

**Existing residential homes** would likely be exempt from any changes to the Model Energy Code with the exception of remodels and additions. There are still measures that homeowners can take to dramatically reduce their energy usage and cost. Switching from incandescent lighting to **compact fluorescent light bulbs (CFLs)** is a simple action with significant impact. Using only a quarter of the electricity and lasting considerably longer than incandescent bulbs, this technology pays for itself in reduced energy bills in about two months and can save the homeowner hundreds of dollars per year. The main obstacle to widespread use of this technology is lack of consumer information. To meet its goals of energy efficiency, the County should aggressively promote the use of CFLs.

**If 2,000 homes per year switch to this technology until a total of 32,000 homes switch, the annual primary energy demand reduction would be 300 billion Btu per year (i.e., 2 million gallons of diesel).**

**“Pay As You Save”** – a program that eliminates upfront costs of home energy systems by allowing consumers to pay for the system through their electricity bill

Another technology appropriate for retrofitting existing homes is the **solar water heater**. With a \$1,000 rebate from the utility, a 35% tax credit from the State, and a 30% tax credit from the federal government, the home owner ends up paying only a fraction of the system cost upfront. Although the remaining upfront cost is still significant, the investment pays for itself in the form of

energy savings in as little as three years. When the **Public Utility Commission (PUC)** institutes the **“Pay As You Save” (PAYS)** program authorized by State Senate Bill SB2957 Act 240, SLH 2006, residents would be able to pay for upfront costs over time through electricity bill savings with no down payment required. This should greatly reduce the financial barrier for those who do not have the funds needed to pay for the system. It would also encourage the installation of solar water heaters on rental units as it is a way renters can pay for the system as it is used. It is recommended that the County heavily promote this technology and the PAYS program upon PUC implementation. A

County-promoted energy online calculator could show consumers that solar water heating can reduce their yearly electricity expenses by more than \$800. It is also recommended that the **Public Benefit Fund** increase the rebate from \$1,000 to \$1,500.

**If 3.5% of existing homes add a solar water heater every year until 2030, 1.6 trillion Btu of primary energy (i.e., 12 million gallons of diesel) would be saved.<sup>3</sup>**

The federal **EnergyStar** program qualifies energy efficient household appliances, providing consumers with information on energy use. Unfortunately, the “**EnergySaver**” guides that come with appliances at retail stores use the much lower mainland electricity prices to estimate annual energy costs and savings. To inform residents of the true energy costs of appliances, the County can create a **Hawai‘i Island EnergySaver** guide using local electricity rates to encourage the purchase of energy efficient appliances. The quickest pay back for the cost premium of EnergyStar appliances in Hawai‘i County occurs with air conditioners, followed by refrigerators, dish washers, and then clothes washers. In addition to creating point-of-sale information, the County or the Public Benefit Fund could create point-of-sale incentives, which decrease the cost premium of efficient appliances. It would be the responsibility of retailers to use the local EnergySaver information to promote efficient models.

**Public Benefit Fund** – a funding mechanism administered by a third-party to pay for energy efficiency programs

Improving the efficiency of **commercial and public sector buildings** is also a key part of achieving the County’s goals. The commercial energy code should be updated to reflect the new standards of ASHRAE/IESNA 90.1-2004. Such updates also could include “cool roof” requirements, rainwater harvesting, and energy life cycle costing for large projects. County incentives can spur efficiency, including establishing a labeling system for efficient projects, establishing financial incentives for building performance, requiring commissioning agents for all large commercial construction projects, encouraging the Hawai‘i BuiltGreen program, and providing rewards for certifying building operators in energy efficiency.

By requiring high standards for energy efficiency in County-owned and financed buildings, the County would be **leading by example**. Requiring LEED or EnergyStar certification of County buildings would save in energy costs, demonstrate the County’s commitment to efficiency, and develop local expertise in constructing energy efficient buildings.

**The electricity use by the commercial and public sectors is 36% of total electric demand. If a 1.5% annual decrease in energy demand is achieved, which corresponds to a total 21% reduction by 2030, the annual efficiency gains would be 2.1 trillion Btu of primary energy (i.e., 16 million gallons of diesel) in 2030.**

---

<sup>3</sup> This only includes the contribution of solar water heaters on existing buildings. The contribution of solar water heaters on new buildings is included in the section on new residential homes.

**Energy Efficiency in Transportation**

Improving the efficiency of the transportation sector can be achieved by increasing fuel efficiency of the car and light truck fleet with feebates, increasing the use of mass transit, ridesharing, and bicycles, and, when the technology becomes available, promoting plug-in hybrid vehicles.

**Feebates** – a revenue-neutral program which charges fees to purchasers of inefficient automobiles and awards rebates to purchasers of more efficient models

To spur automotive fuel efficiency, the County can encourage the State to initiate a strong **feebate program** in which automobiles are assessed a fee or given a rebate depending on their fuel efficiency. The program can be

**Pivot point** – the set point at which automobiles with higher fuel efficiencies receive a rebate and those with lower efficiencies pay a fee

revenue neutral, with fee revenue paying for rebates and modest program administration charges. This would create no net financial burden on residents yet guide automobile purchasing practices towards more efficient vehicles.

**Taking into account the time for fleet turnover, a successful feebate program could increase the average fuel efficiency of cars and light trucks from 23 miles per gallon**

**Take back effect** – the phenomenon where improvements in energy efficiency lead to additional energy use; in the case of automobiles, greater fuel efficiency is shown to lead to an increase in miles driven

**to 30 miles per gallon by 2030, reducing transportation fuel use by roughly 2.2 trillion Btu or 18 million gallons of diesel per year.** A 10 % take back effect was assumed as energy efficiency improvements typically result in slightly increased consumption.

To demonstrate its commitment to automotive fuel efficiency, the County can lead by example and require that new purchases for its vehicle fleet meet the energy efficiency standards set forth in Hawai‘i Revised Statutes §103D-412 for State vehicle fleets. The County should also require its heavy-duty vehicle fleets to meet **Alternative Fuel Standards** such as the use of **B20** in all diesel-powered vehicles.

The increase in use of **mass transit** in Hawai‘i County over the past two years is a great success story. Ridership has nearly doubled since Hawai‘i Mass Transit implemented the “Hele-on” free bus policy. Increased usage is saving consumers money on fuel and car maintenance, decreasing traffic congestion, creating safer roads, and decreasing demand for automotive fuel. In addition, Hawai‘i Mass Transit is launching a **rideshare program** to encourage carpooling. To expand on this success, the County is actively promoting bus use and rideshare in conjunction with a marketing class from the University of Hawai‘i at Hilo. By providing more buses and more bus routes, the County can continue this rapid growth in public transportation.



**If 20% annual increases in ridership occur through 2015, followed by annual growth of 5% through 2030, the energy savings of these programs would total 2.2 trillion Btu or roughly 18.4 million gallons of diesel per year.**

Where appropriate, the County should require spacing for **bicycle lanes** during the construction of new subdivisions, roads or improvements on existing roadways. Although bicycle lanes are typically most effective in dense urban areas, towns such as Kona, Hilo, and Waimea have sufficiently compact downtown areas to support the use of bicycles. Pending the popularity of bicycle use in these areas, the County should be prepared to offer bicycle rack areas for residents to lock their bikes while riding in and around town. Due to the distance and terrain between the larger town centers on the Island, high demand for bike lanes on these highways is not anticipated. However, the County should ensure that safe bike paths exist wherever possible for any bikers who may wish to travel longer distances. An additional consideration is to purchase cross-island buses with bicycle racks so that riders can use a combination of bicycle and public transportation to travel around the Island; such bus models are readily available from other communities.

**Plug-in hybrid electric vehicles** are an emerging vehicle technology capable of operating as an electric vehicle using an electric charge, as a typical fossil-fuel engine using gasoline or diesel fuel, or as a hybrid electric vehicle (on a combination of electricity and motor fuel). These vehicles simply “plug-in” to a wall outlet like another appliance in order to charge their batteries. General Motors recently announced its intention to produce plug-in hybrids in passenger car and SUV models starting in 2010 and other companies are expected to pursue similar paths.

Since these cars get much of their energy from the electric grid, the environmental performance of their operation depends on the fuel mix that goes into electricity production. In Hawai‘i County, a plug-in hybrid using electricity from the current fuel mix would use fossil fuels on the grid at a rate of 41 miles per gallon of gasoline equivalent. By increasing the share of renewable energy on the grid, a more distinct advantage can be created.

Since these vehicles use utility-generated electricity, the grid must be able to accommodate their charging capacity. Of particular importance is predicting the effect of

**Load curve** – a chart showing the demand for electricity over time throughout a 24-hour period

these vehicles on the **load curve**, an essential tool in electricity planning. Since the utility does not store electricity, the amount of electricity generated at any given time must match the amount demanded by consumers. On the Island of Hawai‘i, residents tend to run many of their appliances and electric products at

the same time, creating a daily peak in electricity demand between 7:00 p.m. and 9:00 p.m. Later at night, after residents go to sleep, electricity demand can drop by over 50%. The utility must have adequate capacity to generate enough electricity to cover these peaks, even if they last for a only few minutes; apart from the utility’s obvious need to provide satisfactory customer service, the sensitivity of electricity grids means that an

inability to meet peak demand could result in brownouts or rolling blackouts. If the plug-in hybrids are charged during evening peak hours, this increases peak demand and requires that the utility utilize its most expensive peak generating units.

By contrast, owners of these cars could avoid contributing to this peak demand problem by plugging them in during off-peak times. This can be encouraged through a strong **time-of-day pricing** system, which charges customers more for electricity used during peak hours and less for electricity used during off-peak hours, a structure that closely reflects the utility's generating costs. A time-of-day pricing scheme is currently proposed (pending PUC approval) for up to 300 homes in the County. Another option would be to offer electric vehicle charging rates and to use technology to control charging stations to prevent use during peak demand periods. If the utility is able to successfully manage charging these vehicles, plug-in hybrids could prove to be a new source of revenue for the utility and allow it to use excess nighttime capacity, especially available renewable generation that must sometimes be curtailed at night due to low demand. Such a charging structure also provides load curve benefits by making demand more consistent throughout the day and night. Given the sensitivity of electricity grids to demand fluctuations, a more balanced load curve also benefits electricity transmission.

**Time-of-day pricing** – charging electricity users more when demand is high and less when demand is low, reflecting actual generation cost fluctuations

Another solution to the potential load problem associated with plug-in hybrids comes in the form of an emerging technology, “**Vehicle to Grid**” or **V2G**, which is currently in development for use with electric vehicles such as PHEVs. Using V2G, the batteries in PHEVs could essentially serve as small, mobile electricity storage and supply systems for the electric grid. Instead of presenting a potential load curve problem, PHEVs would offer a compelling partial-solution to load curve problems associated with electricity peaks and valleys. V2G is also envisioned as acting as a buffer to the intermittency of certain forms of renewable power like wind, for which an unpredictable supply represents a barrier to use. Capable of capturing power generated by wind energy, V2G could store this power for the grid.

**If this technology proves viable, and if by the year 2030, forty thousand of the cars on the Island (about 15%) are plug-in hybrids, the net efficiency gains from these vehicles would be 1.0 trillion Btu or 9 million gallons of gasoline per year, assuming that 74% of miles driven are on an electric charge and there is a take back effect of 10%.**

These fuel reduction estimates do not account for ongoing advancements in PHEV technology that promise to increase the battery range to 100 miles per charge and further reduce expected fuel demand through mile per gallon ratings of more than 100 mpg. In the absence of V2G technology, the PUC and the utility should work to create a strong time-of-day pricing scheme to help make plug-in hybrid operation significantly less expensive than traditional automobiles and capture fuel reduction and load curve benefits.

When PHEVs become available, the County should lead by example and adopt them as a pilot program into their fleet.

### **Energy Efficiency of the Water System**

With most of the County's water supply coming from ground water that requires extensive pumping, water usage is linked to energy use. In fact, the **Department of Water Supply** is the largest consumer of electricity in the County, representing 5% of total use. There are five main areas for potential improvement: repair the most extensive leaks in the water system, create a water conservation policy, develop more storage capacity to prevent the need for peak pumping, institute a pump system maintenance and efficiency program, and install generating pressure reducing valves.

**Generating pressure reducing valve** – an apparatus that captures energy from the pressure in the water system that must be reduced before distribution to the customers

As recently as 2006, the Hilo area water system had extensive **water transmission leaks** that resulted in up to 44% of pumped water being lost during transmission. In 1999, the Department of Water Supply launched a program to identify leaks and estimate the cost of their repair and found that the median pay back time is less than one year. The repairs that have been conducted have been largely successful, with Island-wide leaks reducing from 23% to 12%.

**With continued implementation of this program, the Department of Water Supply can reduce electricity usage by 5 million kWh per year, or the equivalent primary energy of 500,000 gallons of diesel.**

A comprehensive **water conservation policy** would further reduce water and energy demand. Currently, the Department of Water Supply requires voluntary and mandatory conservation of its customers only during low water events such as droughts, equipment malfunctions, or storage problems. There is no day-to-day water conservation policy. Conservation could include rainwater harvesting on large commercial properties, installing water re-use systems, creating a progressive pricing scheme that rewards water efficiency, and creating point-of-sale incentives for water efficient appliances.

**If a conservation policy were to reduce water demand by 20%, the primary energy savings would be 270 billion Btu in 2030 (i.e., 2 million gallons of diesel).**

The number of viable sites for **generating pressure reducing valves** needs to be closely examined by the Department of Water Supply and these valves should be installed where cost effective.

**If it is found that two of these units can be installed each year, each rated at 40 kW and achieving 75% utilization, 150 billion Btu of primary energy (1 million gallons of diesel) would no longer need to be taken from the grid each year by 2030.**

### **Energy Efficiency through Reduced Electric Transmission Losses**

With a majority of the electric generation capacity on the East side of the Island and a large and increasing demand on the West side, adequate cross-island **transmission** is essential to grid stability and the minimization of **line losses**.<sup>4</sup> Current system-wide losses are between eight and nine percent of generation; improved transmission lines would cut these losses to less than seven percent. Plans are already underway for the utility to improve three of these lines, alleviating some of the concerns for overcrowding and reducing line losses.

**Line losses** – electricity that is lost during transmission over power distribution lines.

**If these upgrades are implemented, it would reduce generation fuel by an estimated 1.8 trillion Btu of primary energy in 2030 annually (i.e., 14 million gallons of diesel).**

### **Renewable Electricity Production by the Utility**

In 2006, over 76% of electricity generation in Hawai‘i County was from petroleum-based fuels (diesel, medium sulfur fuel oil, and naphtha), 17% was from geothermal at Puna Geothermal Venture, 5% was from hydropower, and 2% was from wind power. The share of generation from wind power will increase to over 10% of generation with the addition of the Hawi and South Point wind farms.

The utility must plan for new generation capacity to meet expected peak demand while creating a system that can also effectively operate at low off-peak levels. Since the Island is an isolated grid, the utility cannot obtain electricity from another region in the event of a serious supply disruption. The penalty for failing to meet demand is severe: blackouts and system damage can occur. HELCO must therefore meet all requirements for power from its own resources and/or from independent power producers under contract to HELCO, a grid structure that is unusual for most of the United States.

All forms of generation are not created equal and some possess distinct advantages over others. It is helpful to segment the different types of generation in the County into five groups:

1. **Non-regulating baseload plants** are units that are intended to be run all of the time, except during repairs. “Non-regulating” refers to their inability to adapt their output to maintain frequency and voltage consistency. The only unit in this category, **Puna Geothermal Venture (PGV)** facility, could become regulating baseload units with technological improvements.
2. **Regulating baseload plants** are also intended to run all or most of the time, but these units are equipped with automatic generation controls to rapidly allow for adjustment to manage frequency and voltage. As these plants are most efficient

---

<sup>4</sup> Longer-term solutions should consider reducing or eliminating the need for cross-island transmission. As the island’s population and hospitality industry continue to grow along the Kona and Kohala coasts, the demand for electricity rises accordingly. The West side of the island possesses an abundance wind and solar resources that offer clean, cheap, and geographically close potential power resources. In particular, the Western demand is ideally suited to a pumped storage hydro installation, which would make use of abundant renewable resources to provide for the significant peak demand brought on by the hospitality industry (resorts, hotels, condominiums).

when operating all day, it is desirable to have baseload generation that does not exceed minimum demand. The Puna and Hill plants, which run on a fuel called MSFO, are examples of regulating baseload plants.

3. **Intermediate or cycling plants** fill in the gaps between baseload generation and peaking plants, running for the portion of the day when demand is higher than the minimum load and compensating for extra baseload or peak demand. The Puna CT-3, Keahole CT2, CT4, CT5, CT7, and Shipman plants are all cycling/intermediate generators.
4. **Peaking plants** provide power for short periods of the day when demand is the highest. Kanoelehua CT-1 is a peaking plant.
5. **Intermittent sources**, which are variable and depend on natural conditions, include photovoltaic power, wind power, and some forms of hydropower. Two new wind farms have recently come online, the Upolu farm located on Upolu Point near Hawi and the Apollo farm located in South Point.

A model was created for this report to assess the feasibility of meeting the County’s renewable energy goals by incorporating more renewable generation in the electrical grid. Four scenarios were examined: three were taken directly from the **utility’s Integrated Resource Planning (IRP)** process (the “Baseline,” the “Preferred Option,” and “Maximum Renewables”). A fourth scenario entitled the “Energy Sustainability Plan” was generated for this study and examines the effect of plant retirements. All four of these scenarios were assessed in concert to determine how the quantification of energy generation by source and total scenario cost compare.

**Baseload plants**– power plants intended to be run all of the time except during repairs  
**Intermediate or cycling plants** – power plants intended to run some of the time  
**Peaking plants** – power plants that generally run only when there is high demand  
**Intermittent sources** – power generation that is variable and determined by natural sources such as wind

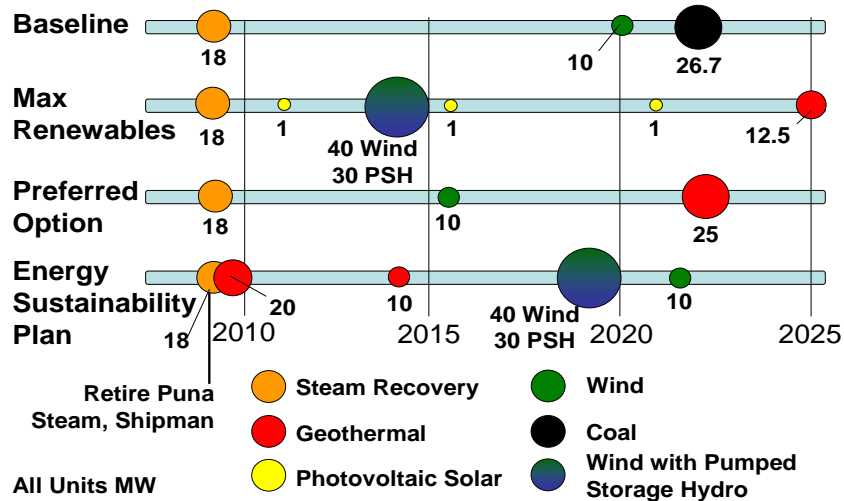
The IRP process is the mechanism by which the utility develops a “preferred” plan that it submits to the Public Utilities Commission (PUC) for approval. The goal of IRP is the identification of resources or the mix of resources for meeting near and long term consumer energy needs in an efficient and reliable manner at the lowest reasonable cost.<sup>5</sup> Nearing the completion of the third planning cycle (IRP-3), the Preferred Plan chosen by the utility involves the addition of a combined cycle unit (i.e., an efficiency improvement) at the Keahole facility in 2009, followed by 10 MWs equivalent of wind power in 2016<sup>6</sup> and 25 MW of firm renewable energy in 2022. In the IRP-3, there are no listed plans for power plant retirements.

**Integrated Resources Planning** – the mechanism by which the utility seeks to identify the resources or mix of resources for meeting consumer energy needs in an efficient and reliable manner at the lowest reasonable cost

<sup>5</sup> Integrated Resource Planning (IRP) Draft Document

<sup>6</sup> The IRP-3 preferred plan actually calls for 37 GWh per year of an intermittent source in 2016, which was modeled as 10 MW of wind power.

A comparison of the four scenarios was performed for this report and a summary is presented below in Figure ES-4. The figure presents a timeline of action under the three plans outlined in the IRP as well as for the Energy Sustainability Plan that was developed for this report.



**Figure ES-4. Comparison of Energy Generation Scenarios**

In the Energy Sustainability Plan scenario, two of HELCO’s least efficient fossil fuel plants (the Puna baseload plant and the Shipman intermediate plant) are retired as soon as possible. This generation capacity is replaced by increasing geothermal production at **Puna Geothermal Venture (PGV)** by 20 MW, equipped with automatic generation controls to allow for grid regulation. PGV, which currently has 30 MW of capacity, is permitted to increase generation output by an additional 30 MW at its existing site, for a total of 60 MW. Of the 20 MW PGV increase, up to 8 MW could be met with a steam recovery unit, which would avoid the need to drill additional wells. In 2014, this Energy Sustainability Plan calls for increasing geothermal output by an additional 10 MW. Five years later, a 40 MW wind farm coupled with a 30 MW pumped hydro storage is added. The use of pumped storage hydro system in conjunction with an intermittent energy source like wind can effectively alleviate the intermittency concerns associated with renewable power. This scenario also calls for 37 GWh per year of an intermittent renewable (possibly wind) in 2022. To match the IRP scenarios, the Energy Sustainability Plan scenario goes until 2025, with the minimum and maximum loads of the Energy Sustainability Plan scenario and the IRP Preferred Plan being quite similar.

**Pumped storage hydro** – a system that pumps water up an incline into a reservoir during periods of low electricity demand and then, during high demand, releases that water down the incline through a turbine to produce electricity

**If this Energy Sustainability Plan scenario were implemented, renewable electricity generation would replace 12 trillion Btu of fossil fuel primary energy in 2030, the equivalent of 94 million gallons of diesel per year.**

This is more than double the expected fossil fuel displacement from renewable utility generation expected to occur in 2007, which is 5.3 trillion Btu of primary energy.

Note: Since the time horizon of this report measures the effects of energy efficiency and renewable energy actions in 2030, the Energy Sustainability Plan adds an additional 20 MW of firm renewable generation in 2026.

There are five essential factors that must be considered when evaluating the costs and savings potential from each of these scenarios:

1. **Base savings** – The current difference between what HELCO pays for its own power and what it pays its Independent Power Producers.
2. **Efficiency gains from retirement** – By retiring the least efficient fossil fuel plants, the remaining (more efficient) plants decrease the average unit cost of power.
3. **De-linking avoided cost savings** – Avoided costs paid to independent power producers are currently linked to HELCO’s fuel costs. This has the perverse effect of raising the cost of renewable energy production (e.g., wind) to the high cost of oil and eliminates the financial benefits of cheap renewable power for the consumers. Payments for renewables should be de-linked from oil prices. A law was passed by the State Legislature in 2006 calling for delinking by the PUC. At this time, no docket addressing delinking has been submitted to the PUC.
4. **The future cost of greenhouse gases** – In light of the Governor’s recent signature enacting the **Global Warming Solutions Act** (Act 234, Session Laws of Hawai‘i 2007) and utilities across the nation funding reductions in the greenhouse gas emissions, it is becoming increasingly likely that a price could be put on such emissions in the near future.
5. **Energy storage costs** – This factor captures the cost of energy storage, including pumped storage hydro, which allows for increased use of intermittent renewables.

**Independent power producer** – privately owned power plants that sell electricity to the utility under a power purchase agreement

**Avoided cost** – the rate the utility pays qualified independent power producers of nonfossil fuels, based on what they “avoid” paying by purchasing rather than producing electrical energy.

Using Energy Information Administration oil price estimates, it was found that the net present value of the Energy Sustainability Plan scenario resulted in a savings of \$230 million over the baseline scenario presented in the IRP-3.<sup>7</sup> By contrast, HELCO’s IRP-3 Preferred Plan results in a net present value savings of \$33 million over the base case.

---

<sup>7</sup> Assuming a 5% discount rate.

The Energy Sustainability Plan scenario cost savings are segmented as follows: The base and efficiency savings minus the storage costs totaled \$38 million. Unlinking the avoided costs resulted in the largest savings: \$129 million. Assuming a cost of carbon at \$20 per ton of CO<sub>2</sub>, \$63 million in the cost of carbon would be saved over the IRP-3 base case.<sup>8</sup>

Several actions can be taken to achieve the benefit of the Energy Sustainability Plan scenario: 1. The County, PUC, and the community can convince the utility that accelerated renewable generation should be pursued. 2. The PUC can delink avoided cost and renewable generation through a strong **competitive bidding process**, with the effect of driving down costs and passing the savings on to the consumer. 3. The PUC can strengthen the **Renewable Portfolio Standard** by removing efficiency from the calculation in order to focus on increasing renewable generation. 4. The PUC can implement utility

**Competitive bidding** – the process of soliciting proposals for a project from a variety of developers and choosing the best proposal based upon criteria set forth in the request for proposals

risk sharing for oil prices, rather than passing through all increases in oil price to the public, and mandate that consistent oil forecasts are used for setting the base rate and the IRP process. 5. Since greenhouse gas regulations seem inevitable, the utility should include the cost of releasing greenhouse gases in its planning, thus including the expected financial and environmental advantages of an accelerated renewables plan.

**Renewable Portfolio Standard** – Hawai‘i Revised Statute Section 269-92 requires each electric utility to meet minimum percentages of generation using renewable

### **Biofuel Use in Power Plants and Transportation**

There are numerous options in the production of biofuels. **Ethanol** can be produced from multiple crops or through emerging processes for cellulosic materials. **Biodiesel** can be produced from oil crops, waste oil including used cooking oil, and algae. In addition to the production of these liquid fuels, biomass can be directly combusted to produce electricity from steam turbines, which includes waste-to-energy technology.

Liquid biofuels can be utilized for transportation and, in some cases, as substitutes for petroleum-based fuel in power plants. A study by the Hawai‘i Agriculture Research Center highlighted the tremendous potential for biofuels in the State of Hawai‘i, estimating that over 100 million gallons of biodiesel could be produced per year in the County of Hawai‘i alone.

A current incentive to produce biofuels for the transportation market is the **Alternative Fuel Standard (AFS)**. The State created the AFS to facilitate the development of alternative fuels by having an escalating share of highway fuels provided by alternative fuels, starting with 10% in 2010 and increasing

**Alternative Fuel Standard** – a state law requiring the development and use of alternative fuels

<sup>8</sup> In the absence of a price for carbon, this assumption is based on current and future carbon prices based on the European Union Emissions Trading Scheme and Regional Greenhouse Gas Initiative. The actual price for carbon in Hawai‘i may be more or less than \$20/ton of carbon equivalent.



to 20% by 2020. Coinciding with AFS, the State created producer tax credits to incentivize producers to construct biorefineries. To date, no plants have been built.

Parties who are interested in developing biofuels in Hawai'i County cite several key challenges:

1. For energy crop production on the Island, agricultural and mill pilot projects are needed to prove crop yields and production costs to investors;
2. Long-term purchase contracts are needed to mitigate some of the risk of the investment;
3. Infrastructure upgrades need to be executed including repairs to the agriculture water systems.

Representing an intersection between energy and agriculture, the cultivation of feedstocks and refining of biofuels introduce new complexities for both of these well-established industries. Several broad concerns are inherent in the development of a biofuel market: energy security, food security, economic viability, impact on natural resources, and end-use efficiency tradeoffs. To best understand the net energy yield, the pollutants released, the resource trade-offs, and the additional energy security associated with the various strategies, the County could fund a life cycle analysis to determine the net benefits.

In many respects, the capacity of the County of Hawai'i government to determine the development path of a nascent biofuels industry is limited. State agencies, HECO, and large private investment would play a significant role in developing this market. In June 2007, HECO announced that it and its subsidiaries would commence steps to transition its existing plants from petroleum diesel to biodiesel. HECO and its partner in this venture, BlueEarth Biofuels LLC, would import palm oil crops with a provision to use locally grown feedstocks when available. This plan provides significant encouragement to grow the market for locally grown and produced biodiesel. HECO stated that a key component of its plan is to encourage the development of locally grown biofuels feedstock to provide the fuel for their operations. Though not having fully developed its plans for use of biodiesel, the utility could meet its Renewable Portfolio Standard goals by using biodiesel in its diesel generators and turbines, as well as investigating the potential for blending ethanol with naphtha.

**If the utility uses 2.3 trillion Btu of biofuels per year by 2030, and the transportation sector (including the Superferry) uses 3.7 trillion Btu per year, 12.5% of the expected primary energy would be met by biofuels.** If the biofuel of choice was biodiesel, approximately 46 million gallons per year would need to be produced, requiring 115,000 acres of agricultural land with yields of 400 gallons per acre. Such a yield may be representative of kukui as the energy crop of choice, with higher yields attainable by palm oil and algae. If ethanol is utilized, 58 million gallons would be needed to meet the energy requirement. The amount of land needed to produce this much ethanol is highly dependent on the type of energy crop chosen (e.g., cellulosic or sugar) and the yields that would be determined through the pilot plot study. Likely, to meet the total demand for biofuel, some combination biodiesel and ethanol would be produced,

determined by market conditions and the ability for the agricultural production and processing to reduce costs and maximize efficiencies.

The potential for biofuels production on Hawai'i Island could increase economic opportunities in farming, extracting, and refining. However, a local biofuels industry also would introduce new pressure on fragile natural resources and existing infrastructure. There are several urgent steps the County should consider in response to this new industry:

1. The County should fund a life cycle analysis to determine the net benefits associated with various biofuel strategies;
2. The County should make available County lands for biofuels feasibility pilot projects;
3. The County should carefully examine capital investment needs for additional infrastructure requirements. New industries, State agencies, and the utility companies should be required to contribute to the improvement of necessary infrastructure upon which they will rely;
4. The County should examine the full range of costs and benefits to the County of having biofuels feedstocks grown on the Island; and,
5. The County should determine the potential impact biocrop cultivation would have on local food production.

One final note, should a local biofuel production industry develop in Hawai'i County, the most appropriate end-use for biofuels becomes an additional concern. Given the inefficiencies of HELCO's power plants and the number of existing alternatives for electricity generation, biofuels may be more appropriate for use in the transportation sector where fewer alternatives exist.

### **Distributed Generation of Photovoltaic Power**

**Solar power** using photovoltaic technology currently represents a small portion of total electricity generation. The global market for photovoltaic systems is rapidly growing and the efficiency of solar modules continues to increase.

Photovoltaic systems are typically used as **distributed generation**, as opposed to a form of centralized power generation. When distributed generation units are attached to the electrical grid, they have the potential to get credit for excess energy going back to the grid. To facilitate this, Hawai'i Revised Statute (HRS) Section 269-101.5

currently requires the utility to allow **net metering**. System sizes are currently limited to 50kW, with cumulative net metering agreements kept below 0.5% of the utility's peak demand. Exemptions can be made on a case-by-case basis to allow net metering for systems larger than 50 kW. Peak demand is approximately 200 MW; cumulative net metering limits are therefore set at approximately 1 MW. Increasing the net metering standards would allow more photovoltaic installations to sell power to the grid. This must be balanced with the need for the utility to utilize effectively this intermittent

**Distributed generation** – non-utility electrical power generated by small sources such as PV panels, micro wind turbines, and some cogeneration systems

generation. Off-grid systems that do not wish to pursue a grid connection are not limited by net metering laws.

**Net energy metering** – measuring the difference between electricity supplied through the grid and electricity generated by an eligible customer-generator that is fed back to the grid in a billing period

For photovoltaic systems, existing federal and state tax credits cover up to 30% and 35%, respectively, of the system cost. These generous tax incentives result in estimated payback periods as low as two years for commercial installations and eight years for residential installations. A Pay As You Save program for residential photovoltaic systems would eliminate the need for a down payment, allowing homeowners and

renters to pay for the upfront cost of a system over time through their monthly electricity bills.

County buildings are unable to claim the federal and state tax credits or use accelerated depreciation, increasing the payback time to 14 years for County installations. The County can, however, use a third-party (i.e., private corporation) PV developer that would retain ownership of the PV installation and charge a fee for electricity provided. The County may be able to negotiate lower costs due to the tax credits and accounting savings enjoyed by the third part PV provider. This is a great option for County facilities.

With ambitious and incremental growth starting immediately, photovoltaics may reach a total installed capacity of between 80 and 130 MW by 2030. This capacity would exceed the net metering allowances, so these installations would either need to use all of the energy on site, allow some of the energy to be wasted, or invest in energy storage.

**The primary energy displaced by 130 MW of photovoltaic modules would be approximately 2.3 trillion Btu annually (i.e., 17 million gallons of diesel equivalent).**

#### **Personnel to Implement the Hawai'i County Sustainable Energy Plan**

For many of these recommendations to be realized, the necessary personnel must be in place to implement them. Although Hawai'i County would spend an estimated \$750 million in 2007 on energy, there are currently no County-funded personnel assigned exclusively to the management of energy issues. In order to achieve the County goals for efficiency and renewable generation, it is recommended that the County create three full-time positions:

1. A **green building expert** who would be responsible for retrofitting existing County buildings with energy efficiency measures, facilitating third-party installations of solar photovoltaic systems, assisting in energy efficiency certification for all new County buildings, and recommending and interpreting updates of the model energy code to the County;
2. An **energy policy analyst** who would be responsible for the implementation and ongoing update of the Sustainable Energy Plan, recommending County positions on State level legislation and PUC dockets, and participating in energy forums and boards; and,

3. An **energy and sustainability advisor** at the cabinet level who would facilitate the delivery of accurate and timely information to the administration, cut across departments and develop consensus between department administrators, and work directly with the Mayor to establish County energy policy.

### **Implementation**

There are numerous actors who each play an important role in meeting the energy goals of the County. A summary of potential actions is provided here:

#### **County Government**

The highest impact actions that the County can take to meet its energy goals include improving the Model Energy Code for residential and commercial buildings; creating incentives for builders to find innovative ways to improve efficiency; mandating that all County buildings obtain EnergyStar labeling or LEED certification; issuing requests for proposals for third party solar installations on County properties; distributing information to residents on compact fluorescent light bulbs, solar water heaters, mass transit, and EnergyStar appliances; increasing the number of buses and routes used for mass transit; encouraging the State to create a feebate system to improve automobile efficiency; and transitioning the County fleet to efficient vehicles.

Other County actions that would also have a positive contribution are continuing the leak detection and repair program at the Department of Water Supply; creating a water conservation policy; adding generating pressure reducing valves to the water system; eliminating the weight tax for efficient vehicles; and creating a County pilot program for plug-in hybrid vehicles when they become publicly available.

In addition to actions that the County can directly execute, the County can also express its support for the recommendations upon which the State, PUC, and utility must act.

#### **Consumers**

At present, solar hot water heaters and energy efficient lighting represent the best actions for consumers in terms of energy conservation and financial savings. Both of these technology retrofits pay for themselves several times over. Additional high impact actions that consumers can take include eliminating use of air conditioners (or if necessary, purchasing an efficient air conditioner), using the free mass transit and ride share systems, and purchasing the most efficient car that meets their needs.

Other actions by residents that could help the County meet its energy goals include participating in the Community Development Planning process; providing feedback to the Consumer Advocate; advocating for the retirement of the least efficient fossil fuel plants; purchasing other EnergyStar appliances; installing cool roof technologies such as radiant barriers; and, if building a new home or addition, hiring a builder who optimizes energy efficiency.

Consumers who support the goals of the Energy Sustainability Plan can assist in its implementation by writing letters of support to local newspapers, telling friends and

family about energy efficient actions that they can take, and expressing their support for energy sustainability measures to their County Council Member.

### **Hawai'i Electric Light Company (HELCO)**

As one the most influential organizations in the County's energy sector, the support of the electric utility (HELCO) would greatly enhance the ability of the County in achieving its goals of efficiency and renewable generation. The utility can accelerate the use of renewable generation by retiring the Shipman and Puna steam facilities, working with Puna Geothermal Venture to increase their capacity to 60 MW, and issuing a request for proposals for a 40 MW wind/30 MW pumped storage hydro development.

The utility can also negotiate its contracts at below avoided cost to lower rates; use consistent oil forecasts for setting their base rate and planning in the IRP process; incorporate the cost of greenhouse gas emissions in their planning; launch the time-of-day pricing system with more smart-meters and a larger price differential; and expand block pricing with a larger price differential.

### **State of Hawai'i**

In addition to the many initiatives that have already passed at the state level, the State could institute a feebate to encourage energy efficient automobile purchases and implement the Global Warming Solutions Act to reduce greenhouse gas emissions.

Other actions that would have a positive effect for the County's energy goals include the elimination of the state sales tax, registration fee, and weight tax for energy efficient vehicles; and weighting the Alternative Fuel Standard and Renewable Portfolio Standard to reflect the life cycle benefits of various biofuel production schemes.

The State should also encourage maximizing renewable energy production at the Natural Energy Lab Hawai'i Authority (NELHA).

### **Public Utilities Commission**

The PUC regulates the electric utility and could require the utility to adopt an IRP plan that focuses on accelerating the use of renewable generation; separate energy efficiency from the Renewable Portfolio Standard; enforce the competitive bidding process; delink avoided costs from the price of oil; incorporate risk sharing of future oil prices in the utility base rate; require that the utility uses the same oil forecasts in settings the base rate and IRP planning; require that the utility incorporate the cost of greenhouse gas emissions in IRP planning; and expand the time-of-day pricing system with more smart meters and a larger price differential.

### **Building and Construction Industry**

In order to meet the County's energy goals, builders can work with the County on developing Model Energy Code requirements; determine which existing incentives for energy efficiency can be claimed for the projects on which they are working; and conform with recommendations in the "Field Guide for Energy Performance, Comfort,

and Value in Hawai‘i Homes”<sup>9</sup> (for residential structures) and “Hawai‘i Commercial Building Guidelines for Energy Efficiency”.<sup>10</sup>

### **The Commercial Sector**

Commercial enterprises should assess the financial viability of installing solar water heaters or photovoltaic modules; introduce water saving techniques and water reuse processes; utilize compact fluorescent light bulbs or advanced tube type fluorescent systems, programmable thermostats, and efficient air conditioners; and require efficient construction. Appliance retailers can provide EnergySaver flyers specific to Hawai‘i County’s electricity costs and promote the purchase of EnergyStar products.

### **Researchers**

To help meet the County goals for the Sustainable Energy Plan, researchers can run agricultural and mill pilot projects for biofuel development; conduct a life cycle assessment on various production schemes for biofuels; and continue to encourage and support research and development into emerging energy technologies such as **hydrogen, ocean thermal energy conversion, and wave energy.**

---

The recommendations outlined in this report should serve as a catalyst for discussion and as a platform for community engagement. The report aims to inspire a productive dialogue among residents, policy makers, industry, and non-governmental organizations.

Hawai‘i Island has long demonstrated a commitment to sustainability and a strong ethic of environmental stewardship. State and County leaders have taken proactive steps to diversify energy supply and encourage energy efficiency. These policies include providing tax incentives for renewable energy generation, instituting a free public bus system on Hawai‘i Island, funding research into and development for alternative energy technologies, installing energy efficient appliances in public buildings and other facilities, and a number of other important initiatives.

This report builds on these efforts to offer a comprehensive and ambitious plan for future energy management on Hawai‘i Island. The recommendations strengthen existing policies, address current policy gaps, and suggest additional courses of action. A multifaceted approach that examines all aspects of supply and demand is essential because energy challenges cannot be effectively addressed in isolation.

---

<sup>9</sup> Available online at: <http://www.Hawai‘i.gov/dbedt/info/energy/efficiency/fieldguide/>

<sup>10</sup> Available online at: <http://www.Hawai‘i.gov/dbedt/ert/cbg>