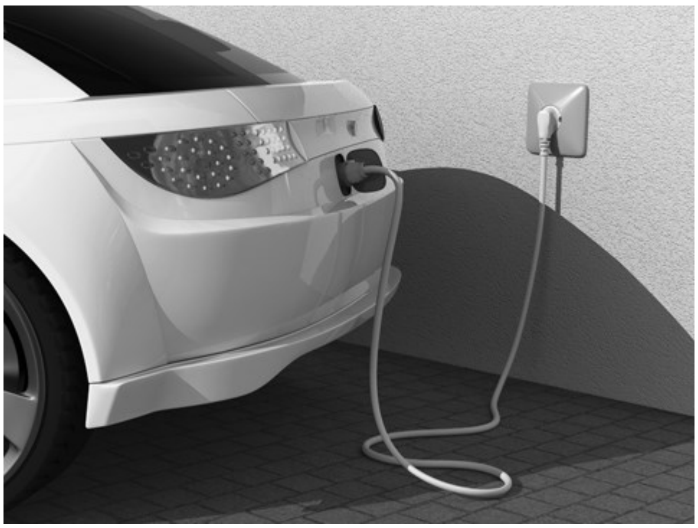
Hawaii Energy Facts & Figures



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Renewable Energy
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Endnotes

May 2017

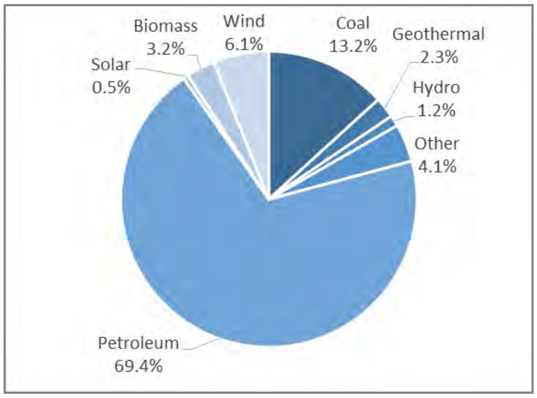
HAWAII STATE Energy Office

State of Hawaii Department of Business, Economic Development, and Tourism
Hawaii State Energy Office · energy.hawaii.gov

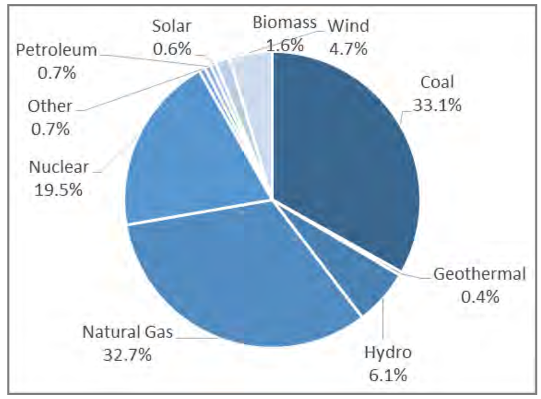
Hawaii Energy Overview

Hawaii depends more on petroleum for its energy needs than any other state. Less than 1% of electricity in the United States is generated using oil. By contrast, Hawaii relied on oil for 69.4% and on coal for 13.2% of its electricity generation in 2015.[1]

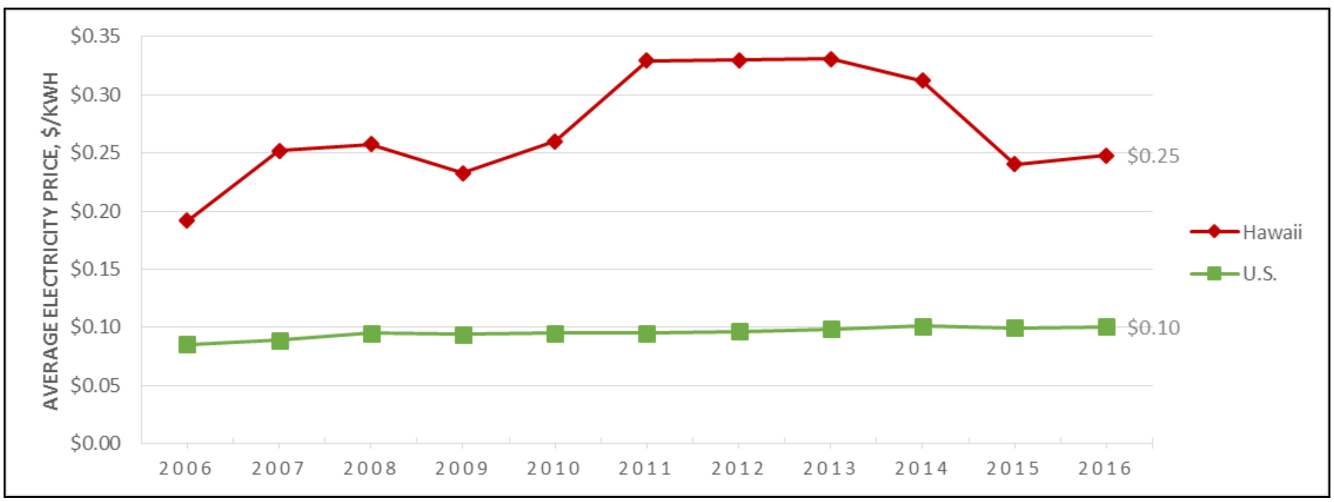
Hawaii Electricity Production by Source (2015)



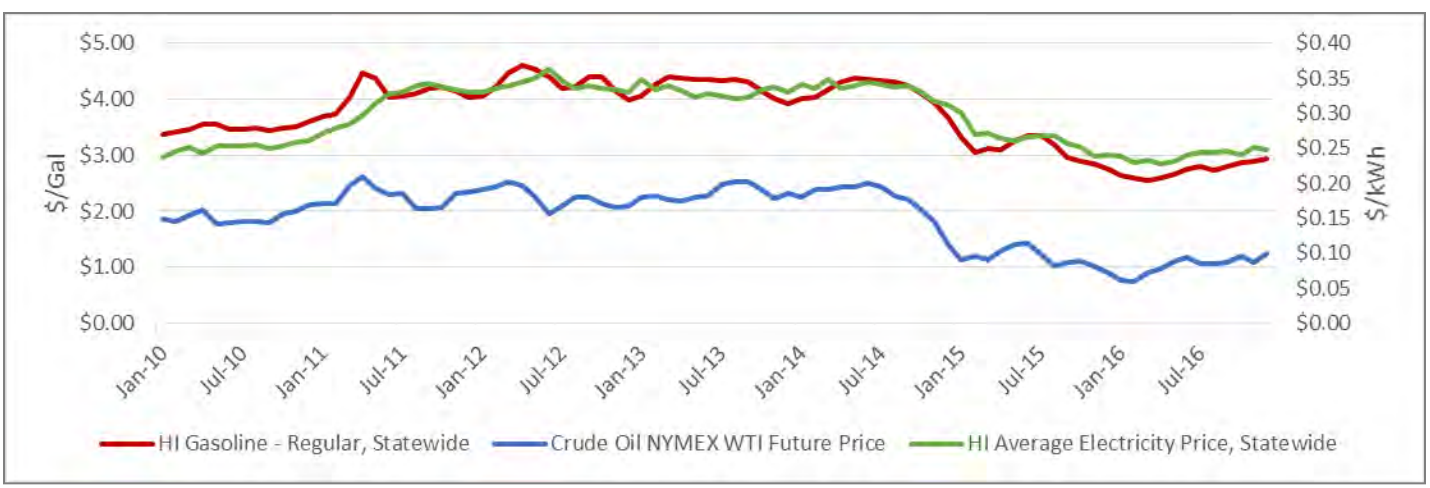
U.S. Electricity Production by Source (2015)



Hawaii's electricity prices are more than double the U.S. average.

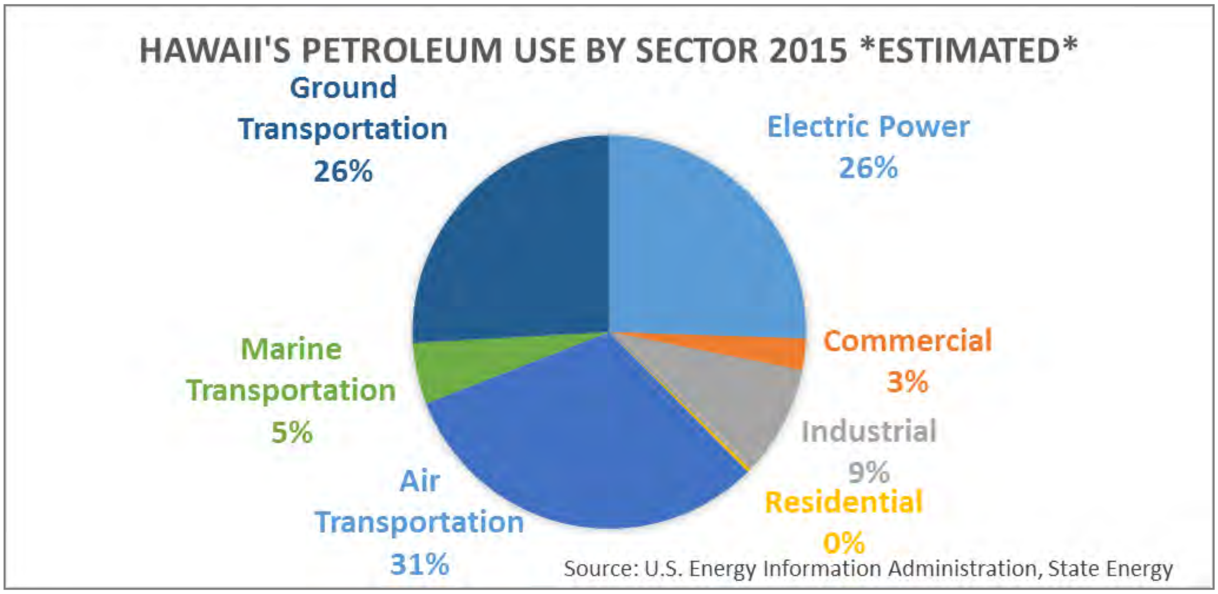


In Hawaii, both electricity and gasoline prices correlate closely with the price of petroleum. This graph shows the prices of crude oil, gasoline, and electricity.[2]



Hawaii Energy Overview

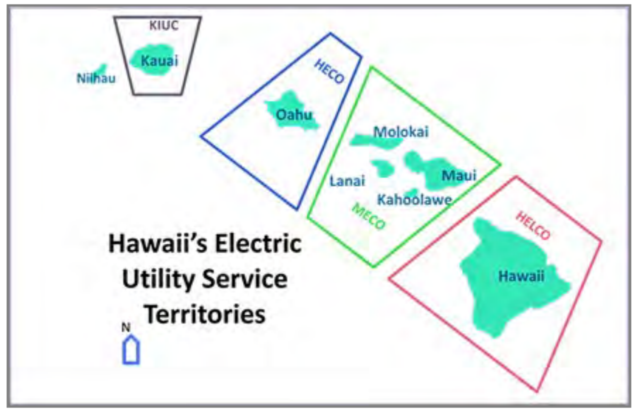
Electricity production and motor gasoline are just part of Hawaii's fossil fuel usage. Large quantities of jet fuel are also used in the state. In Hawaii, the air transportation sector accounts for the highest percentage of petroleum use, followed by ground transportation and electricity production, with the remainder used for marine transportation, commercial, industrial and residential uses.[3] The figures below represent estimated 2015 petroleum use reported by the U.S. Energy Information Administration (EIA). The shift in use from ground transportation to marine transportation is primarily attributed to a modeling update for motor fuel by the EIA.



2016 total foreign crude oil imports (million barrels)[4]	29.0	2016 fuel for electricity production (million gallons)[5]	379
2016 total foreign petroleum imports (million gallons)[6]	1,639	2016 impacted foreign fuel for air transportation (i.e. jet fuel) (million gallons)[7]	316
2016 Hawaii's rank among 50 states for energy prices[8]	1	2016 fuel for ground transportation (million gallons)[9]	516

Hawaii Energy Overview

ELECTRIC UTILITES



The two primary electric utilities that service the power needs of the state are Hawaiian Electric Industries Inc. (HEI) and Kauai Island Utility Cooperative (KIUC).

Hawaiian Electric Industries is the largest supplier of electricity in the state and serves the majority of Hawaii's population. Under HEI are three electric utilities: Hawaiian Electric Company, Inc. (HECO) serves Oahu; Maui Electric Company, Limited (MECO) serves Maui, Molokai, and Lanai; and Hawaii Electric Light Company, Inc. (HELCO) serves Hawaii Island.

Unlike HEI (an investor owned utility), KIUC operates as a cooperative and is not structured in the same manner. However, both utilities are committed to the adoption and integration of renewable sources of energy in the effort to reduce the states dependency on oil and both are regulated by the Public Utilities Commission (PUC) which maintains oversight over both entities.

RESIDENTIAL ELECTRICITY USE, RATES, AND MONTHLY BILLS

In general the residential electricity use, rates, and bills have declined since 2011. (Source: State of Hawaii Data Book)

RESIDENTIAL, AVERAGE MONTHLY USE (KWH)

Year	State Total	Oahu	Hawaii	Kauai	Lanai	Maui	Molokai
2011	**584**	609	520	473	435	612	373
2012	**543**	561	494	465	413	574	345
2013	**514**	523	473	464	430	557	329
2014	**496**	501	458	464	443	545	312
2015	**497**	504	454	474	424	541	306
2016	**484**	488	450	478	425	517	312

Source: State of Hawaii Data Book

RESIDENTIAL, AVERAGE RATE ($/KWH)

Year	State Total	Oahu	Hawaii	Kauai	Lanai	Maui	Molokai
2011	**$0.35**	$0.32	$0.42	$0.43	$0.44	$0.36	$0.43
2012	**$0.37**	$0.35	$0.42	$0.45	$0.47	$0.39	$0.46
2013	**$0.37**	$0.35	$0.42	$0.44	$0.46	$0.38	$0.46
2014	**$0.37**	$0.35	$0.42	$0.43	$0.46	$0.38	$0.47
2015	**$0.30**	$0.28	$0.35	$0.34	$0.38	$0.31	$0.38
2016	**$0.28**	$0.26	$0.32	$0.34	$0.34	$0.29	$0.33

Source: State of Hawaii Data Book

Hawaii Energy Overview

RESIDENTIAL, AVERAGE MONTHLY BILL							
Year	**State Total**	**Oahu**	**Hawaii**	**Kauai**	**Lanai**	**Maui**	**Molokai**
2011	**$202**	$195	$218	$205	$192	$219	$161
2012	**$203**	$197	$210	$209	$192	$222	$159
2013	**$189**	$181	$199	$205	$199	$211	$153
2014	**$185**	$178	$192	$199	$203	$206	$147
2015	**$149**	$141	$157	$163	$159	$168	$115
2016	**$135**	$127	$142	$163	$142	$147	$102
Source: State of Hawaii Data Book							

COMPETITIVE BIDDING

Hawaii's electric utilities deliver electricity generated with their own units as well as power generated by Independent Power Producers (IPPs). If new or replacement generation is required, HECO, MECO, and HELCO are required to follow the "Competitive Bidding Framework" for new generation with capacities greater than 5 MW (Oahu) or 2.72 MW (MECO, HELCO), or receive a waiver of the competitive bidding requirements from the Hawaii Public Utilities Commission (PUC). As noted on HECO's *Competitive Bidding for New Generation* webpage, current procurement activities include:

HECO: An RFP for 600-800 gigawatt-hours (or 200 MW) of as-available renewable electricity for use on Oahu is being redrafted per a July 2013 Order from the PUC. The redrafted RFP will remove references to the Lanai Wind Project and eliminate solicitations for an undersea transmission cable. Also in July 2013, the PUC opened a new docket (No. 2013-0169) to examine whether the Oahu-Maui Grid Tie may be in the public interest. This proceeding is still awaiting determination by the PUC.

MECO: On May 5, 2016, Maui Electric Company asked the PUC for permission to begin the process of acquiring approximately 40 megawatts (MW) of dispatchable, firm generation - about 20 MW from renewable resources and 20 MW from fuel-flexible resources - by 2022. The next steps in the process are for the PUC to rule on opening a docket leading to Maui Electric issuing a request for proposals under the PUC's competitive bidding rules and for the selection of an independent observer to oversee the process.

On January 6, 2017, Maui Electric asked the PUC for permission to begin the process of acquiring new renewable energy generation on the island of Maui that can be placed in service by the end of 2020, consistent with the Near-Term Resource Plan proposed in the Company's Power Supply Improvement Plan. The next steps in the process are for the PUC to rule on opening a docket leading to Maui Electric issuing a request for proposal under the PUC's competitive bidding framework and for the selection of an independent observer to oversee the process.

DISTRIBUTED ENERGY RESOURCE PROGRAMS

On August 21, 2014, the PUC issued Order 32269, instituting a proceeding (Docket No. 2014-0192) to investigate distributed energy resource policies as they relate to HECO, HELCO, MECO, and KIUC; this proceeding is also known as the DER docket.

- March 31, 2015 – Order No. 32737. The PUC established the statement of issues and procedural schedule for Phase 1 of the DER docket. Issues for resolution included: revising interconnection rules to allow for new distributed functions and capabilities such as grid-supportive services; transtitioning the current NEM program, if necessary; and creating new market choices for non-exporting and 'smart' exporting systems.
- October 12, 2015 – Decision & Order No. 33258. The PUC closed the NEM program to new applicants and grandfathered existing NEM customers and approved two interim programs, customer grid-supply (CGS) and customer self-supply (CSS). The PUC also required HECO to re-submit their Time-of-use proposal, develop a self-certification process for approved advanced inverter functions, develop a test plan for priority advanced inverter functions; and complete the circuit-level hosting capacity analysis for all islands.

Hawaii Energy Overview

- December 9, 2016 – Order No. 34206. The PUC established the statement of issues and procedural schedule for Phase 2 of the DER docket. The PUC envisions two parallel tracks, the technical track will focus on technical and interconnection issues, and the market track will focus on market and economic issues. These tracks will address issues that include: characterizing grid capacity for DER and renewable resources; safely integrating DER in a cost-effective manner; revising interconnection standards and procedures; developing successor tariffs; evaluating alternative rate designs; and expanding DER options and customer participation.

HECO PROGRAMS

As of 1/3/2017

	NEM	CGS	CSS	SIA	FIT
HECO					
Total Systems (executed)	45,956	908	5	253	104
Rated Capacity (MW)	299.20	5.80	< 1	59.60	17.60
MECO					
Total Systems (executed)	11,115	196	1	28	32
Rated Capacity (MW)	80.02	1.35	< 1	12.00	4.00
HELCO					
Total Systems (executed)	10,924	262	-	39	16
Rated Capacity (MW)	69.61	1.61	-	9.78	2.51

Source: HECO Weekly Interconnection Queue Report

NET ENERGY METERING (NEM)

Previously, the NEM program was available to permanent customers who own (or lease from a third party) a solar, wind turbine, biomass, or hydroelectric energy generating facility, that was located on their own property, and had a capacity of 100 kW or less. Under the NEM program:

- Customers receive a credit at retail rate for electricity exported to the grid.
- If a customer uses more electricity than is exported, the customer is charged for that net amount.
- If a customer exports more electricity than is used, the customer is considered a net electricity producer, is charged a minimum bill (e.g. $17 for Oahu residential customers), and is allowed to carry any excess credits forward to the next month.
- At the end of the customer's 12-month billing cycle any excess credit are forfeited or used to reimburse any energy charges previously paid.

CUSTOMER GRID-SUPPLY (CGS)

The CGS program can be seen as a modified version of the NEM program. Under the CGS program:

- Customers receive a PUC approved credit (see below) for energy exported to the grid.

ISLAND	CREDIT (¢/kWh)
Oahu	15.07
Maui	17.16
Molokai	24.07
Lanai	27.88
Hawaii Island	15.14

Source: Docket 2014-0192

- Customers are charged the retail rate for energy received from the grid and use credit received from exported electricity to offset these charges.
- If a Customer's credit exceed their energy charge, the customer is charged a minimum bill (e.g., a residential customers are charged $25).
- Unlike the NEM program, any excess credit remaining at the end of the monthly billing cycle is forfeited.

When the PUC established this interim program, they established a cap for each of the HECO Companies' service territories: 25 MWac for HECO, 5 MWac for MECO, and 5 MWac for HELCO. These caps were established as the PUC concluded that it was not in the public interest to allow unconstrained growth in the grid-supply option, particularly if such growth comes at the expense of future opportunities to acquire even lower-cost renewable energy from other sources, or prevents the HECO Companies from offering community-based renewable energy options for their customers. By September 2016, all three HECO Companies met their designated cap limits.

In April 2017, the HECO Companies collectively transferred over 20 MW of capacity from the NEM program to the CGS program. This was in result of PUC Order No. 34458 which ordered the HECO Companies to transfer capacity from all NEM applications that have been cancelled or withdrawn since the closure of the NEM program (October 2015) to the CGS program. The PUC also noted that any cancelled or withdrawn capacity after October 21, 2017 would not be transferred to the CGS program.

Fixed rates for electricity exported to the grid under the CGS program.

CUSTOMER SELF-SUPPLY (CSS)

The CSS program is available to permanent customers who own (or lease from third party) a solar generating facility that is located on their own property and has a capacity that is less than 100 kW. These systems may include an energy storage device and are designed to not export electricity to the grid. CSS systems are also eligible for expedited review and approval of applications in areas with high levels of PV. Under the CSS program:

- Customers are not compensated for electricity exported to the grid.
- Customers pay for the amount of electricity used from the grid.
- A residential customer is charged a minimum monthly bill of $25.

STANDARD INTERCONNECTION AGREEMENT (SIA)

All permanent customers are eligible to interconnect a renewable or non-renewable energy generating facility through the SIA program. These system are not compensated for any power exported to the grid, and in some cases are restricted from exporting power. Lastly, unlike NEM, CGS, and CSS systems, there are no capacity restrictions for SIA systems.

FEED-IN TARIFF (FIT)

The FIT queue is now closed. Prior to this, renewable electricity suppliers with generators smaller than 5 MW were eligible to participate in the HECO Companies' FIT Program, supplying as-available power to the utility at constant, contracted rates over 20 years.

Hawaiian Electric Companies' Feed-in Tariff Rates									
Tier	Island	Photovoltaics (PV)		Concentrating Solar Power (CSP)		On-Shore Wind		In-line Hydro	
		Rate (¢/kWh)	Size Limit	Rate (¢/kWh)	Size Limit	Rate (¢/kWh)	Size Limit	Rate (¢/kWh)	Size Limit
1	All	21.8* 27.4**	20 kW	26.9* 33.1**	20 kW	16.1	20 kW	21.3	20 kW
2	Oahu	18.9* 23.8**	500 kW	25.4* 27.5**	500 kW	13.8	100 kW	18.9	100 kW
	Maui & Hawaii		250 kW		500 kW				
	Lanai & Molokai		100 kW		100 kW				
3	Oahu	19.7* 23.6**	5 MW	31.5* 33.5**	5 MW	12.0	5 MW	--	--
	Maui & Hawaii		2.72 MW		2.72 MW	--	--	--	--

*with tax credit of 35% **with tax rebate of 24.5%

FIT aggregate limits: Oahu 60 MW; Hawaii Island 10 MW; Maui, Lanai, Molokai (combined) 10 MW

In December 2014, the PUC accepted HECO and the Independent Observer's joint plan to administer the FIT queues. Future revisions or modifications to the FIT Program will be addressed in Docket No. 2014-0192 or 2014-0183.

Hawaii Energy Overview

COMMUNITY-BASED RENEWABLE ENERGY (CBRE)

Act 100, Sessions Laws of Hawaii 2015, was signed into law on June 8, 2015 and was passed to lay the foundation for a Hawaii CBRE Program that would make the benefits of renewable energy generation more accessible to a greater number of Hawaii residents. The long-term vision for the CBRE Program is to create a market-based structure that enables greater customer choice, particularly for those currently unable to participate in onsite distributed generation and allowing them to participate in off-site projects through a bill credit arrangement.

On February 10, 2017, the PUC issued Order No. 34388 (in Docket No. 2015-0389), providing their proposed CBRE Program Model Tariff Language for comments and feedback due on March 1, 2017 from the Parties. Since then, PUC called for a Technical Conference to be held early June 2017 to solicit feedback in addressing the issues raised by docket Parties in response to Order No. 34388.

KIUC PROGRAMS

As of 1/1/2017

KIUC	NEM	NEM Pilot	Schedule Q
Total Systems (executed)	171	150	3414
Rated Capacity (MW)	0.72	3.24	17.64

Source: KIUC Annual NEM/Schedule Q Report

SCHEDULE Q MODIFIED

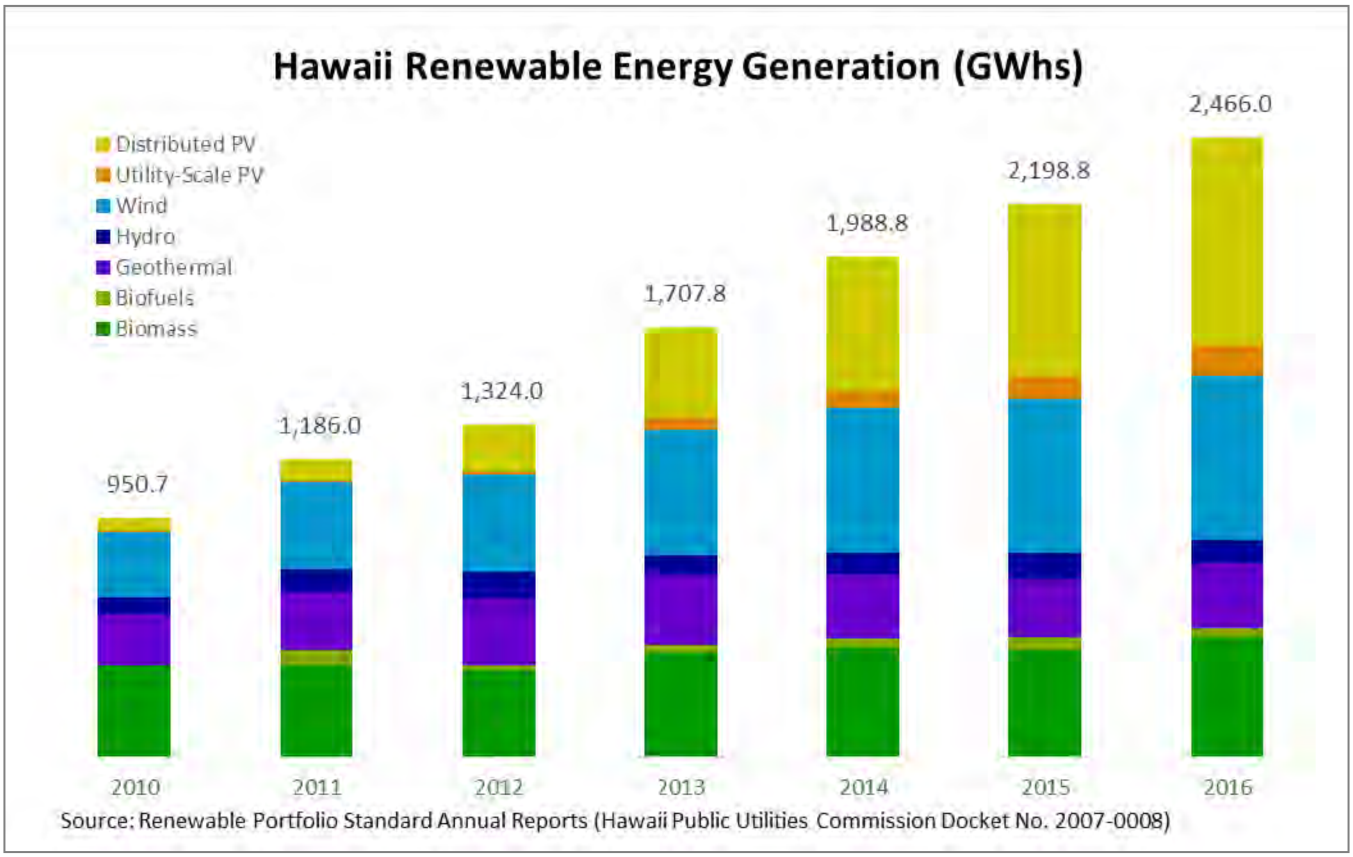
Currently only Schedule Q Modified is available to KIUC customers who own (or lease from a third party) a Qualifying Facility as described in PUC's Administrative Rules, Chapter 74 of Title 6, Subchapter 2; which requires the primary energy source of the facility to be biomass, waste, renewable resources, solar, wind, geothermal, or a combination thereof, and more than seventy-five per cent of the total energy input shall be from these sources. Under KIUC's Schedule Q Modified Tariff:

- Customers have the choice (1) to not sell electricity to KIUC, or (2) to sell excess energy to KIUC.
- If a customer chooses to sell electricity to KIUC they are charged a monthly metering charge (i.e. single-phase customers - $24.75/month).
- The rate that KIUC pays participants for electricity changes monthly and reflects the amount KIUC would have had to pay to generate the power if they didn't buy it from the customer ("avoided cost"). As more renewables come on line, the amount paid under Schedule Q is expected to drop.

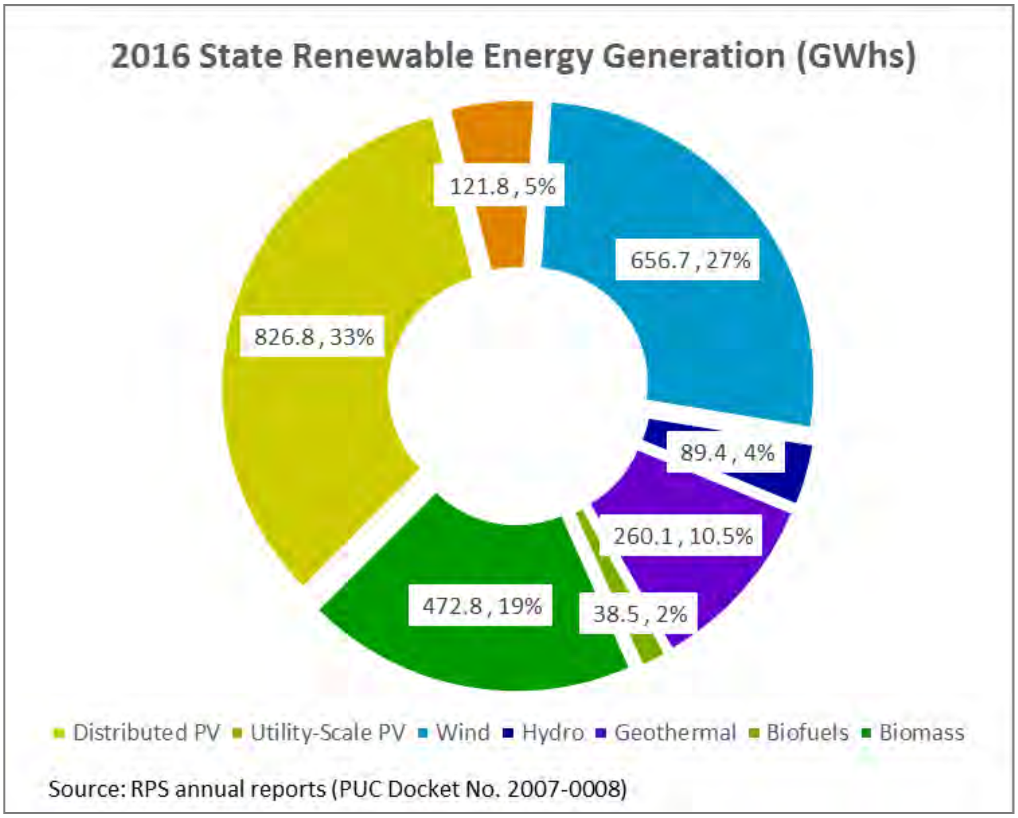
Renewable Energy

As defined by Section 269-91 Hawaii Revised Statutes (HRS), "renewable energy" means energy generated or produced using the following sources:

- Wind;
- Sun;
- Falling water;
- Biogas, including landfill and sewage-based digester gas;
- Geothermal;
- Ocean water, currents, and waves, including ocean thermal energy conversion;
- Biomass, including biomass crops, agricultural and animal residues and wastes, and municipal solid waste and other solid waste;
- Biofuels; and
- Hydrogen produced from renewable energy sources.



Renewable Energy



Renewable Energy Resource	2016 Generation (GWh)	% of Renewable Energy	% of Total Sales
Distributed PV	826.8	33.5%	8.9%
Utility-Scale PV	121.8	4.9%	1.3%
Wind	656.7	26.6%	7.1%
Hydro	89.4	3.6%	1.0%
Geothermal	260.1	10.5%	2.8%
Biofuels	38.5	1.6%	0.4%
Biomass	472.8	19.2%	5.1%
Total	**2,466.0**	**100.0%**	**26.6%**

Source: RPS Annual Reports (Docket No. 2007-0008)

RENEWABLE PORTFOLIO STANDARDS (RPS)

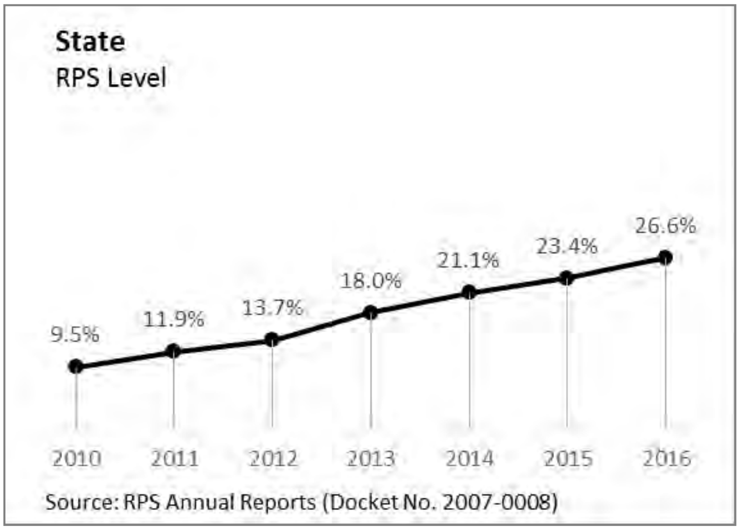
As required by Section 269-92 HRS, each electric utility company that sells electricity for consumption in Hawaii shall establish a renewable portfolio standard of:

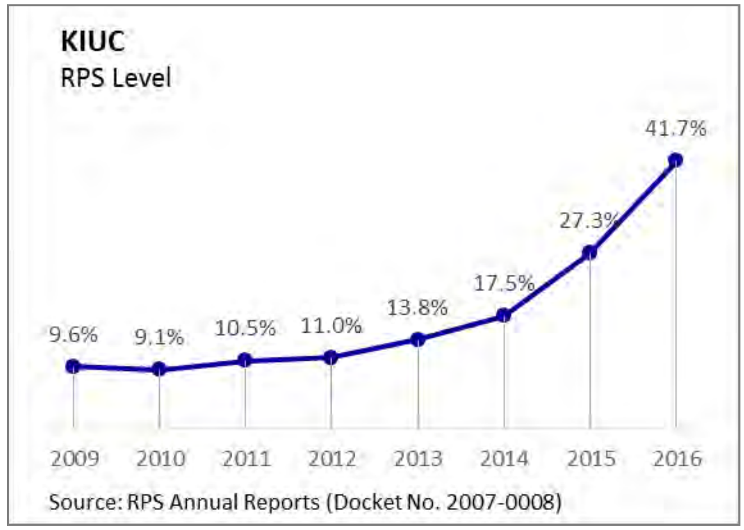
- 30% of its net electricity sales by December 31, 2020;
- 40% of its net electricity sales by December 31, 2030;
- 70% of its net electricity sales by December 31, 2040; and
- 100% of its net electricity sales by December 31, 2045.

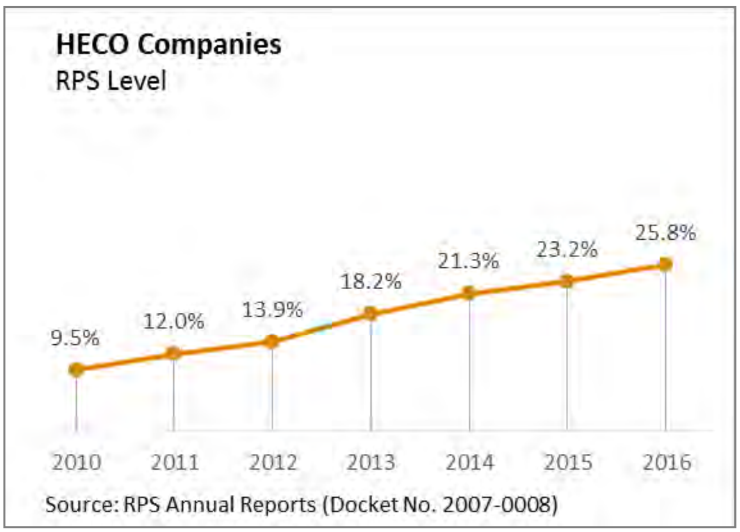
Where "renewable portfolio standard" means the percentage of electrical energy sales that is represented by renewable electrical energy (Sec 269-91 HRS). Beginning January 1, 2015, renewable electrical energy generated by the utility, independent power producers, and customer-sited, grid-connected sources are counted towards their RPS. While electrical savings from energy efficiency and solar water heating are not.

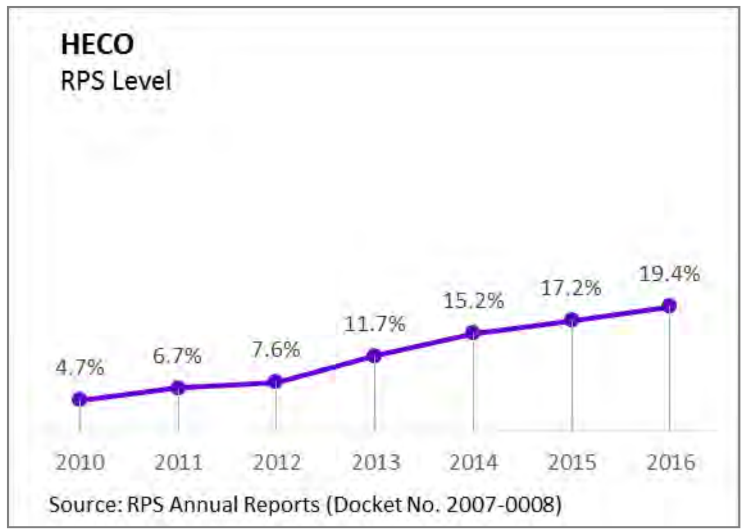
Each electric utility is also required to file an annual RPS status report to the PUC (Docket No. 2007-2008). Instead of filing individual RPS's for each company, the HECO Companies opt to consolidate their RPS's.

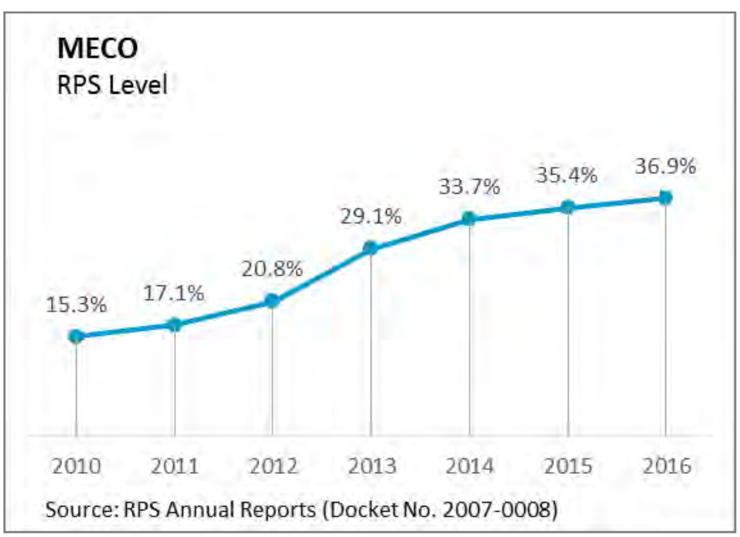
Renewable Energy

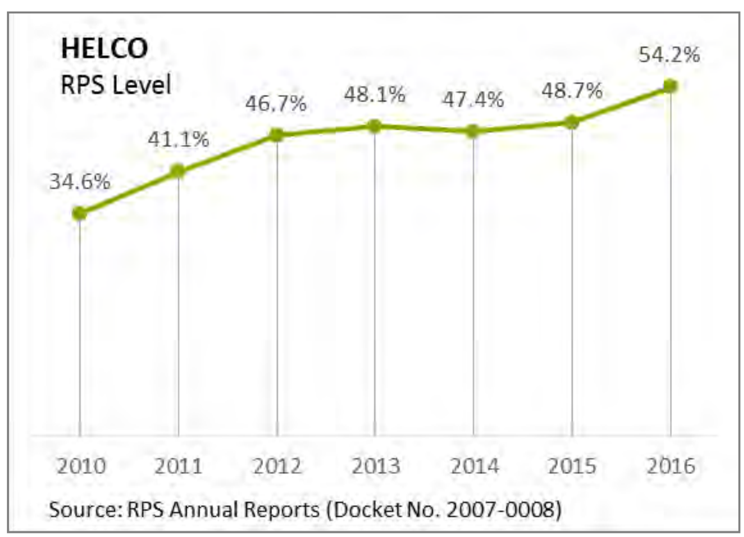












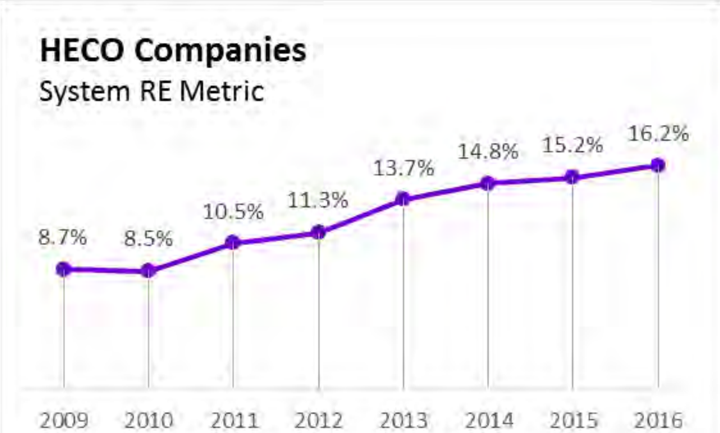
Renewable Energy

HAWAIIAN ELECTRIC COMPANIES KEY METRICS

The Hawaiian Electric Companies provide various key performance metrics on their website, two of these metrics are System Renewable Energy and Total Renewable Energy.

System Renewable Energy (System RE)

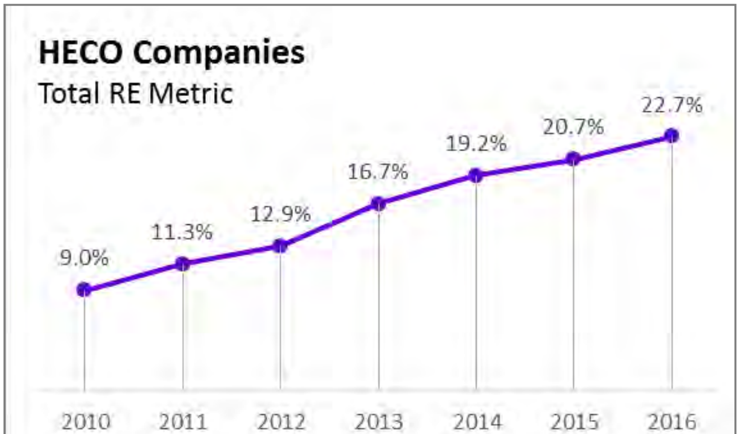
The System Renewable Energy metric differs from the Renewable Portfolio Standard because it estimates the percent of total net generation that is represented by renewable energy rather than being based on sales and does not include customer-sited renewable generation. Net generation is the amount of electricity generated and transmitted to the utility grid from the source (i.e., power plant). Generation from independent power producers ("IPPs") and utility power plants is recorded at the net generation level. Sales are lower than the net generation due to losses in transmitting the electricity from the source to the customers. Therefore, the System Renewable Energy will result in values lower than the RPS since customer-sited renewable generation is not included and net generation is used instead of sales. The charts below show the results for the Companies on a consolidated and individual basis.



Source: HECO's *Key Performance Metrics* Webpage

Total Renewable Energy (Total RE)

The Total RE metric differs from the RPS because it is based on total energy and not sales. The Total RE metric is the total renewable generation provided by independent power producers, the utility, and estimates for customer-sited, grid-connected renewable energy, divided by the total generation provided by independent power producers, the utility, and estimates for customer-sited, grid-connected renewable energy.



Source: HECO's *Key Performance Metrics* Webpage

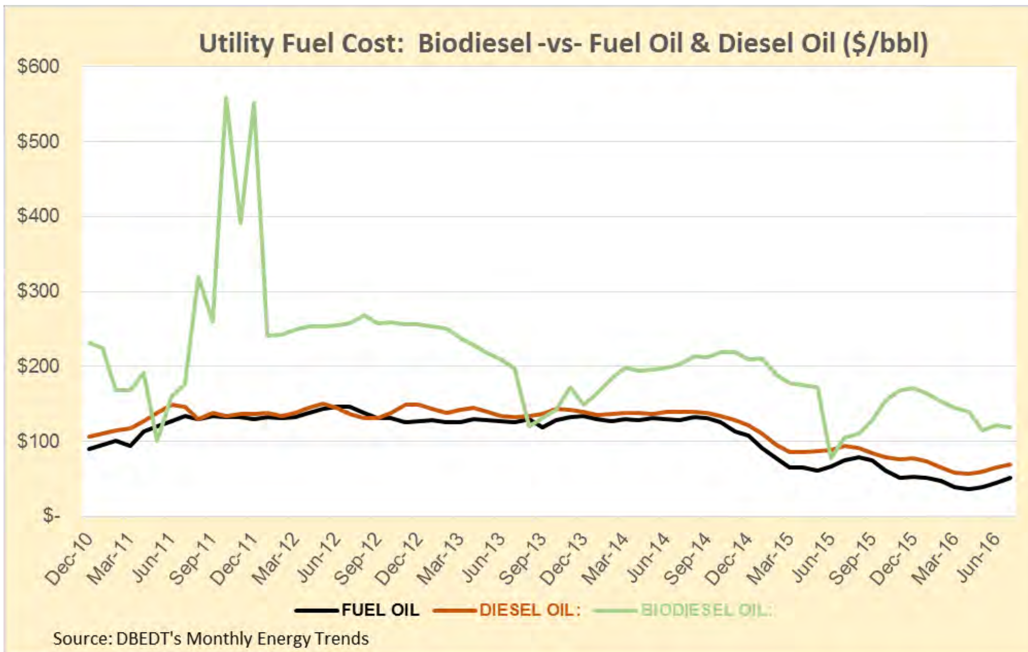
Bioenergy

"Bioenergy" includes both electricity generation and fuel production from biomass.

Biomass is plant and animal matter, including energy crops, wood, grasses, algae, vegetable oils, and agricultural and municipal wastes. Bioenergy production potential in Hawaii depends on the availability of land and feedstock; CO_2 sources (for algae); markets and values for primary products (electricity, fuels) and by-products (animal feed); and overall revenues compared to costs.

"Biofuel" sometimes is used interchangeably with bioenergy, however biofuels is more commonly used specifically to describe liquid bioenergy fuels. Biofuels are a renewable energy source that can be stored and transported in a manner similar to fossil fuels, can often be used in existing equipment and be blended with petroleum fuels. One ton of biomass replaces approximately one barrel of oil.

Since biodiesel fuel imports for electricity production began in 2010, the relative cost of the imported biodiesel fuel has been significantly higher than for the fossil-based fuels used for electricity generation in Hawaii.



DBEDT 2012 BIOFUEL REPORT

In December 2012 and in accordance with Act 203, Session Laws of Hawaii, 2011, the Hawaii State Department of Business, Economic Development and Tourism (DBEDT) provided a final report to the state Legislature, *Biofuels Study*. The following were taken from this report.

- Hawaii's energy systems are highly dependent on liquid fuels. Petroleum is used for electricity production; ground, air, and marine transportation; military activities; and other needs. Each year, Hawaii uses between 1.7 and 2.2 billion gallons of liquid petroleum fuels (fuel oil, gasoline, diesel, jet fuel, bunker fuels, and others). These needs could be met by a combination of petroleum-based and renewable fuels (i.e. biofuels).
- The materials (feedstocks) that could be used for biofuel production include sugars (from plants such as sugarcane or sweet sorghum); starch (such as from corn or cassava); fiber (from grasses, trees, husks, stalks, fibers from oilseeds, and from waste materials such as paper, sawdust, or other organic materials); and oil (such as jatropha, kukui, microalgae, soybean, peanut, sunflower, oil palm, or waste cooking oil).
- A biofuels industry of between 100 and 300 million gallons per year beyond 2023, representing about 10% of liquid fuel demand, appears to be both significant and achievable, given the right conditions, continued high or increasing oil prices, and clear and consistent public policy. Construction, manufacturing, and agricultural sector jobs would be supported. Although it is difficult to predict how a biofuel and related products industry might develop in Hawaii, employment potential from an industry using 137,000 acres could create about 2000 jobs and generate revenues of $500 million to $1 billion.

Bioenergy

Active Bioenergy Facilities

Technology	Project Name	Capacity	Island	Location
Biofuel	Kauai Algae Farm	Demonstration	Kauai	Lihue
Biofuel	Honolulu International Airport Dispatchable Standby Generation Project	10 MW	Oahu	Honolulu
Biofuel	Pacific Biodiesel Honolulu Plant	1 MGY	Oahu	Honolulu
Biofuel	HECO Campbell Industrial Park Generating Station	110 MW	Oahu	Kapolei
Biofuel	Pacific Biodiesel Biofuel Crop Demonstration Project	Feedstock Demonstration	Maui	Central Valley
Biofuel	Cellana Algae Kona Demonstration Facility	Demonstration	Hawaii	Kailua-Kona
Biofuel	Big Island Biodiesel	5 MGY	Hawaii	Keaau
Biofuel	Hawaii Pure Plant Oil	Demonstration	Hawaii	Keaau
Biomass	Green Energy Biomass-to-Energy Facility	6.7 MW	Kauai	Koloa
Biomass	HC&S Co-Generation Facility	16 MW	Maui	Puunene
Waste-to-Energy	Hawaii Air National Guard Waste-to-Energy Microgrid System Demonstration	Demonstration	Oahu	Joint Base Pearl Harbor-Hickam
Waste-to-Energy	HPOWER	88 MW	Oahu	Kapolei (Campbell Industrial Park)
Waste-to-Energy	PVT Bioconversion Feedstock Processing Facility	Feedstock Production	Oahu	Nanakuli

Source: Hawaii State Energy Office, Renewable Energy Projects Directory

Geothermal

CURRENT PRODUCTION

Hawaii's single geothermal power plant, Ormat's Puna Geothermal Venture (PGV) facility located on the Island of Hawaii, produced 260.1 gigawatt-hours (GWh) in 2016, which is approximately 24.4% of the total electricity distributed on Hawaii Island in 2016 or 2.8% of the State's overall electricity needs in 2016 (Hawaiian Electric Companies' 2016 Renewable Portfolio Standard Status Report). The PGV facility, which began operating in 1993 and was expanded from 30 megawatts (MW) to 38 MW in 2011, produces both baseload and dispatched electricity for residents of Hawaii Island.

Puna Geothermal Venture Power Plant, Pahoa, Hawaii Island

Geothermal

STATUS OF COMPETITIVE SOLICITATION

In May 2012, the Hawaii Electric Light Company (HELCO) initiated a competitive bidding procedure (request for proposals) seeking 50 MW of dispatchable geothermal firm capacity generation; however, in February 2016, HELCO notified the Hawaii Public Utilities Commission (PUC) and all other parties that power purchase agreement negotiations for this procurement had concluded unsuccessfully (PUC Docket No. 2012-0092).

RESOURCE PLANNING

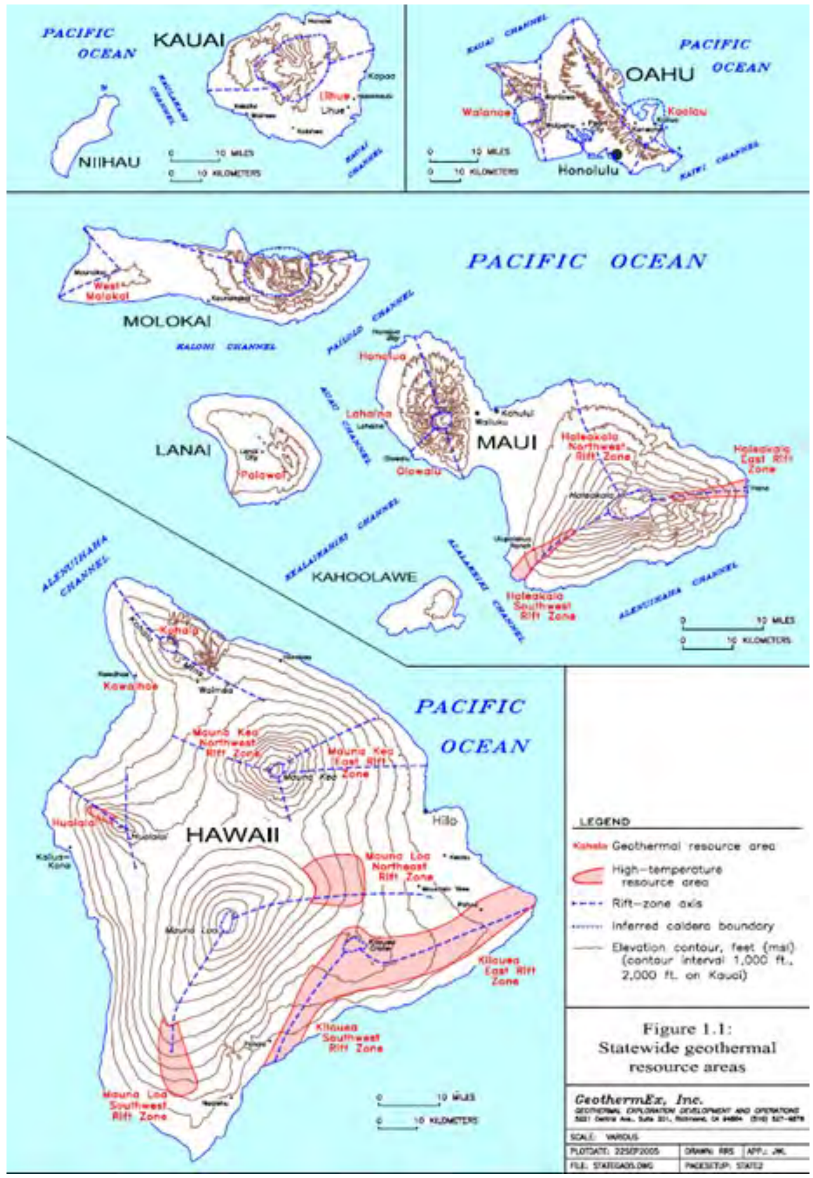


Figure 1.1: Statewide geothermal resource areas

Geothermal's promise as a firm, cost-competitive source of baseload renewable energy continues to support ongoing efforts to better understand the resource and its use potential. Geothermal resources are difficult to characterize without exploration and drilling since Hawaii's high-temperature resources are usually more than a mile beneath the surface. Studies indicate the Islands of Maui and Hawaii combined have a minimum potential geothermal capacity of 525 MW, with a more likely combined capacity of 1,535 MW (GeothermEx, Inc., 2005). Reaching that level of production would require interconnection of the islands' grids. Hawaiian Electric's PSIP Update Report: December 2016 (PUC Docket No. 2014-0183) forecasts 40 MW of geothermal development on Maui by the year 2040 and an additional 40 MW of geothermal on Hawaii Island by the year 2030. Other Hawaiian islands, such as Kauai, Oahu, Lanai, and Molokai, do not show as much potential for geothermal development, but are still under consideration for additional study and possible use.

Continued geothermal exploration will contribute to better understanding of Hawaii's geothermal resources. Ormat had expressed interest in exploring on Maui, focusing on the southwest rift zone of Haleakala, with partial funding from the U.S. Department of Energy (USDOE) (Ulupalakua Geothermal Mining Lease and Geothermal Resource Subzone Modification Application, 2012). The University of Hawaii (UH) is also exploring rift zones on Hawaii Island using a non-invasive technique called magnetotellurics (MT) designed to detect subsurface electrical conductivity. Findings from this effort and other geothermal and groundwater resource analyses can be found at the Hawaii Groundwater & Geothermal Resources Center (https://www.higp.hawaii.edu/hggrc/). The Hawaii Play Fairway Project, managed by UH and supported by USDOE, will compile and integrate all geothermal-relevant data across the state into a map showing the probability of encountering a resource in the subsurface. In essence, this will provide the first statewide geothermal resource assessment conducted since the late 1970s. Results from this effort will also indicate areas warranting additional geothermal resource exploration. Recently completed surficial geophysical studies in the Saddle Road area of Hawaii Island indicate the potential presence of geothermal and groundwater activity (Final Report: Magnetotelluric and AudioMagnetotelluric Surveys on DHHL Lands Mauna Kea East Flank, 2016).

Geothermal

PRICING

Geothermal electricity is generally cheaper than energy produced from petroleum fuels and other forms of renewable electricity in Hawaii. GeothermEx, Inc. estimates the levelized power cost of geothermal for a hypothetical 30 MW plant on Hawaii would be between 7¢ to 8.7¢ per kilowatt-hour (kWh), with operation and maintenance costs between 4¢ to 6¢ per kWh and capital costs between $2,500 to $5,000 per installed kilowatt (Assessment of Energy Reserves and Costs of Geothermal Resources in Hawaii, GeothermEx, Inc., 2005). The prices at which the 38 MW capacity PGV sells power to HELCO are (per kWh):

- First 25 MW: 18.8¢ on-peak, 15.9¢ off-peak
- Next 5 MW: 11.8¢
- Last 8 MW: 9¢

ENVIRONMENTAL CONSIDERATONS

Concerns over the impacts to human health, the environment, and cultural practices continue to be voiced as the state evaluates geothermal's role in achieving its renewable energy goals. Advancements in technology, education, and resource understanding have helped alleviate some of these concerns. However, any new geothermal developments in Hawaii would require careful consideration, environmental impact analysis, thoughtful planning, and considerable community engagement prior making a determination on the viability of a given project.

Hydropower

Wailuku River Hydroelectric Power Plant, 11 MW, Hilo, Hawaii

Hydroelectricity was the first renewable energy technology used to generate electricity in Hawaii; plants date back to 1888. Early hydroelectric facilities were located in Honolulu and Hilo, and on the island of Kauai. During the sugar era, additional hydroelectric plants were installed to help power sugar operations, and likely contributed to a significant percentage of the area's total energy needs. The technology is fully commercial and reliable but is limited by fluctuating water levels in Hawaii's streams and irrigation ditches. For example, the Puueo Hydropower facility on Wailuku River on Hawaii Island was originally built in 1910 and remains operational today. Due to Hawaii's geology, run-of-the-river and run-of-the-ditch systems, which have no dams, are currently being used. Smaller home-scale plants, smaller commercial and municipal installations, and utility-scale hydropower facilities are currently in operation in Hawaii.

CURRENT PRODUCTION

Hawaii County Dept. of Water Supply's 45 kW in-line hydro plant in Kona,

Hawaii currently has about 37 megawatts (MW) of installed hydroelectricity capacity statewide – the largest being the 11 MW Wailuku River plant on Hawaii Island – and about 50 MW of hydroelectric projects proposed or under development (Hawaii Renewable Energy Projects Directory). In 2016, hydropower accounted for just under 1% of the total energy distributed by Hawaii's electric utilities statewide (2016 Renewable Portfolio Standard Status Reports). Hydro is an important part of the energy portfolio on Kauai, where it represented about 7.8% of the electricity sold in 2016, and on the island of Hawaii, where it represented about 5% of the island's total electrical sales in 2016. Kauai Island Utility Cooperative (KIUC) continues to investigate new hydroelectric projects including in-line river hydropower and pumped storage hydropower which, if successful, could provide more than 20% of the island's annual electricity requirements.

Hydropower

Another related technology is in-line hydro, which harvests energy within water pipelines. For instance, the Hawaii County Department of Water Supply (DWS) has three small in-line hydro power plants which each have capacities of under 100 kilowatts (kW). These facilities capture the energy in pipes carrying water to DWS customers in West Hawaii.

HAWAII HYDROPOWER ASSESSMENTS

The U.S. Army Corps of Engineers (USACOE) conducted a Hydroelectric Power Assessment for the State of Hawaii in 2011, which is a feasibility study that identifies, evaluates, and recommends solutions to address the potential hydroelectric power needs in the State of Hawaii. USACOE studied more than 160 hydro sites and ocean energy areas across Hawaii as part of this assessment.

Grand River Dam Authority (GRDA) Salina Pumped-Storage Project, Oklahoma

Pumped storage hydro is a related technology. A non-hydro source of electricity (e.g., wind, solar, conventional generation) is used to pump water from one reservoir to a second, higher reservoir. The water stored in the upper reservoir can be released as needed, running through a turbine on the way back down and generating power. KIUC is investigating the possibility of financing and owning a 25 MW pumped storage hydro facility on Kauai using the Puu Lua Reservoir, which was one of the four project sites of focus in the 2011 USACOE Hydropower Assessment. Other reservoirs on Hawaii Island, Maui, and Oahu (Lake Wilson, Nuuanu) have also garnered attention for their pumped storage use potential.

Hawaii hydropower projects have the potential for significant agricultural, cultural, ecological, and other impacts. However, if done properly, hydropower can also support these resources and other activities that depend upon Hawaii's surface waters.

Ocean

Surrounded by the Pacific Ocean, Hawaii is rich in ocean renewable energy resources. Ocean or marine energy includes both hydrokinetic and thermal resources. Hydrokinetic technologies tap the movement in the ocean—waves, currents and tides—to generate electricity. Ocean Thermal Energy Conversion (OTEC) makes use of the temperature differences between warm surface waters and cold, deep ocean waters. Hawaii has superior potential for wave energy and OTEC, however, does not currently depend on wave or OTEC for any substantive energy production. Ocean current and tidal resources are not as promising in Hawaii due to its relatively mild tidal shifts compared to other parts of the world. Ocean energy technology continues to evolve as numerous ocean energy research, development, and demonstration projects are taking place in Hawaii and elsewhere in the world.

WAVE POWER

The first ocean wave-generated electricity ever transmitted to the grid in the United States was generated by an Ocean Power Technologies (OPT) PowerBuoy at Kaneohe Bay in 2010. In a cooperative program with the U.S. Navy, three OPT buoys were deployed from 2004 to 2011 .

Ocean

Currently, the U.S. Navy has partnered with the Hawaii National Marine Renewable Energy Center (HINMREC) at the University of Hawaii-Manoa, one of three federally-funded centers for marine energy research and development in the nation, to establish a multiple-berth wave energy test site (WETS) at Kaneohe Bay, Oahu. The purpose of the WETS is to collect and analyze wave buoy equipment performance (grid-connected), cost, and durability (which will help guide industry design improvements), as well as monitor environmental impacts from wave energy technologies (EMF, sediment, ecology). The first new tenant, Northwest Energy Innovations (NWEI), deployed its first Azura prototype wave buoy at the WETS 30-meter-deep berth.

Lifesaver Wave Energy Device, Kaneohe Bay, Oahu

The Azura buoy is the fourth wave buoy attached to the 30 meter berth since 2004, however, it is significant as it is the first grid-connected wave buoy in the U.S. to provide data for third-party (HINMREC) analysis. The Navy plans to remove the Azura buoy in 2016 after the trial demonstration period is over. Local Hawaii marine services companies, Healy Tibbitts Builders and Sea Engineering, Inc., Hawaii Natural Energy Institute's marine services partner, performed the installation. NWEI, with $5 million in additional funding from the Energy Department, will apply lessons learned from this current phase of development to modify the device design in order to improve its efficiency and reliability. NWEI plans to then test the improved design with a full-scale device rated between 500 kilowatts and one megawatt at WETS at even deeper test berths of 60 meters to 80 meters over the next several years, further supporting efforts to build a robust and competitive marine hydrokinetic (MHK) industry in the United States. In March 2016, the U.S. Marine Corps and the Naval Facilities Engineering Command, Engineering and Expeditionary Warfare Center (NAVFAC EXWC) announced the launch of a second wave buoy to be connected to the WETS; Norwegian company Fred Olson, Ltd.'s Lifesaver wave energy converter

OTEC Pilot Project, Keahole Point, Kona

OCEAN THERMAL ENERGY CONVERSION (OTEC)

The Natural Energy Laboratory of Hawaii Authority (NELHA) at Keahole Point, Kona, is among the world's premier OTEC research centers. NELHA's Hawaii Ocean Science and Technology Park (HOST) houses enterprises that test renewable energy technologies on the cusp of commercialization. Major milestones in OTEC were achieved at NELHA in the 1980s and '90s, including a 1-MW floating OTEC pilot plant, Mini-OTEC (the world's first demonstration of net power output from a closed-cycle plant) and other demonstrations in both open- and closed-cycle OTEC.

NELHA's cold seawater supply pipes are the deepest large-diameter pipelines in the world's oceans, extending to 2,000-foot depths; providing a temperature variance between 6°C (43°F) at lower depths to 24° – 28.5°C (75° – 83°F) near the surface. The laboratory's location, with access to both warm surface water and cold deep ocean water, makes it a prime site for OTEC R&D. Presently, Makai Ocean Engineering is operating a heat exchanger test facility at NELHA, testing components and materials. A 100 kilowatt (kW) OTEC generator has been added to the test facility and became operational in August 2015. A 1 megawatt (MW) OTEC demonstration facility at NELHA is in the planning stages and power plants up to 100 MW in capacity have been proposed for locations off Oahu.

Solar

Due to Hawaii's high-electricity prices, abundant solar resource, and progressive energy policies, the state has experienced unprecedented growth in solar generation. In recent years solar has become the primary renewable energy resource in Hawaii. The majority of solar generation is provided by distirbuted PV systems. Largely incentivized by tax credits and the utilities' distributed energy resource programs (i.e. net energy metering), distributed PV has grown significantly. Beyond distributed PV the state has pursued utility-scale PV projects, some of these projects include:

- In January 2017, HECO brought the EE Waianae Solar project into service. Developed by Eurus Energy America, the 27.6 MWac PV system is currently the State's largest PV system. Eurus will sell power to HECO at about 14.5 cents per kWh.
- KIUC partnered with SolarCity to develop a 13 MWac PV system with a 13 MW / 52 MWh Tesla Powerpack lithium-ion battery energy storage system. SolarCity will sell power to KIUC at 13.9 cents per KWh. Operations are expected to begin in 2017.
- KIUC partnered with the AES Corporation to develop a 20 MWac PV system with a 20 MW / 100 MWh battery energy storage system. This system will sell power to KIUC at about 11 cents per kWh. Construction is expected to start in October 2017 and the facility is expected to be operational by October 2018.
- The Navy is proposing to lease land to a developer for the development of a utility-scale PV and battery energy storage system at the Pacific Missile Range Facility at Barking Sands on Kauai. The PV system would generate up to 44 MWdc.

Some of Hawaii's active utility-scale PV systems

Project Name	Capacity	Island	Location
KRS1 Anahola Solar Farm	12 MW	Kauai	Anahola
Port Allen Solar Facility	6 MW	Kauai	Eleele
Kapaa Solar Project	1 MW	Kauai	Kapaa
KRS2 Koloa KRS2 Solar Farm	12 MW	Kauai	Koloa
MP2 Kaneshiro Solar Project	300 kW	Kauai	Lawai
Wilcox Memorial Hospital Solar PV Farm	500 kW	Kauai	Lihue
Waimea Research Center PV Facility	250 kW	Kauai	Waimea Research Center
Hawaii American Water Solar Array	250 kW	Oahu	Hawaii Kai
Kalaeloa Renewable Energy Park	5 MW	Oahu	Kalaeloa
Kalaeloa Solar Power II	5 MW	Oahu	Kalaeloa
Kapolei Sustainable Energy Park	1 MW	Oahu	Kapolei
Waihonu South Solar Project	1.5 MW	Oahu	Mililani
Waihonu North Solar Project	5 MW	Oahu	Mililani
Pearl City Peninsula PV	1.23 MW	Oahu	Pearl Harbor
Dole Plantation Solar Array	500 kW	Oahu	Wahiawa
EE Waianae Solar	27.6 MW	Oahu	Waianae
Waianae PV-2 Solar Farm	500 kW	Oahu	Waianae
Hawaii FIT Forty, LLC	570 kW	Oahu	Waianae
Hawaii FIT Two	596.7 kW	Oahu	Waianae
La Ola Solar Farm	1.2 MW	Lanai	Lanai City
Cyanotech Solar Array	500 kW	Hawaii	Kailua-Kona

Source: Hawaii State Energy Office, Renewable Energy Projects Directory

Solar

NATIONAL RECOGNITION

In result of Hawaii's aggressive integration of solar PV systems, our state has garnered national attention and recognition.

In 2016:

- Hawaii ranked #1 in the nation for residential solar power per household (Union of Concerned Scientists, Clean Energy Momentum, 2017)
- Honolulu ranked #1 in the nation for solar PV capacity installed per capita and #3 for total solar PV capacity installed (Environment America Center, Shining Cities 2017, 2017)

Smart Electric Power Alliance (SEPA) Awards

Since 2010, Hawaii's electric utilities have been recognized by SEPA as one of the top ten utilities for annual PV capacity installed per customer, annual solar capacity installed, and annual storage capacity installed per customer.

Annual Solar Capacity Installed Per Customer			
Year	**Rank**	**Company**	**Watts/Customer**
2010	#3	HECO	33.2
2011	#7	MECO	100.2
	#10	HECO	82.9
2012	#2	KIUC	282.1
	#4	HECO	219.6
	#6	MECO	198.3
2013	#5	HECO	328.7
	#7	HELCO	182.1
	#8	MECO	177.6
	#9	KIUC	166.5
2014	#4	KIUC	503
	#8	HECO	192
	#9	MECO	191
2015	#7	KIUC	591
	#9	MECO	386

Annual Solar Capacity Installed			
Year	**Rank**	**Company**	**MW**
2012	#10	HECO	65.2
2013	#8	HECO	97.8

Annual Storage Capacity Installed Per Customer			
Year	**Rank**	**Company**	**Watts/Customer**
2016	#7	MECO	17

Wind

ONSHORE WIND

Wind energy is Hawaii's second most utilized renewable energy resource (behind distributed solar), accounting for just under 27% of Hawaii's total renewable energy portfolio in 2016, which equates to about 7% of the total energy sold and distributed by Hawaii's electric utilities in 2016 (2016 Renewable Portfolio Standard Status Reports). This is nearly double the 3.4% of Hawaii's overall energy needs provided by wind power in 2011.

Hawaii has one of the most robust and consistent wind regimes in the world, with capacity factors exceeding those commonly found elsewhere. In 2011, the U.S. Energy Information Administration (EIA) estimated the capacity factor of the Pakini Nui Wind Farm on the Big Island at 65%, Kaheawa Wind Power I on Maui at 47%, and the Hawi Renewables Wind Farm on the Big Island at 45%.

EXISTING UTILITY-SCALE WIND ENERGY PROJECTS

There are currently seven existing utility-scale wind energy projects in Hawaii located on the islands of Oahu, Maui, and Hawaii (none on Kauai). In addition, other large-scale utility wind projects have been proposed or are now under development, including: the 25 MW Na Pua Makani Wind Farm in Kahuku, Oahu, which could consist of up to 10 turbines and have an estimated project footprint of 46 acres; and, the 3.3 MW Lalamilo Wind Farm, which could consist of up to 5 turbines covering 126 acres and would provide power to water wells owned by the Hawaii County Department of Water Supply. There are also numerous smaller, distributed wind turbines (up to 100 kW) currently in operation throughout Hawaii.

Kaheawa Wind Power I, 30 MW, Maui

Project Name	Year In-stalled	Island	Developer	Capacity (MW)	Site Acres	Acres per MW
Hawi Renewable Development	2006	Hawaii	Hawi Renewables	10.5	250	23.8
Kaheawa I Wind Farm	2006	Maui	First Wind, SunEdison (now TerraForm Power)	30	200	6.7
Pakini Nui Wind Farm	2007	Hawaii	Tawhiri Power, Apollo Energy Corp.	20.5	67	3.3
Kahuku Wind Farm	2011	Oahu	First Wind, SunEdison (now TerraForm Power)	30	578	19.3
Kawailoa Wind Farm	2012	Oahu	First Wind, SunEdison (now D.E. Shaw)	69	650	9.4
Kaheawa II Wind Farm	2012	Maui	First Wind, SunEdison (now TerraForm Power)	21	143	6.8
Auwahi Wind	2012	Maui	Sempra Generation	21	68	3.2

Source: Hawaii State Energy Office, Renewable Energy Projects Directory

HAWAII WIND POTENTIAL

Hawaii's strong wind regime and aggressive renewable energy goals are reflected by the amount of wind power Hawaii's electrical utilities plan to integrate into their respective grids by the year 2045. The Hawaiian Electric Companies' Power Supply Improvement Plan (PSIP) Update Report: December 2016 plans for up to an additional 64 megawatts (MW) of onshore wind on Oahu by the year 2045, and up to 200 to 800 MW of offshore wind of Oahu by 2045. The Hawaiian Electric Companies plan for between 42 MW to 150 MW of new onshore wind on Maui by 2045, up to 5 MW of new wind on Molokai by 2020, and up to 102 MW of additional wind on Hawaii Island. The current plan estimates this amount of wind, in combination of many other types of renewable energy, could be needed to get Hawaii to 100% renewable energy by the year 2045.

Wind

This plan is subject to stakeholder review and approval by the Hawaii Public Utilities Commission and does not guarantee any of the proposed MW will be installed, but they do provide options for planning consideration.

CHALLENGES FACING WIND ENERGY DEVELOPMENT IN HAWAII

- Endangered avian (birds, bats) and plant species can complicate the siting, development, and operation of wind projects in Hawaii's unique environments. Proactive measures, such as the development of area-wide habitat conservation plans, could be helpful for species protection as well as easier project siting in the future. The increased level of ecological monitoring required for new farms in Hawaii has helped to increase the amount of information available on impacted species and habitats. Due to the limited knowledge of certain species, such as the Hawaiian Hoary Bat, new and ongoing studies will be invaluable in determining the health and behavior of these species populations and the effectiveness of any available mitigation measures.
- Given the height of wind turbines and limited sites suitable for wind development in Hawaii, visual and cultural impacts must be thoroughly identified and assessed early in the project siting phase. Developers must work closely with local communities early in the process to identify important community resources and values, which are core to the appropriateness of project siting.
- The intermittent nature of Hawaii's wind resource can make integration into the electrical grid a challenge. Mitigation measures, such as forecasting, controls, and improved communication technologies can help mitigate some of these concerns.

OFFSHORE WIND

In response to an invitation from then governor Abercrombie, the Bureau of Ocean Energy Management (BOEM) established the BOEM/Hawaii Intergovernmental Renewable Energy Task Force to promote planning and coordination, and to facilitate effective and efficient review of requests for commercial and research seafloor leases and right-of-way grants for power cables on the federal outer continental shelf (OCS), which begins three nautical miles offshore Hawaii. Members of the Task Force, whose meetings and matters are open to the public, include representatives of federal, state, and local government agencies.

Attention to offshore wind in Hawaii has increased following notice of multiple unsolicited applications received by BOEM for seafloor lease applications for wind farms off-shore of Oahu; currently, still undergoing BOEM review. Multiple public meetings were conducted in 2016, with community members and other stakeholders voicing concerns, recommendations, and other opinions about the prospect of wind turbines off of Oahu's South and Northwest shores. In April 2017, BOEM notified its Hawaii Task Members it is still working to determine whether an area offshore Oahu is suitable for commercial wind leasing.

Renewable Energy Resources

RENEWABLE ENERGY PROJECTS DIRECTORY

The Renewable Energy Projects Directory is an interactive map of existing and proposed renewable energy projects statewide, showcasing the variety of renewable energy resources that are moving the state closer to reaching energy independence. The Directory also serves to inform all stakeholders of planned and existing renewable energy projects of interest.
>> http://energy.ehawaii.gov/epd/public/energy-projects-map.html

PERMITTING

Permitting any large project in Hawaii, including a utility-scale renewable energy project, requires a thorough understanding of local processes, issues, and stakeholders. The development of numerous large-scale renewable energy projects over the last ten years has provided community members, regulators, and developers a more informed opinion of future projects in terms of potential benefits and impacts. With some of the more desirable locations now developed or otherwise not available, appropriate project siting and regulation will remain a challenge moving forward.

Some strategies to support the siting and permitting of renewable energy projects in Hawaii:

- Know the requirements and processes - retain professionals with experience in Hawaii.
- Review past studies / permits (EIS) for the site - where available, lessons learned from earlier efforts can provide a wealth of information.
- Meaningful community participation - engage public early in the project siting and design process.
- Identify the appropriate community contacts - seek out community members with knowledge of the area.
- Engage all stakeholders - identify and address all stakeholders and issues early in the process.
- Site projects appropriately - seek compatible areas to minimize environmental impacts.
- Be diligent - go slow in the beginning to go fast in the end.
- 1 submittal / 1 review - present agencies with well-planned projects, complete applications.
- Electronic permit processing - saves time, reduces back and forth, transparency, tracking.

The tools described below provide information on these topics, as well as guidance to assist appropriate project siting and due diligence. These tools also seek to lower project "soft" costs by reducing the resources needed to undergo the permitting processes without removing any of the environmental or community safeguard processes in place. Many local federal, state, and county agencies contributed to the development to these tools.

DEVELOPER & INVESTOR CENTER, SELF-HELP SUITE (HAWAII STATE ENERGY OFFICE)

The Hawaii State Energy Office's interactive *Developer & Investor Center* and *Self-Help Suite* provide comprehensive information on the siting, permitting, and development of renewable energy facilities in Hawaii. The Energy Office aims to regularly update these resources as requirements, policies, and procedures change. The Center focuses on permitting assistance through its *Project Permitting Assistance and Resources* website, which also provides a permit Guidebook and individual briefs on numerous county, state, and federal permit processes.
>> http://energy.hawaii.gov/developer-investor

In addition to these resources, the Center provides lists of environmental consultants familiar with planning and permitting in Hawaii. While not exhaustive, this list identifies numerous firms with experience permitting and siting renewable energy projects in Hawaii.
>> http://energy.hawaii.gov/developer-investor/project-permitting-assistance-and-resources

RENEWABLE ENERGY PERMITTING WIZARD (HAWAII STATE ENERGY OFFICE)

The *Permitting Wizard* was developed to help those proposing renewable energy projects understand the county, state, and federal permits that may be required for their individual projects. Software upgrades and content updates to the *Wizard* were last completed by the Hawaii State Energy Office in 2015, however, the Energy Office is seeking to update the *Wizard* content.
>> http://wizard.hawaiicleanenergyinitiative.org/

Renewable Energy Resources

RENEWABLE ENERGIS MAPPING TOOL (HAWAII STATE ENERGY OFFICE, OFFICE OF PLANNING)

Renewable EnerGIS provides renewable energy resource and site information for specific Hawaii locations selected by the user. *EnerGIS* helps users understand the renewable energy potential and permitting requirements for specific selected sites. DBEDT is currently upgrading *EnerGIS*, and anticipates the release of the new version later in 2017.
>> http://energy.hawaii.gov/resources/renewable-energis-map

HAWAII CLEAN ENERGY PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (U.S. DEPARTMENT OF ENERGY)

In September 2015, the U.S. Department of Energy (USDOE) published the *Hawaii Clean Energy Final Programmatic Environmental Impact Statement* which assesses common impacts and best management practices associated with 31 clean energy technologies.
>> http://energy.hawaii.gov/testbeds-initiatives/hawaii-clean-energy-peis/peis-overview

ELECTRONIC PERMITTING

Electronic permitting is another effective method of streamlining the permit review process without removing any of the environmental or community safeguards in place. Some examples of state and county agencies in Hawaii utilizing electronic permitting include:

E-PERMITTING PORTAL (HAWAII DEPARTMENT OF HEALTH/DOH)

The DOH Environmental Health Administration (EHA) e-Permitting Portal provides access to environmental permit applications. e-Permitting allows for efficient and accurate electronic application compilation and submission, tracking, processing, management, and fee payment.
>> https://eha-cloud.doh.hawaii.gov/epermit/

ONLINE BUILDING PERMITS (CITY AND COUNTY OF HONOLULU/CCH)

Oahu's Department of Planning and Permitting website provides for the electronic submission and processing of building permits required for residential solar heating, photovoltaic, and electric vehicle charger installations in the City and County of Honolulu. Building Permit status can also be monitored online.
>> https://tinyurl.com/mmdj5vf

ELECTRONIC PLAN REVIEW (EPLAN) AND BUILDING PERMIT STATUS (COUNTY OF KAUAI)

Kauai's Department of Public Works, Building Division, offers online tools to submit building permits electronically (Electronic Plan Review or "ePlan") and get information on Building Permit status, details, and other relevant information.
>> http://www.kauai.gov/EPR

ONLINE PERMITTING (DEPARTMENT OF LAND AND NATURAL RESOURCES)

In late 2016, DLNR launched new electronic permit and asset management tools for DLNR's Engineering Division and Division of Forestry and Wildlife, Native Invertebrates Program. These resources are designed to support the electronic submission, processing, and issuance of select DLNR permits.
>> https://inforps-dp.hawaii.gov/DLNRInvPermitting/#/login

Energy Systems and Planning

Planning for a 100 percent clean energy future in the electricity sector involves studying and analyzing the needs and technological developments that will be necessary to fully complete the transition. Balancing electricity demand and available generation becomes increasingly challenging as intermittent renewable energy in the energy resource mix grows. At higher levels of renewable energy penetration, solutions will need to be found to ensure reliability and resilience at a reasonable cost. Smart grids, interisland transmission, electric vehicles, demand response, energy storage, and rapidly evolving technologies all represent possible contributions to tackling the challenges ahead that should be thoroughly examined and planned for on the path to independence from imported fossil fuels.

Renewable Portfolio Standards (RPS) milestones[10]

12/31/2020	**30%**	12/31/2030	**40%**
12/31/2040	**70%**	12/31/2045	**100%**

Smart Grid

WHAT IS SMART GRID[11]

The electric "grid" is a network of transmission and distribution lines, substations, transformers and more that deliver electricity from power plants to homes and businesses. It's what electric lights and appliances are plugged into. A "smart grid" is one that has more automatic sensors, controls, energy storage, and intelligent systems to better manage the complexity of constantly fluctuating demand and production of electricity efficiently and cost-effectively. Some common "smart grid" components are:

- Smart ("Advanced") Metering Infrastructure
  - Provide timely and detailed energy use information for customers
  - Allow for time variant rates
- DERMS (Distributed Energy Resource Management Systems)
  - Monitor conditions in real time
  - Improved forecasting of intermittent resources
  - Increased control and integration of Distributed Energy Resources
- Energy Storage (batteries, capacitors, flywheels, pumped hydro, hydrogen)
  - Supports increased renewable energy penetration
  - Stabilize the grid by conditioning power and smoothing fluctuations
- Demand Response (managing electricity use in response to available supply)
- U.S. Department of Energy gave $3.4 billion in grants for smart grid projects and grid upgrades in recent years[12]

POTENTIAL MARKET IN HAWAII

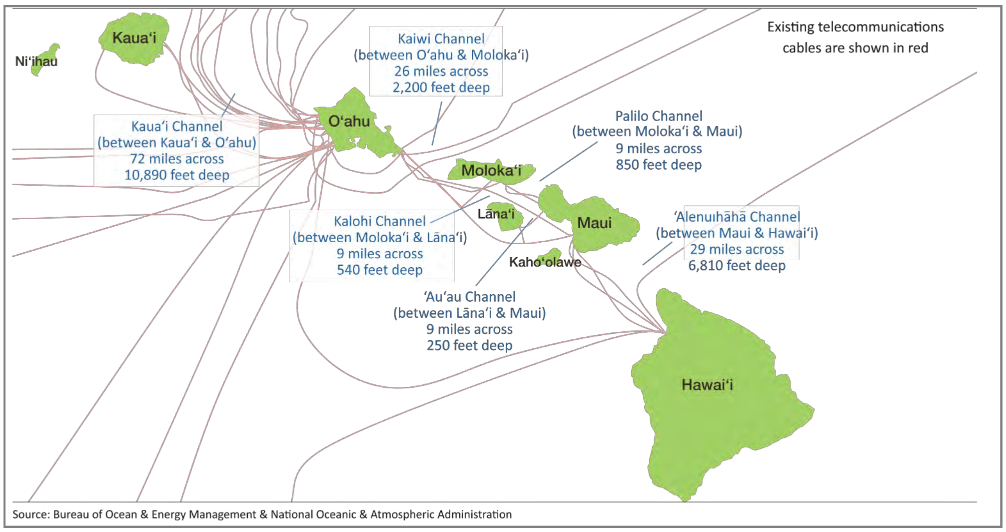
- Residential and commercial building energy management systems may become even more effective when connected to a utility-wide smart grid.
- Over 500,000 housing units and condos,[13] and tens of thousands of commercial and government buildings statewide, can take advantage of smart grid technologies.

Smart Grid

On March 31, 2016, the Hawaiian Electric Companies filed an application with the Public Utilities Commission (Docket No. 2016-0087) requesting approval to commit funds and recover costs for a Smart Grid Foundation (SGF) Project. The purpose of the SGF Project is to implement the initial Smart Grid capabilities that will serve as the platform to support not only immediate customer benefits, but also as the cornerstone for additional projects that can expand customer options, such as optimizing the integration of distributed energy resources ("DER"), implementing demand response ("DR"), time-of-use ("TOU") rates and real-time-pricing ("RTP"), and increasing reliability through distribution automation ("DA").[14] The SGF project concluded with PUC order 34281, which dismissed the application and directed the HECO companies to submit a detailed, scenario-based grid modernization strategy for each utility. As updated in PUC order 34436, a draft shall be submitted for stakeholder review and comment by June 30, 2017 and by August 29, 2017, a final grid modernization strategy, at which time a new docket will be initiated.

INTERISLAND TRANSMISSION

As Hawaii considers a path for achieving a 100 percent renewable portfolio in the electricity sector connecting the islands through integrated, modern grids should continue to be considered as an option to utilize our best natural resources at a scale that will reduce electricity costs and improve overall system efficiency. Communities need to be a key part of this discussion as Hawaii balances economic, technical, environmental and cultural considerations.



Hawaii's islands are already connected by several telecommunications cables.

A 200 MW HVDC cable bundle is no more than 10 inches in diameter. The bundle shown in the picture is for transmission of 500 MW.

There have been at least 22 similar projects globally, including the following noteworthy ones:

- Trans Bay Cable (California), 53 miles: 660 MW installed in 2010.
- Cross Sound Cable (New York - Connecticut), 24 miles: 330 MW installed in 2002.
- Neptune (New York-New Jersey), 50 miles: 660 MW installed in 2007.
- NorNed (Netherlands – Norway) (longest HVDC submarine cable), 360 miles: 700 MW installed in 2008.
- SAPEI (Italy) (deepest HVDC submarine cable, at 5,380 feet), 261 miles: 1,000 MW installed in 2011.

In December 2016, the Hawaiian Electric Companies filed their updated power supply improvement plan (PSIP) with the Public Utilities Commission (Docket No. 2014-0183). In their updated PSIP they contracted E3 to run a "copperplate" scenario, where resource and transmission potential were not accounted for to simulate unrestrained interconnection between islands. E3 found that "total costs savings across all islands is roughly $3 billion in 2016 dollars. This cost difference is an approximate upper bound value and more detailed scoping should be done to investigate both the engineering feasibility of building the cable and the engineering and siting feasibility of the large grid-scale renewable resource build."[15]

Longest undersea power cable	360 miles
Highest capacity undersea HVDC system	2,000 MW
Year of installation, first HVDC undersea power cable	1954
Expected undersea transmission cable life	30 - 50 years
Deepest undersea power cable	5,380 feet

Electric Vehicles

An electric vehicle (EV) uses electricity in place of gasoline, reducing the need for petroleum-based fuel. Since EVs can use electricity produced from renewable resources available in Hawaii (i.e. sun, wind, hydropower, ocean energy, geothermal energy), the transition from gasoline fueled vehicles to EVs supports Hawaii's energy independence goals.

Based on statewide averages, the amount of fossil fuel used to power an electric vehicle in Hawaii is 34%-40% less than the fossil fuel required to power a similar gasoline-fueled vehicle.[16] This is expected to improve as renewable energy increases in Hawaii.

Registered EVs[17] and Public Charging Stations[18] in Hawaii

County	Electric Vehicles	Level 2[19] Charging Station Ports	Level 3[20] Charging Station Ports	Total Ports
Oahu	4,273	307	11	318
Maui	800	78	43	121
Hawaii	250	47	5	52
Kauai	179	37	1	38
Total statewide	**5,502**	**469**	**60**	**529**

Fuel Cost Comparison

Vehicle	**2016 Nissan Versa**	**2016 Honda Civic**	**2016 Nissan LEAF[21]**	
Fuel Type	**Gasoline**	**Gasoline**	**Electricity**	
Miles Per Gallon (MPG)	34 mpg combined 367 miles total range	35 mpg combined 4634miles total range	112 combined MPG 107 miles total range	
Fuel Costs	$3.07/gallon	$3.07/gallon	Residential Electricity Rate: $0.278/kWh [22]	EV Time of Use Electricity Rate: $ 0.188/kWh[23]
Fuel Cost per Year[24]	$854.63	$830.21	$739.12	$498.44

Fuel cost comparisons show approximate savings between internal combustion engine and electric vehicles. The example above shows that fuel costs are lower for the Nissan LEAF than for a comparable gasoline fueled vehicle.

Hawaii EV Dealers and Showrooms by County

County	Nissan-LEAF	GM/ Chevy Volt	Toyota plug-in Prius & Prius Prime	Ford Focus, C-MAX, Fusion Energi	BMW i3 & i8	Cadillac ELR	Porsche Panamera S E-hybrid	Tesla Showroom	Kia Soul EV	Audi A3 E-Tron	Smart Car EV Smart
Oahu	3	3	3	4	1	1	1	1	3	1	1
Maui	1	1	1	1	0	0	0	0	1	-	-
Hawaii	1	1	2	0	0	0	0	0	2	-	-
Kauai	1	1	1	1	0	0	0	0	1	-	-

Electric Vehicles

HAWAII'S ELECTRIC VEHICLE LAWS AND INCENTIVES

· Free parking is provided in state and county government lots, facilities, and at parking meters.
· Vehicles with EV license plates are exempt from High Occupancy Vehicle lane restrictions.
· Parking lots with at least 100 public parking spaces are required to have at least one parking space, equipped with an EV charging system, reserved exclusively for EVs.
· Non-EVs parked in a space designated and marked as reserved for EVs shall be fined not less than $50 nor more than $100.
· Hawaiian Electric Co. offer EV Time of Use Rates designed to incentivize customers, through lower rates, to charge their EVs during off-peak times of day.
· Multi-family residential dwellings or townhomes cannot prohibit the placement or use of EV charging systems altogether.

For more information about state and federal laws and incentives, visit energy.hawaii.gov/testbeds-initiatives/ev-ready-program/laws-incentives.

EV QUICK FACTS

The first car to arrive in Hawaii was Electric.[25]	Year 1899
Amount of energy a fully charged Nissan LEAF has potential to tap.	24 kWh
Best temperature range to operate lithium ion batteries (most common EV batteries today).	68°- 95° Fahrenheit
Hawaii ranks second in the nation behind California in the number of EVs registered per thousand people.[26]	2.94 out of every 1,000 registered light cars and trucks in Hawaii are EV
Cost for a government or commercial property owner to install a Level 2 charging station:	Approximately $4,000-$8,000 per station. A relatively simple project in Hawaii can range from $4,000 to $25,000 to $100,000; however, prices vary considerably.[27]

EV STATIONS HAWAII

The Hawaii State Energy Office developed a mobile app designed to help drivers locate publicly available EV charging stations statewide. EV Stations Hawaii helps drivers pinpoint charging stations as well as provide detailed information of the station giving them the confidence that they can recharge while on the road. The free app is available for Apple and Android smartphones and mobile devices.
energy.hawaii.gov/testbeds-initiatives/ev-ready-program/ev-stations-hawaii-mobile-app

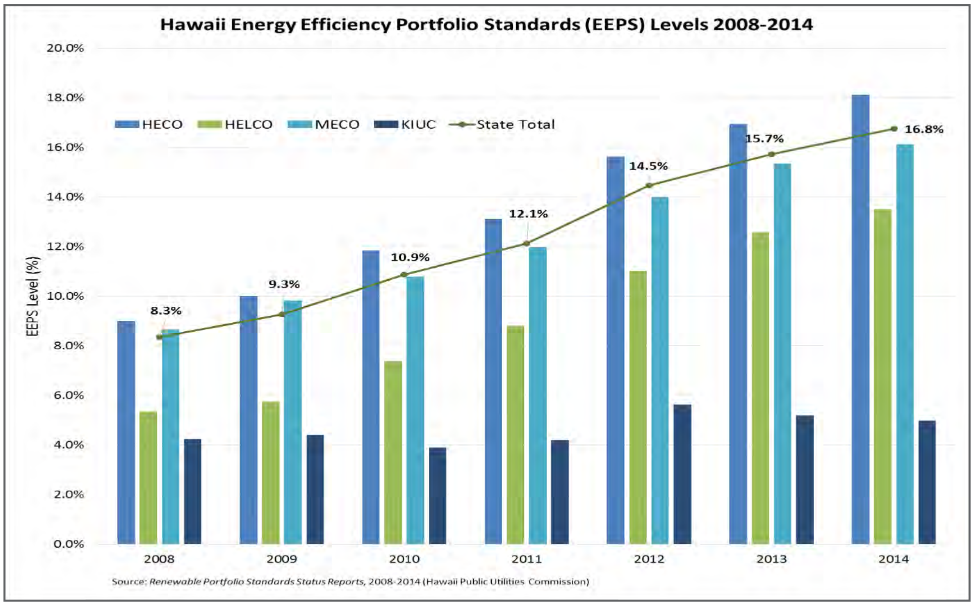
EVs ON THE MOVE

EVs have a greater initial purchase price[28] than comparable gasoline-fueled vehicles. Most experts, including Hawaii's auto dealers, believe that widespread acceptance of EVs will grow as a full battery charge provides greater driving range and the cost of EVs more closely matches the cost of conventional internal combustion engine (ICE) vehicles.

Energy Efficiency

ENERGY EFFICIENCY PORTFOLIO STANDARDS

Per legislative changes taking effect on January 1, 2015, renewable portfolio standards (RPS) reporting no longer includes energy efficiency portfolio standards (EEPS). Under HRS 269-96, relating to EEPS, the PUC is responsible for establishing standards that will maximize cost-effective energy-efficiency programs and technologies. EEPS levels from 2008-2014 appear below; the original goal for EEPS was a reduction of electricity consumption by 4,300 gigawatt-hours by 2030. HSEO held a Hawaii Clean Energy Initiative Energy Efficiency Charrette for stakeholders on May 8 and 9, 2017, to discuss the status of EEPS and the Public Benefits Fee and the Public Benefits Fee Administrator.



Hawaii Energy (HE) continues to be a major contributor to the state's EEPS goals. Hawaii Energy encourages and rewards smart energy decisions which will allow our state to reach 100 percent clean energy faster and cheaper through energy efficiency and conservation. As the Public Benefit Fee Administrator, HE serves all of the islands except for Kauai. From July 1, 2016 through March 31, 2017, the program invested over $22 million to deliver more than 1.2 billion kWh in estimated lifetime customer-level energy savings at a rough cost of two-cents per kWh. This is the equivalent to building a 64 MW solar farm, enough to power 195,000 homes for a year. In addition, this reduced greenhouse gas emissions by nearly 1 million tons.

Energy Performance Contracting

Energy Performance Contracting (EPC) finances energy and water efficiency improvements with the future savings from the energy and water conservation measures installed. Under an EPC, the energy service company contracted for the conservation measures will guarantee the savings or pay for the shortfall. EPC lets government agencies maximize their energy investments because they can include deferred maintenance and performance period maintenance services under a single contract with guaranteed savings measures. The economic impacts of performance contracting are significant, providing great value to the state.

Performance contracting allows agencies to install energy efficiency retrofits in a timely manner. Retrofits can take less than one year to up to three years to install. Therefore, energy savings occur sooner than later. Capital improvement projects can take from six to 10 years, resulting in missed opportunities for annual energy savings. State and county agencies face increasing energy costs and the need to upgrade aging, inefficient, and obsolete energy- and water-consuming equipment. Capital improvement and operating budgets have been unable to keep up with the needed upgrades for energy and water efficiency.

Energy Performance Contracting

RACE TO THE TOP AWARD

For five consecutive years, Hawaii has garnered further national recognition with the Race to the Top award from the Energy Services Coalition* (ESC). The award is given to the national leader with the highest per capital investment in performance contracting projects. With the Department of Transportation, Airports Division, performance contract for nearly $209.8 million, ESC recognizes Hawaii with the distinction of signing the single largest performance contract by a state agency. Since 2012 through 2016 the ESC awarded Hawaii the Race to the Top for its per capita investment. In 2016 ESC also recognized the State of Hawaii as an Energy Stewardship Champion for outstanding accomplishments leveraging performance contracting to achieve infrastructure modernization, environmental stewardship, and economic development. "The State of Hawaii has shown great leadership not only in this contract, but also in their overall program that promotes the use of guaranteed energy savings performance contracting in public facilities. They are a great example for other states to follow," said Jim Arwood, Executive Director, ESC.

Energy Services Coalition Ranking			
State	**Population**	**Performance Contracting**	**Dollars per Capita**
1. Hawaii	1,360,301	$504,312,409	$370.74
2. Kentucky	4,339,367	$750,000,000	$172.84
3. Delaware	897,934	$138,707,463	$154.47
4. Massachusetts	6,547,629	$865,349,091	$132.16
5. Ohio	11,536,504	$1,252,683,627	$108.58

Since HSEO started the performance contracting program in 1996, state and local government agencies have signed a total of over $504 million in performance contracts that are estimated to save in excess of $1.1 billion over the life of the contracts. These savings are the equivalent of powering 401,997 homes for one year. The projects comprise over 112 million square feet in 295 existing buildings or facilities.

**ESC is a national nonprofit organization of experts working together to increase energy efficiency and building upgrades through energy performance contracting.*

Energy Performance Contracting

BUILDING BETTER BUILDINGS

On September 10, 2013, HSEO became a partner in the DOE's Better Buildings Initiative, a national leadership initiative calling on state and local officials to "make substantial commitments to improve the energy efficiency of their buildings and plants, save money, and increase competitiveness." HSEO joined the Better Buildings Performance Contracting Accelerator "to significantly expand the use of performance contracting by state and local governments … to catalyze public sector energy efficiency investments of $2 billion from January 2013 to December 2016…" The partnership committed the state to executing $300 million in performance contracting within the three-year period. The State of Hawaii exceeded its commitment to the US Department of Energy (USDOE) and signed nearly $335.5 million in performance contracts for energy efficiency improvements for state and county facilities. This national achievement is recognized by the USDOE as the state that met the highest goal. Hawaii's outstanding milestone not only exceeded Hawaii's goal but also put the USDOE's Performance Contracting Accelerator Program over the top to reach and exceed their $2 billion national goal.

Hawaii's landmark $335.5 million total is the result of contracts signed by the City and County of Honolulu for the Kailua Wastewater Treatment Plant, the City and County of Honolulu Board of Water Supply, and the State Department of Transportation for all three divisions for Highways, Harbors, and Airports. The projects impact over 24.4 million square feet of building space and include installation of over 136,000 lighting retrofits, 13 megawatts of photovoltaic power, and other energy efficiency improvements. Savings from these projects are expected to save over $865.9 million over the life of the contracts. The energy savings from these contracts are equivalent to powering 20,464 homes in one year and over the life of the contracts power 389,381 homes.

Hawaii's progress in energy performance contracting prompted a letter of congratulations to Gov. David Ige from the USDOE in October 2016. The letter recognized the success of Hawaii's programs for "driving greater energy efficiency" and thanked the governor for his leadership.

"Congratulations to our state partners on their impressive investment in energy efficiency," said Kathleen Hogan, Deputy Assistant Secretary for Energy Efficiency at the US Department of Energy. "By accelerating the use of Energy Service Performance contracting, Hawaii has led by example and demonstrated how to save money for taxpayers and create well-paid jobs, through energy efficiency."

The greatest contributor to Hawaii's meeting and exceeding its $300 million goal was the State Department of Transportation, which under a Request for Proposals, executed a total of $296.3 million in contracts. The Harbors Division executed a contract in excess of $26.2 million, the Highways Division for about $60.3 million, and Airports Division for 12 airports for nearly $209.8 million. The work will be done by Johnson Controls as the energy service company. For the Airports Division alone installations will include air conditioning upgrades, over 98,000 light fixtures, and over 24,400 photovoltaic panels for a total of 7.9 megawatts of power generation.

DBEDT estimates that over the life of the Department of Transportation Airport's contract, which ends in 2034, the economic impacts will be as follows:

- $27.3 million in tax revenues (in 2016 dollars),
- $186.6 million in income to households (in 2016 dollars), and
- 867 jobs generated or supported each year during the first two years of construction in Phase I with 257 jobs supported each year during Phase II construction and installation and an average of 63 jobs generated or supported each year during the performance period.*

The energy savings is equivalent to powering 9,264 homes a year. Over the life of the project the energy saved could power more than 175,267 homes.

*Source: DBEDT Research & Economic Analysis Division

State of Hawaii Agencies Lead By Example

STATE AND COUNTY ENERGY PERFORMANCE CONTRACTING

The chart below illustrates the number of EPC projects conducted by state and county agencies from 1996 through 2017. In addition, over $8 million in rebate incentives have been claimed from Hawaii Energy, reducing the cost of the energy efficiency improvements through performance contracting projects. Looking ahead, the state anticipates more EPC investments.

Agency	Year(s)	Contract Amount ($)	Estimated Savings Over Life of Contract ($)
U.H. Hilo	1996-2012	$6,402,695	$14,630,066
County of Hawaii	1997-2026	$2,215,546	$8,157,880
County of Kauai	1998-2012	$525,965	$1,205,990
C&C of Honolulu	2001-2025	$11,900,205	$36,066,761
Hawaii Health Systems Corporation	2002-2022	$21,936,997	$55,766,364
Judiciary	2003-2012	$1,474,406	$9,785,036
Dept. of Accounting & General Services Phase I	2009-2029	$36,873,266	$72,580,767
Department of Public Safety	2010-2030	$25,511,264	$57,211,112
University of Hawaii Community Colleges	2012-2032	$34,207,392	$37,000,000
C&C Honolulu Kailua Wastewater Treatment Plant	2013-2033	$6,054,178	$13,693,910
Dept. of Accounting and General Services Phase II	2013-2033	$17,400,000	$28,000,000
Department of Transportation	2013-2034	$306,685,097	$795,560,746
Honolulu Board of Water Supply	2016-2036	$33,125,398	$56,846,668
Total		**$504,312,409**	**$1,186,505,300**

For nearly 20 years, HSEO has been leading the state's award-winning EPC efforts with a policy offering technical assistance to state agencies contemplating performance contracting. We've assisted the following entities:

- University of Hawaii at Hilo
- Hawaii Health Services Corporation
- City and County of Honolulu's four city buildings and Kailua Wastewater Treatment Facility
- County of Hawaii
- County of Kauai
- The Judiciary
- Department of Accounting and General Services (DAGS)-Phase I-10 large office buildings
- University of Hawaii Community Colleges
- Department of Public Safety's four large facilities
- Department of Transportation: Airports, Highways and Harbors
- DAGS Phase II - 33 buildings
- Honolulu Board of Water Supply

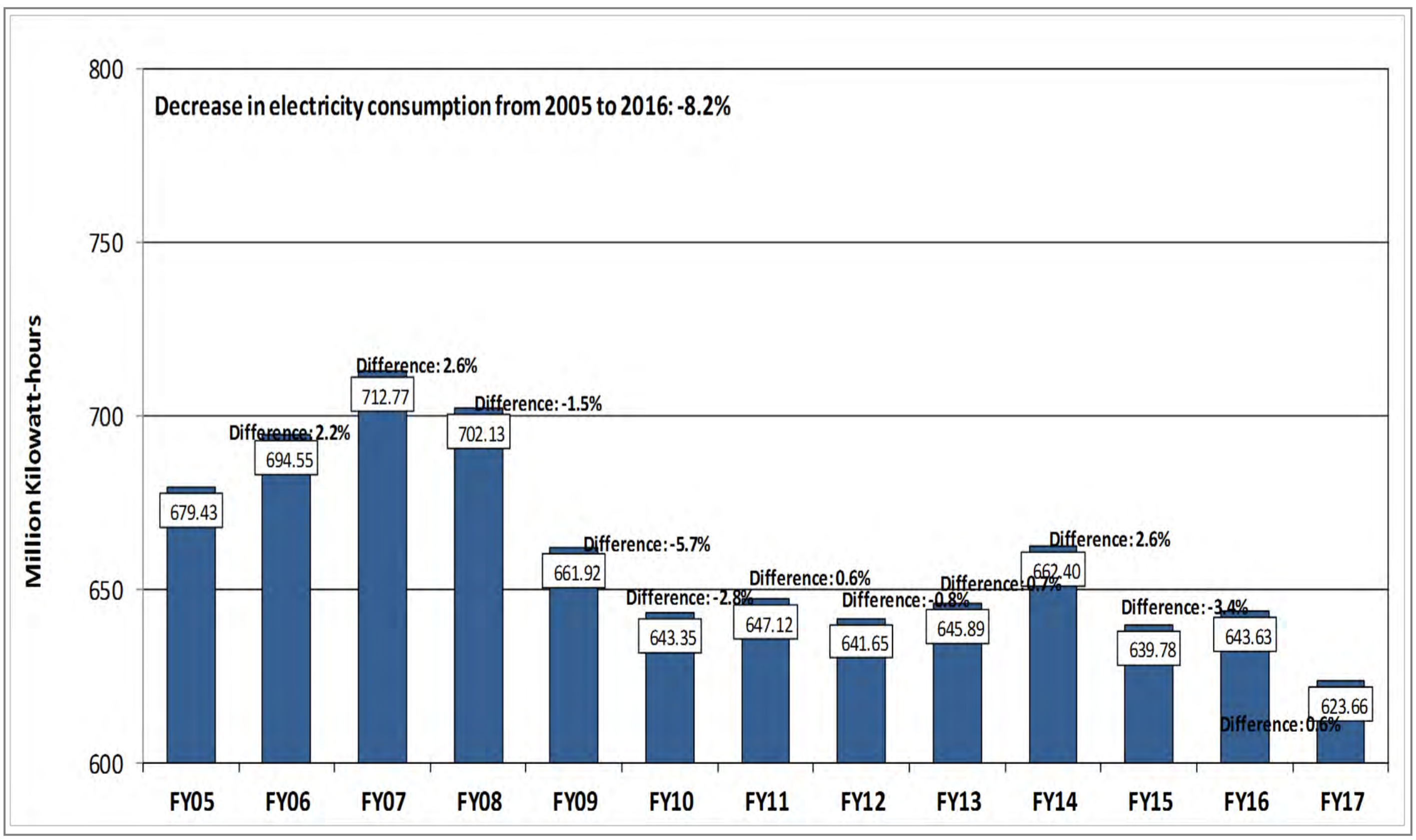
State of Hawaii Agencies Lead By Example

The types of technical assistance offered, pending funding, include:

1. Assisting an agency in compiling building plans and other information to use in solicitations
2. Reviewing draft solicitations
3. Evaluating proposed energy conservation measures, including renewable and water efficiency measures
4. Setting energy performance baselines
5. Reviewing methods for estimating energy savings (including formulas and simulation models); measurement and Verification
6. Reviewing investment grade energy audits
7. Reviewing draft contract documents
8. Advising on commissioning
9. Advising on how project risks can be allocated and minimized for the state agency

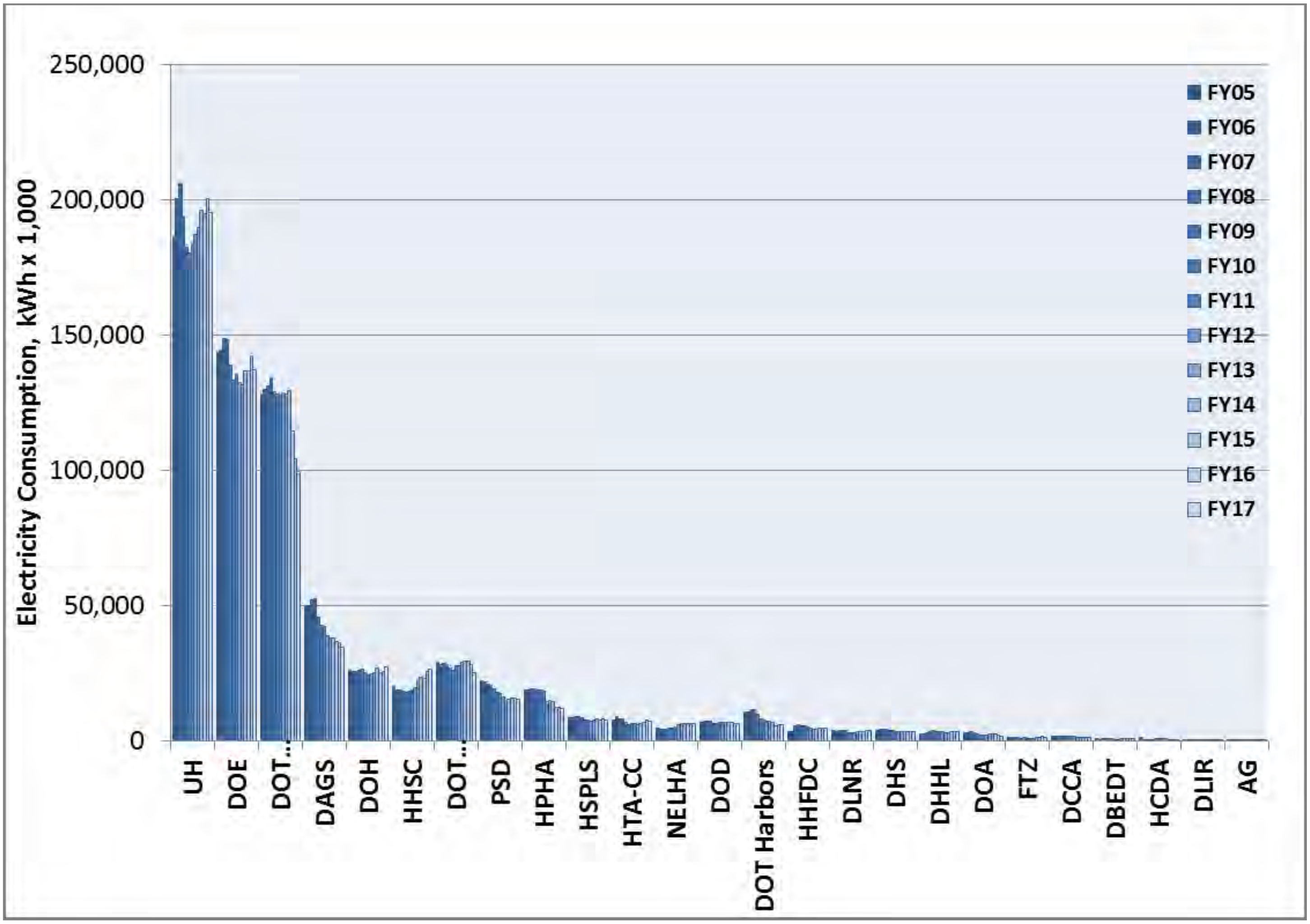
In 2006 legislative and executive mandates to incorporate energy and resource efficiency and conservation in government facilities, fleets, and personnel practices gave impetus to the state's Lead by Example (LBE) initiative to put state agencies at the forefront of energy independence efforts. As shown in the graph below, Hawaii state agencies' electricity consumption through 2016 has declined 5.3 percent from 2005 (the baseline year). Due to staff reductions, HSEO will no longer provide a special report on LBE, but we will continue to track and report electricity use by state agencies.

Comparison of State Agencies' Electricity Consumption in kWh: FY05 to FY17



State of Hawaii Agencies Lead By Example

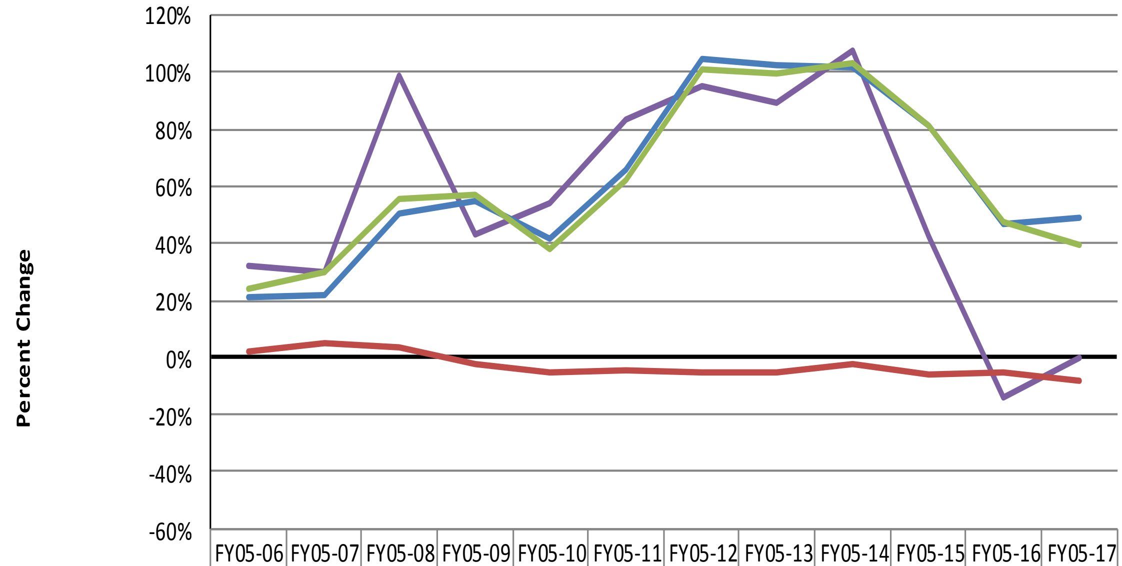
Comparison of kWh Consumption by Agency by Year



AG	Department of the Attorney General	DOT Harbors	Department of Transportation/Harbors Division
DAGS	Department of Accounting and General Services	DOT Highways	Department of Transportation/Highways Division
DBEDT	Department of Business, Economic Development & Tourism	FTZ	Foreign-Trade Zone Division
DCCA	Department of Commerce and Consumer Affairs	HCDA	Hawaii Community Development Authority
DHHL	Department of Hawaiian Home Lands	HHFDC	Hawaii Housing Finance & Development Corporation
DHS	Department of Human Services	HHSC	Hawaii Health Systems Corporation
DLIR	Department of Labor and Industrial Relations	HPHA	Hawaii Public Housing Authority
DLNR	Department of Land and Natural Resources	HSPLS	Hawaii State Public Library System
DOA	Department of Agriculture	HTA-CC	Hawaii Tourism Authority – Convention Center
DOD	Department of Defense	NELHA	Natural Energy Laboratory of Hawaii Authority
DOE	Department of Energy	PSD	Department of Public Safety
DOH	Department of Health	UH	University of Hawaii
DOT Airports	Department of Transportation/Airports Division		

State of Hawaii Agencies Lead By Example

Statewide Electricity Consumption Since 2005



	FY05-06	FY05-07	FY05-08	FY05-09	FY05-10	FY05-11	FY05-12	FY05-13	FY05-14	FY05-15	FY05-16	FY05-17
Price of Oil ($/bbl)	31.8%	30.0%	99.1%	43.0%	54.2%	83.1%	94.9%	89.1%	107.9%	42.3%	-14.4%	-0.3%
Total State Avg Retail Price (All Sectors; $/KWH)	20.9%	22.1%	50.5%	54.5%	41.8%	65.5%	104.6%	102.5%	101.5%	81.5%	46.7%	48.7%
Total SOH Building Electricity Cost ($)	23.7%	30.3%	55.4%	57.3%	38.2%	62.0%	101.3%	99.5%	103.4%	81.1%	47.2%	39.5%
KWH	2.2%	4.9%	3.3%	-2.6%	-5.3%	-4.8%	-5.6%	-4.9%	-2.5%	-5.8%	-5.3%	-8.2%

Sources: NYMEX WTI Future Price; EIA-826 ; Utilty (HECO, MECO, HELCO, & KIUC) Billing data

Percentage change in energy consumption, from baseline (2005) and each following year. Shown are the price of oil, the average retail price of electricity*, total statewide electricity costs and electricity consumption (kWh).

Since 1996 state agencies have received nearly $11.5 million in efficiency rebates from Hawaii Energy, the Hawaiian Electric Company and its subsidiaries. Combined, these rebates have resulted in more than $221 million estimated cumulative dollar savings and 1.2 billion kWh electricity savings. Over the life of the equipment, the savings would be enough to power about 190,000 households for a year. From June 2016 through March 2017, state agencies received $345,000 in rebates.

*Based on U.S. Energy Information Administration-826 reporting, dividing utility total revenues by total kWh sold, including fuel adjustment cost.

State Energy Building Code Update

On July 14, 2015, the State Building Code Council (SBCC) unanimously voted to adopt the International Energy Conservation Code (IECC) 2015, with the Tropical Climate Zone Code for residential dwellings and other amendments appropriate for Hawaii's climate. After a public hearing which garnered full support of IECC 2015, Gov. Ige signed and approved IECC 2015 on March 20, 2017, to adopt Chapter 3-181.1, into Hawaii Administrative Rules.

HSEO serves on the SBCC, which was established by statute to update building codes. HSEO provided IECC 2015 technical assistance and staff training for over 300 private and public sector design professionals and county building officials. HSEO also will testify in support of IECC 2015 when the county councils hold public hearings on their adoption.

The estimated net savings from the 2015 IECC with Hawaii amendments is 12,962 MWh in 2016, 1,083,590 MWh in 2026 (year 10), 1,991,059 MWh in 2030 and 4,702,738 MWh in 2036 (year 20). These savings could power 732,514 homes in 2036, assuming the code is adopted by all counties.

Commercial Code Savings: Commercial buildings would achieve a 35-40 percent energy saving by adopting the base 2015 IECC with references to ASHRAE 90.1-2013 (compared to 2006 HEC with references to ASHRAE 90.1-2004). Amendments under consideration by HSEO will further increase potential energy savings.

Residential Code Savings: Fully conditioned 2015 IECC residences would achieve a 6 to 9 percent improvement in energy efficiency.

HSEO's website has more information on the updated energy code at energy.hawaii.gov/hawaii-energy-building-code, including a report on the analysis of the code amendments, FAQs gathered from the various training sessions statewide, presentation webinars, fact sheets and a report forecasting the energy savings for the updated code.

Leadership in Energy and Environment Design (LEED)

The U.S. Green Building Council (USGBC) released its State Market Briefs. The brief highlights the number of LEED certified and registered projects in the state, as well as the gross square footage. As of May 2017, Hawaii has 173 LEED certified projects and 255 registered projects. This totals 428 total projects for a gross square footage of over 49 million gross square feet. Utilizing less energy and water, LEED-certified spaces save money for families, businesses and taxpayers; reduce carbon emissions; and contribute to a healthier environment for residents, workers and the larger community. The certified buildings included numerous private developments, as well as federal, state, and county public buildings.

HSEO remains a member of the U.S. Green Building Council (USGBC), the non-profit entity which administers the LEED program.

The state requires all new construction and major renovation to meet LEED Silver standards, to the extent possible. The Hawaii State Energy Office continues to promote LEED training opportunities for state agency staff.

U.S. Department of Energy Competitive Award

The state submitted a winning proposal to a national competition conducted by the DOE, garnering a $350,000 award to implement a project to strengthen whole building retrofit energy efficiency programs, identify best practices, develop a database of over 500 state facilities and explore financing options for energy savings. In two years, Hawaii benchmarked 416 state facilities, which included over 2,600 buildings covering more than 29 million square feet. The average EUI is 32 and an average ENERGY STAR score is 85. Benchmarking efforts included securing data points to calculate EUIs, but we were not able to secure all data points for ENERGY STAR verification for all of the state facilities in the data base. The data points gathered and the EUIs will be held in a central repository for agencies to access when needed for future use.

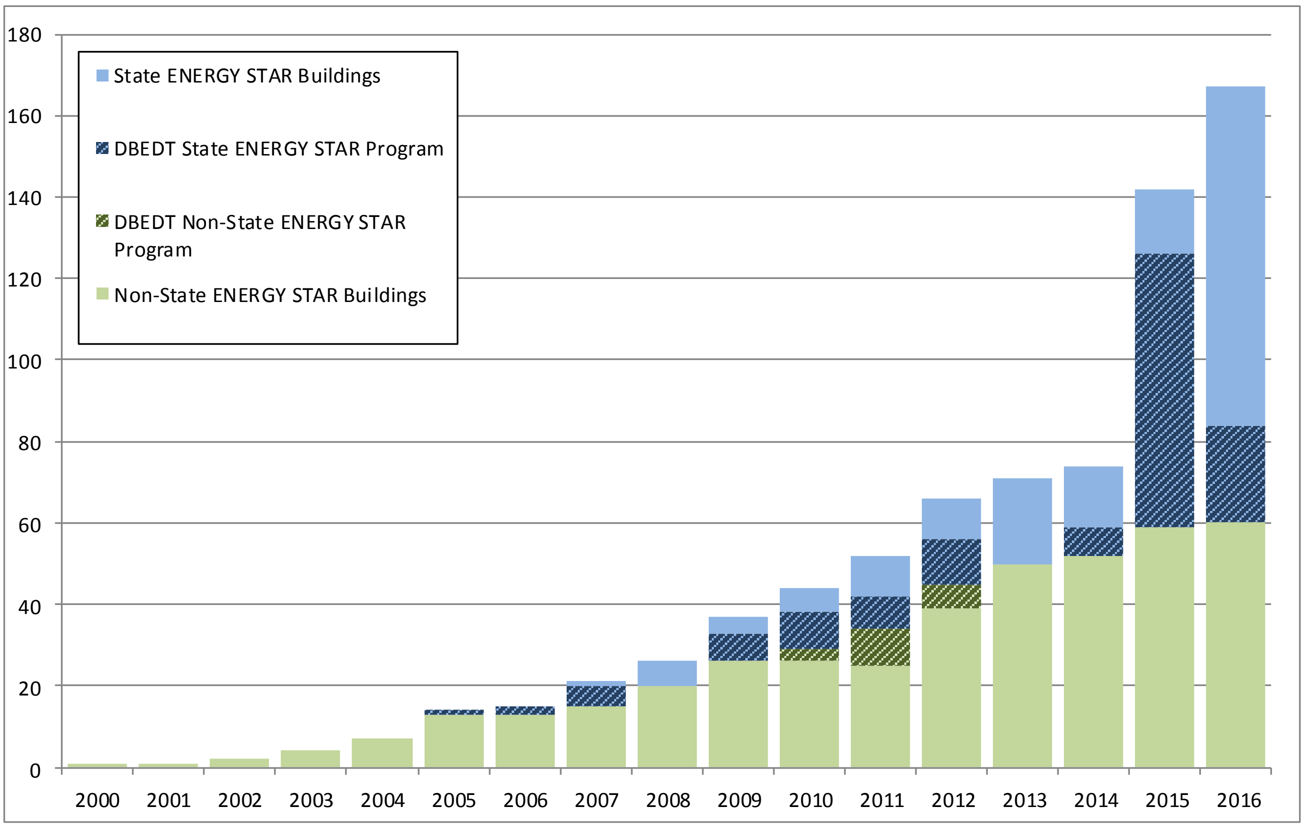
Due to the Cooperative Agreement, 59 state facilities received ENERGY STAR certifications in 2015. In 2016, 24 state facilities were certified. These certifications contributed to Hawaii's rankings in the US EPA's 2016 ENERGY STAR ranking: Honolulu was #22 in the Top 25 for larger Metro Areas. For Mid-Size cities, Honolulu was #2. For small cities, Hilo was #8, and Kahului-Wailuku-Lahaina was tied at #9 with 2 other cities. Other noteworthy achievements were:

1. Completing certification of 83 Schools for ENERGY STAR label. Previous to this project, to the best of our knowledge, the State Department of Education had certified only 1 school.
2. Creating a large database of 2,600 buildings/facilities with the state's energy use, building data, and other information found in the DRT. This was previously not available. In addition, this project allowed us to "clean" the data base. Agencies previously had not reviewed addresses to meters to "clean" the meter data to correctly attribute meters to properties, an important ENERGY STAR basic requirement.
3. Housing the data base in one central repository for agencies to draw from, add, and reference for present and future use to help them better manage their buildings/facilities. This was previously not available.
4. Completing numerous (26) training sessions which were attended by 332 public and private sector employees to introduce, extend knowledge, and encourage use of benchmarking and ENERGY STAR Portfolio Manager.
5. Providing agencies with a better understanding of benchmarking and ENERGY STAR Portfolio Manager and how it can contribute to a comprehensive Building Management program.
6. Examining data and assessing agency readiness and capability for implementing performance contracting by bundling building and facilities. Promoting performance contracting options to agencies and inviting participation when they are ready.
7. Establishing numerous ENERGY STAR Portfolio Manager accounts (17) for agencies which may not have had used this tool. Updating the information for agencies with accounts.
8. Establishing of a good working relationship with state agencies and Hawaii Energy for future energy efficiency projects. Through this Cooperative Agreement, HSEO has been able to provide a range of training opportunities including CEM & OEM training, which were more technical than some of the Energy Star training. In turn, agency staff have found it to be extremely valuable, and we intend to continue to build on this knowledge and relationship to support additional training and encourage increased energy efficiency improvements.
9. Completion of a Showcase publication featuring the State Department of Transportation performance contracting project for 12 state airports and becoming the nation's single largest state performance contract at $158M. Completion of a Gap Analysis, Best Practices Analysis, and Financing Mechanisms Options Report.
10. Energy Services Coalition (ESC) State Spotlight: Hawaii - Hawaii was recognized at the recent ESC Market Transformation Conference for the fifth consecutive year as the nation's leader for per capita investment in guaranteed energy savings performance contracting (GESPC). Hawaii's investment of $325.25 per capita in 2016 earned the state a No. 1 ranking.

ENERGY STAR® Buildings

To help identify energy efficiency investment priorities, agencies and private sector building owners and managers can benchmark buildings to compare energy usage with other buildings in their portfolio or similar buildings nationally. If a building's performance, as reflected in its ENERGY STAR score, ranks in the top 25 percent of all buildings of its type, it can be certified as an ENERGY STAR building.

The following chart shows the rapidly increasing number of ENERGY STAR certified buildings in Hawaii. To qualify for certification, a building must meet ENERGY STAR requirements as verified by a licensed professional engineer or architect. The U.S. Environmental Protection Agency (EPA) then evaluates the verification submitted and, if approved, will officially certify the applicant as an ENERGY STAR building. Since 2000, 166 Hawaii buildings have received the ENERGY STAR certification, including 103 public and 63 private buildings. During this time, HSEO has helped benchmark 83 state facilities. Because energy use is constant, buildings should be verified and certified as ENERGY STAR annually to ensure optimum efficiency.



In 2016 Hawaii communities appeared in the EPA's ENERGY STAR Top Cities rankings. Honolulu ranked 22nd of the Top 25 Cities, with 69 buildings totaling over 9.6 million total square feet, saving $23 million a year. Honolulu also ranked second among Top Mid-Size Cities. Among Top Small Cities, Hilo ranked 8th with 9 buildings and Kahului/Wailuku/Lahaina ranked 9th with 8 buildings.

Hawaii Green Business Program

Hawaii's businesses are also contributing to the clean energy movement by improving their operations in an environmentally, culturally and socially responsible manner. To help businesses implement energy and resource efficiency practices, the state set up the Hawaii Green Business Program as a partnership between HSEO, the Department of Health, the Board of Water Supply and the Chamber of Commerce of Hawaii. When businesses embrace green business practices, they don't just enjoy utility cost savings – they also contribute to Hawaii's collective energy independence goals and, ultimately, a more sustainable environment.

From 2009-2017, over 100 business and government entities have benefited from the program, including sectors such as hospitality, commercial office, retail, restaurant, food services, grocery, venue and green events. Their savings amounts to:

- 18.9 million kWh of energy (equivalent to powering 2,940 homes for one year in Hawaii)
- 136.8 million gallons of water
- $5.7 million in energy costs

For more information on the Hawaii Green Business Program, visit greenbusiness.hawaii.gov

GreenSun Hawaii Loan Program

The GreenSun Hawaii Loan Loss Reserve Program was established with American Recovery and Reinvestment Act of 2009 (ARRA) funds and was successful in issuance of 203 loans totaling over $4.8 million. For three years, the GreenSun Hawaii program helped extend loan availability to a larger pool of Hawaii property owners for energy efficiency and renewable energy retrofits to their homes, apartment complexes, and facilities. It did so by providing local financial institutions with access to a DOE-funded loan loss reserve that could cover up to 100 percent of actual losses. The public-private partnership had the ability to leverage $4.25 million in federal funds into $85 million in energy efficiency and renewable energy equipment loans statewide. The 203 GreenSun Hawaii loans will save 29.9 million kWh of electricity over the life of the installations, which will save participants in excess of $13.2 million over the life of the installations and reduce CO_2 by 2,247,000 lbs. annually (44.9 million lbs. over the life of the installations). Energy savings over the life of the equipment is equivalent to powering 4,657 households in one year.

Due to changes in the ARRA finance program rules, GreenSun Hawaii program funds can be repurposed for broader uses pursuant to the rules of DOE's Energy Efficiency and Conservation Block Grant Program.

Endnotes

[1] U.S. Energy Information Administration, “1990-2015 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, EIA-923)”, http://www.eia.gov/electricity/data/state/
[2] DBEDT’s Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends/
[3] Volumes. Source: Energy Information Administration, State Energy Data System
[4] DBEDT’s Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends-2/
[5]DBEDT’s Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends-2
[6] 1 barrel = 42 U.S. gallons
[7] DBEDT’s Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends-2/
[8] Electricity: http://www.eia.gov/state/rankings/#/series/31 (last accessed 5/17/17); natural gas: http://www.eia.gov/state/rankings/#/series/28 (last accessed 5/17/17)
[9] DBEDT’s Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends-2/
[10] Chapter 269-91 et. seq., Hawaii Revised Statutes. http://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0269/HRS_0269-0092.htm
[11] SmartGrid.gov: http://www.smartgrid.gov/the_smart_grid
[12] RECOVERY ACT: SMART GRID DEMONSTRATION PROGRAM (SGDP):https://energy.gov/oe/information-center/recovery-act-smart-grid-demonstration-program-sgdp
[13] Hawaii Data Book: http://files.hawaii.gov/dbedt/economic/databook/db2015/section01.pdf
[14] Hawaiian Electric Companies. Docket No. 2016-0087, Approval for Smart Grid Foundation Project. March 31, 2016
[15] PSIP Update filed with the Hawaii Public Utilities Commission on December 23, 2016 at P-43
[16] State of Hawaii, Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii, 2012. http://energy.hawaii.gov/wp-content/uploads/2011/10/ReportMauiElectricVehicleAlliance_12_20_12.pdf
[17] EV figures updated DBEDT monthly energy trends (March 2017) http://dbedt.hawaii.gov/economic/energy-trends-2/
[18] EV Stations Hawaii app (as of September 2016) http://energy.hawaii.gov/testbeds-initiatives/ev-ready-program/ev-stations-hawaii-mobile-app
[19] Level 2 charging is at 240 volts. All electric vehicles are equipped for this type of charging. A “charger” can have one or more ports. The number of “ports” determines how many vehicles each charger can service at a time. One “port” can service one vehicle
[20] Level 3, also known as “fast charging,” can provide an 80% charge for some vehicles in less than 30 minutes, depending on vehicle and charger specifications. Not all vehicles can use fast charging
[21] Fuel cost comparisons show approximate savings between internal combustion engine and electric vehicles. The example shows that fuel costs are lower for the Nissan Leaf than for a comparable gasoline fueled vehicle. Nissan Leaf: 24 kWh battery; 0.34 kWh per mile
[22] Electricity rate based on Residential rate for Dec. 2016 was 27.78 cents. Source: Monthly Energy Trend, READ, DBEDT
[23] Electricity rate based on EV Time of Use Mid-Day Rate (Residential Rate - $0.09). Source: HECO Website: https://www.hawaiianelectric.com/clean-energy-hawaii/electric-vehicles/electric-vehicle-rates-and-enrollment/residential-rates
[24] Based on fuel prices and 9,465 annual miles per year from Hawaii State Data Book. http://dbedt.hawaii.gov/economic/databook/. Figure does not include operations and maintenance costs, which are generally shown to be lower for electric vehicle ownership
[25] The Hawaiian Gazette., October 10, 1899, Page 4, Image 4 http://chroniclingamerica.loc.gov/lccn/sn83025121/1899-10-10/ed-1/seq-4/
[26] U.S. Department of Energy Vehicle Technology Office http://energy.gov/eere/vehicles/fact-936-august-1-2016-california-had-highest-concentration-plug-vehicles-relative
[27] Hawaii State Energy Office, Report to the Maui Electric Vehicle Alliance Driving EVs Forward: A Case Study of the Market Introduction and Deployment of the EV in Hawaii (PDF) http://energy.hawaii.gov/wp-content/uploads/2011/10/ReportMauiElectricVehicleAlliance_12_20_12.pdf
[28] Ranging from mid-$30,000 to $40,000