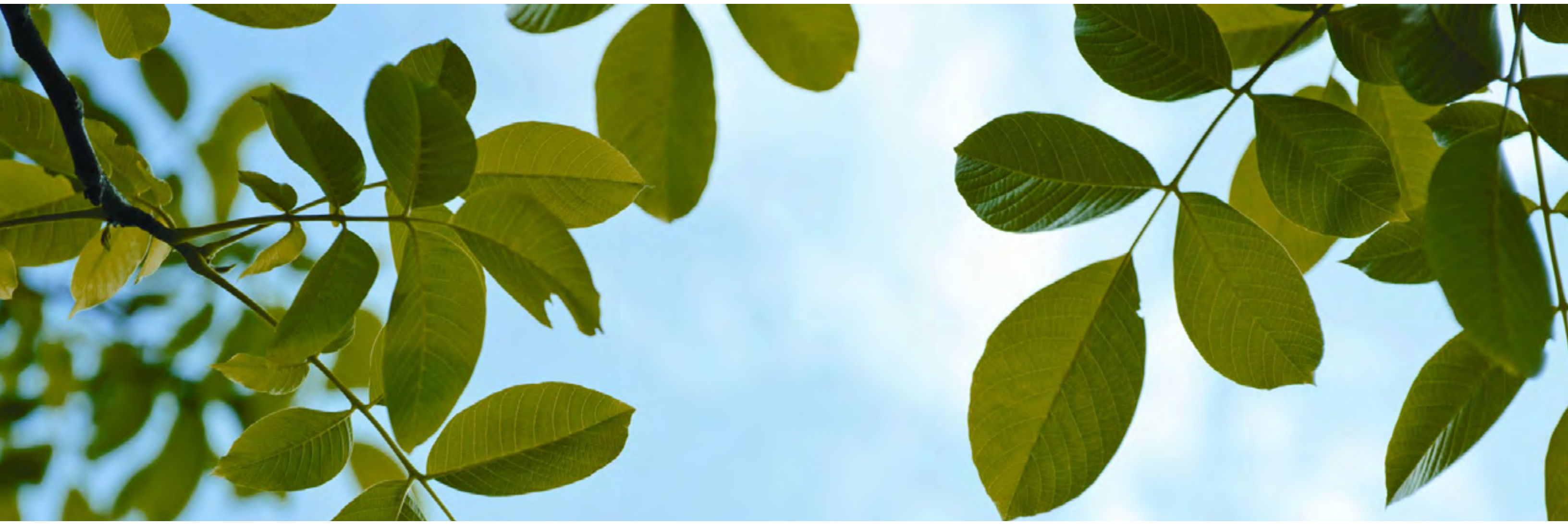
Hawaii Energy Facts & Figures

November 2016



HAWAII STATE
Energy Office

State of Hawaii Department of Business, Economic Development, and Tourism

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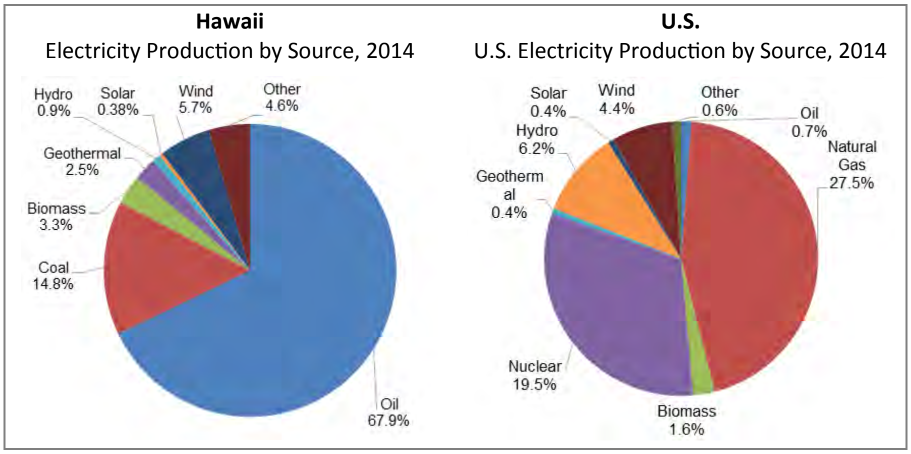
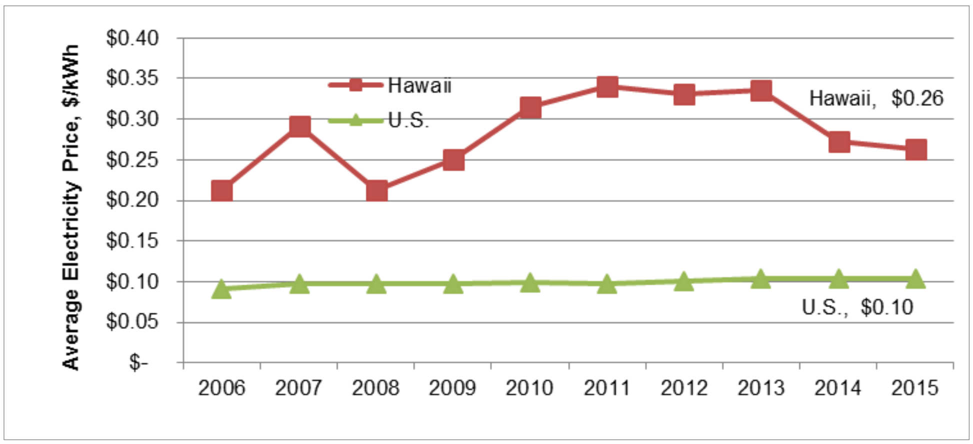
Hawaii Energy Overview

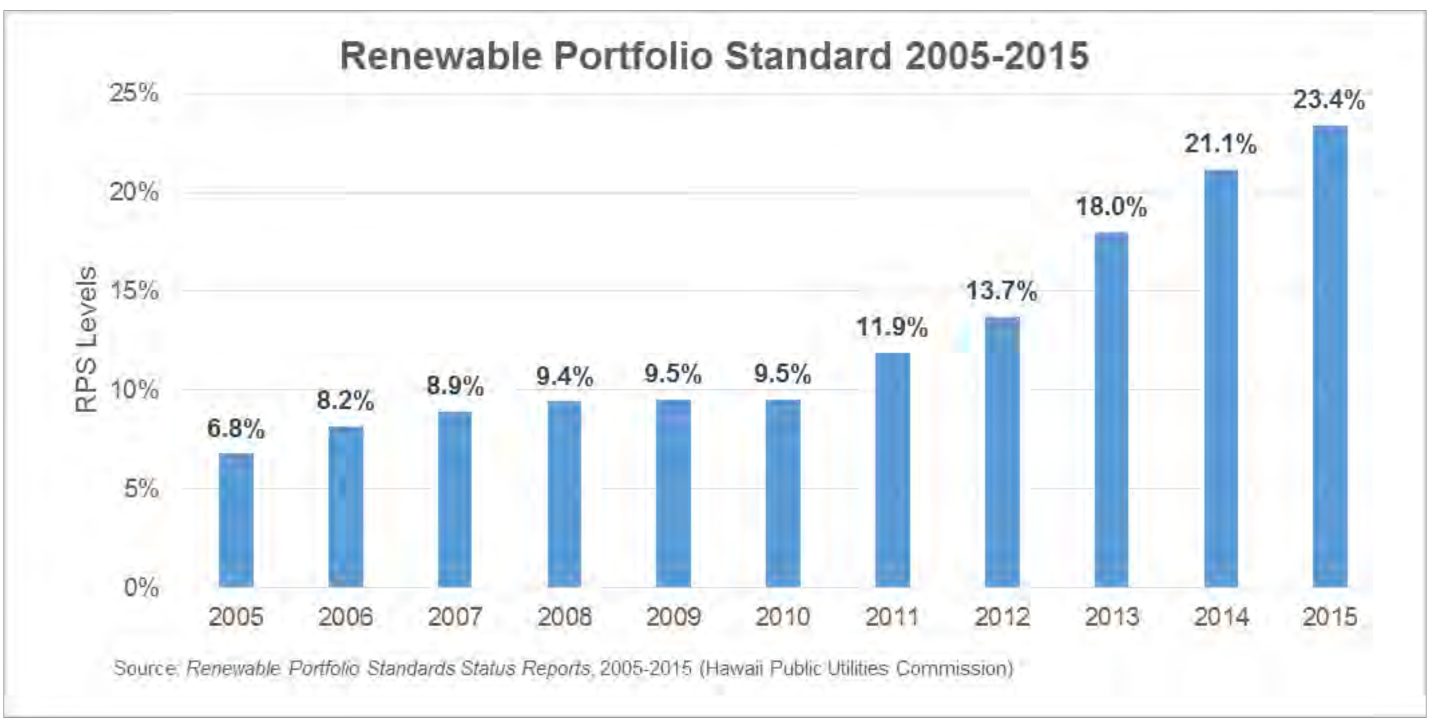
Hawaii is the only state that depends so heavily on petroleum for its energy needs. Whereas less than 1% of electricity in the nation is generated using oil. In 2014, Hawaii relied on oil for 67.9% and on coal for 14.8% of its electricity generation.[1]



Hawaii's electricity prices are almost two times higher than the U.S. average.[2, 3]

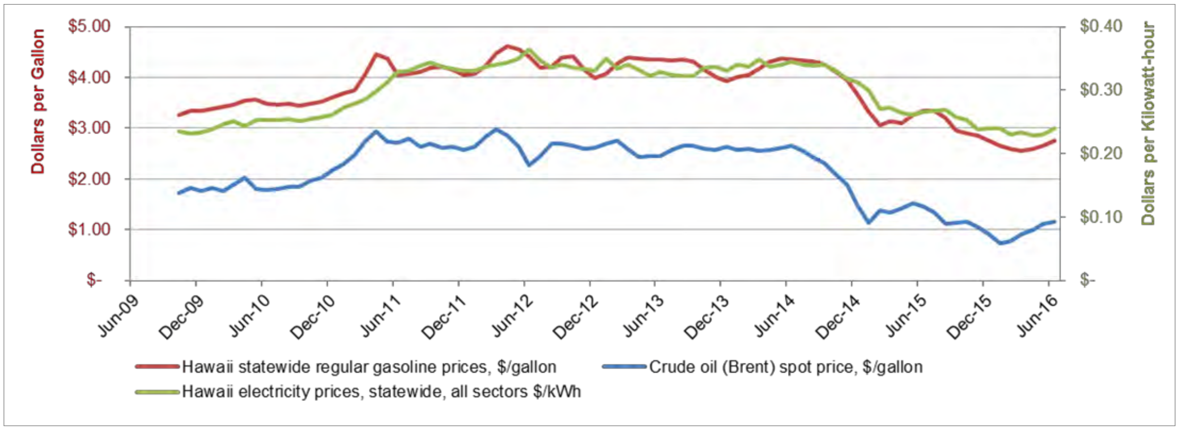


Although Hawaii's electricity production and costs are still heavily reliant on oil, renewable energy has been increasing in all counties.[4]

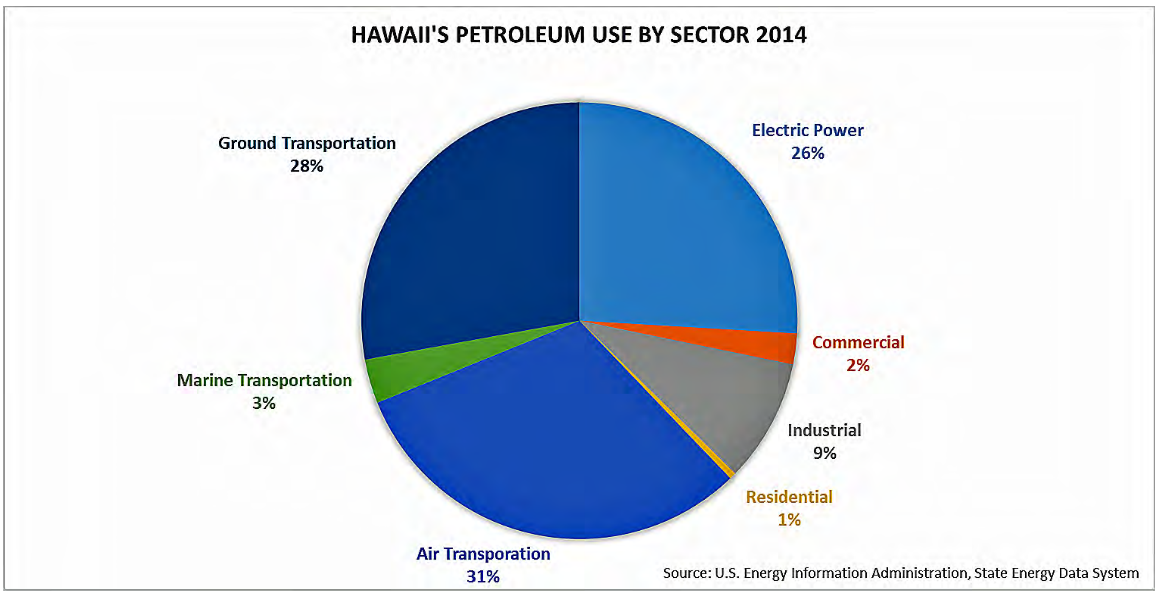


Hawaii Energy Overview

In Hawaii, both electricity and gasoline prices follow the price of petroleum. This graph shows the prices of Brent crude oil, gasoline, and electricity.[5]



Electricity production and motor gasoline are just part of Hawaii's energy picture. Large quantities of jet fuel are also used (as opposed to the mainland where most petroleum is used for ground transportation). 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.[6]



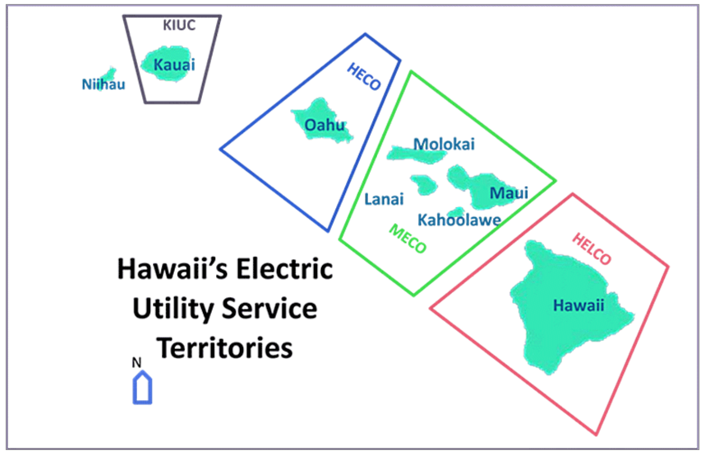
2016 Total crude oil imports (million barrels per year)[7]	**39.0**	2016 Fuel for electricity production (million gallons per year)[8]	**394**
2016 Total petroleum use (million gallons per year)[9]	**1,639**	2016 Fuel for air transportation (i.e. jet fuel) (million gallons per year)[10]	**569**
2016 Hawaii's rank among 50 states for energy prices[11]	**1**	2016 Fuel for ground transportation (million gallons per year)[12]	**468**

Electric Utilities

Each of Hawaii's six main islands has its own electrical grid, not connected to any other island. Hawaiian Electric Company (HECO) and its subsidiaries, Maui Electric Company (MECO) and Hawaii Electric Light Company (HELCO), serve about 93% of the state's electric utility customers.[13] The island of Kauai is served by Kauai Island Utility Cooperative (KIUC).

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).[14] Current procurement activities include:[15]



HECO: A request to the Public Utilities Commission (PUC) to open a docket and appoint an Independent Observer (IO) to allow HECO to solicit proposals for new renewable energy generation to be in service by the end of 2020 that is consistent with the Five-Year Action Plan proposed in the Company's Power Supply Improvement Plan.

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.

CONVERTING MW OF CAPACITY INTO MWh OF ELECTRICITY PRODUCTION

Generators do not always produce at full capacity due to resource limits (sun not shining, wind not blowing), maintenance requirements, or power not needed.

CAPACITY FACTOR ASSUMPTIONS FOR RENEWABLE RESOURCES	Capacity Factors (assumed)*	MWh produced per MW capacity[16]
Biomass-Direct Firing	80%	7,000
Wind (Oahu, Hawaii, Kauai)**	35%	3,100
Wind (Lanai, Molokai)	40%	3,500
Wind (Maui)	45%	3,900
Geothermal	96%	8,400
Hydro	44%	3,900
Solar (rooftop)	23%	2,000
Solar (utility)	24%	2,100
Ocean	35%	3,100

Capacity factors presented in this table are assumptions used by Booz Allen, under contract to the National Renewable Energy Laboratory, in the *Hawaii Clean Energy Initiative Scenario Analysis*, Appendix C, Slide 26. March 2012.
*Actual capacity factors may vary from the assumptions presented here.
**The Pakini Nui wind farm (on Hawaii Island) generally has an annual capacity factor of over 60%.

The "capacity factor" is the percent of time a facility is expected to operate at full capacity (or its equivalent, in terms of energy production) over a one year period. For example, if a facility has a capacity of 1 MW and a capacity factor of 100%, it will generate (1MW) x (24 hours/day) x (365 days/year) = 8,760 MWh per year.

Residential Electricity Use, Rates, and Monthly Bills

In general the residential electricity use, rates, and bills have declined since 2011.[17]

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

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

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

FEED-IN TARIFF (FIT)

The FIT queue is now closed.[18] Prior to this, renewable electricity suppliers with generators smaller than 5 MW would be eligible to participate in the HECO Companies' Feed in Tariff,[19] supplying as-available power to the utility at constant, contracted rates over 20 years.

Feed-in Tariff (FIT) Rates, Hawaiian Electric Companies' Service Areas									
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 Islands	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	18.9* 23.8**	250 kW	25.4* 27.5**	500 kW	13.8	100 kW	18.9	100 kW
	Lanai & Molokai	18.9* 23.8**	100 kW	25.4* 27.5**	100 kW	13.8	100 kW	18.9	100 kW
3	Oahu	19.7* 23.6**	5 MW	31.5* 33.5**	5 MW	12.0	5 MW	--	--
	Maui & Hawaii	19.7* 23.6**	2.72 MW	31.5* 33.5**	2.72 MW	--	--	--	--

* With tax credit of 35%. ** With tax rebate of 24.5%.
HECO and the Independent Observer submitted a joint plan to the PUC for administering the FIT queues in September 2013. The joint plan was accepted by the PUC on 12/5/14.[20] Future revisions or modifications to the FIT program will be addressed in Docket No. 2014-0192 or 2014-0183.
FIT aggregate limits: Oahu: 60 MW; Big Island: 10 MW; Maui, Lanai, Molokai (combined): 10 MW

Residential Electricity Use, Rates, and Monthly Bills

DISTRIBUTED ENERGY RESOURCE PROGRAMS

On August 26, 2014, under PUC Docket No. 2001-0206, the HECO companies delivered to the PUC the Reliability Standards Working Group's distributed generation interconnection plan (DGIP). The DGIP has been merged into the DER Docket (PUC Docket No. 2014-0192)[21, 22] along with other relevant proceedings, and is presently under review.

On October 12, 2015, the PUC under Docket No. 2014-0192 (Decision & Order No. 33258), issued new reforms relative to distributed energy resources (DER). One notable change is the closing of the Net Energy Meeting (NEM) program at existing levels, whereby "current NEM customers are grandfathered and new customers with NEM applications submitted by 10/12/15 are unaffected." Going forward the PUC has designed two (2) interim programs for customers seeking DER resources: customer grid-supply (CGS), and customer self-supply (CSS).

On October 3, 2016, the PUC (Decision & Order No. 33958) stated that "all major issues raised in Phase I of this proceeding has been resolved,"[23] and requested comments on their preliminary statement of issues for Phase II. The PUC sees Phase II as having two parallel tracks for investigation, a "technical" and a "market" track. These tracks will address the following issues: further review of Hosting Capacity Analysis; further revisions to applicable interconnection standards; improvements to existing DER tariffs, which include NEM, CSS, CGS, TOU, and electric vehicle tariffs; and a successor tariff(s) for CGS, CSS, and the Interim TOU Program.

NET ENERGY METERING (NEM)[24]

Previously, customers who generated renewable solar, wind, hydro, or biomass energy on their own property could have been eligible for NEM to offset their own use. Under the NEM program, customers experience the following:

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

CUSTOMER GRID-SUPPLY (CGS)[25]

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

Island	Credit
Oahu	15.07 ¢/kWh
Hawaii	15.14 ¢/kWh
Maui	17.16 ¢/kWh
Molokai	24.07 ¢/kWh
Lanai	27.88 ¢/kWh

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

When the PUC established this interim program, they established a cap for each service territory: 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.[26] As of September 2016, all three HECO Companies have met their designated cap limit.[27]

CUSTOMER SELF-SUPPLY (CSS)[28]

The CSS program is intended only for solar PV installations that are designed to not export any 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 any export of energy sent to the grid.
- Customers pay for the amount of electricity used from the grid.
- A residential customer will pay a minimum monthly bill of $25.

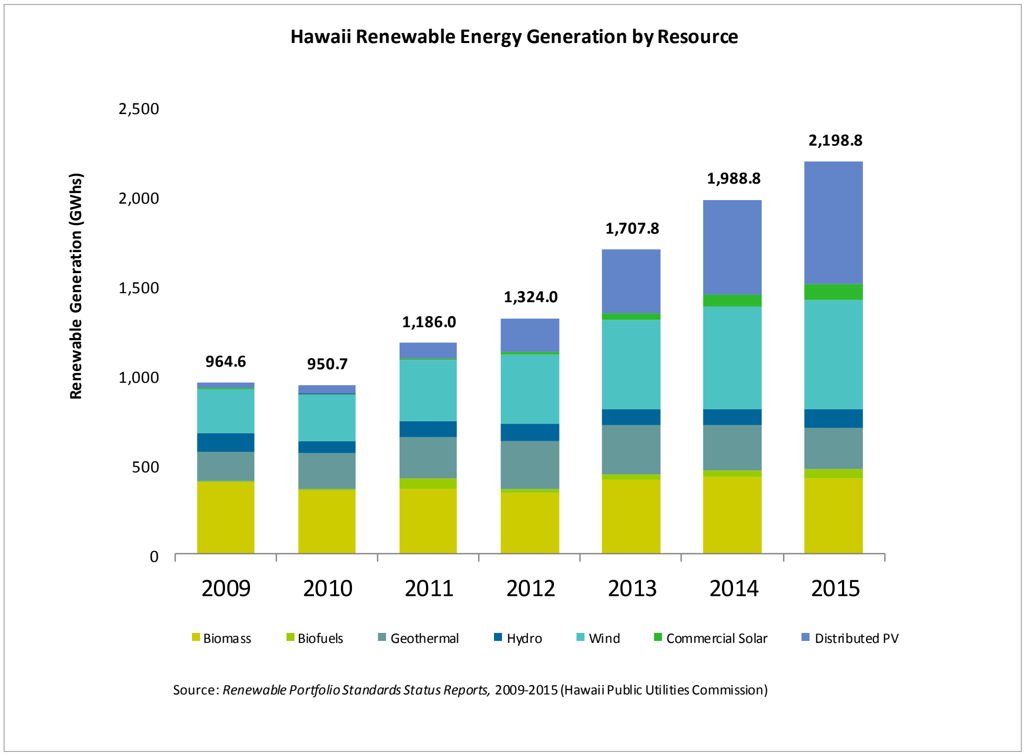
KIUC: New interconnections use Schedule Q[29] (100 kW or less) and "NEM Pilot"[30] (200 kW or less; 20¢/kWh for excess).

Renewable Energy

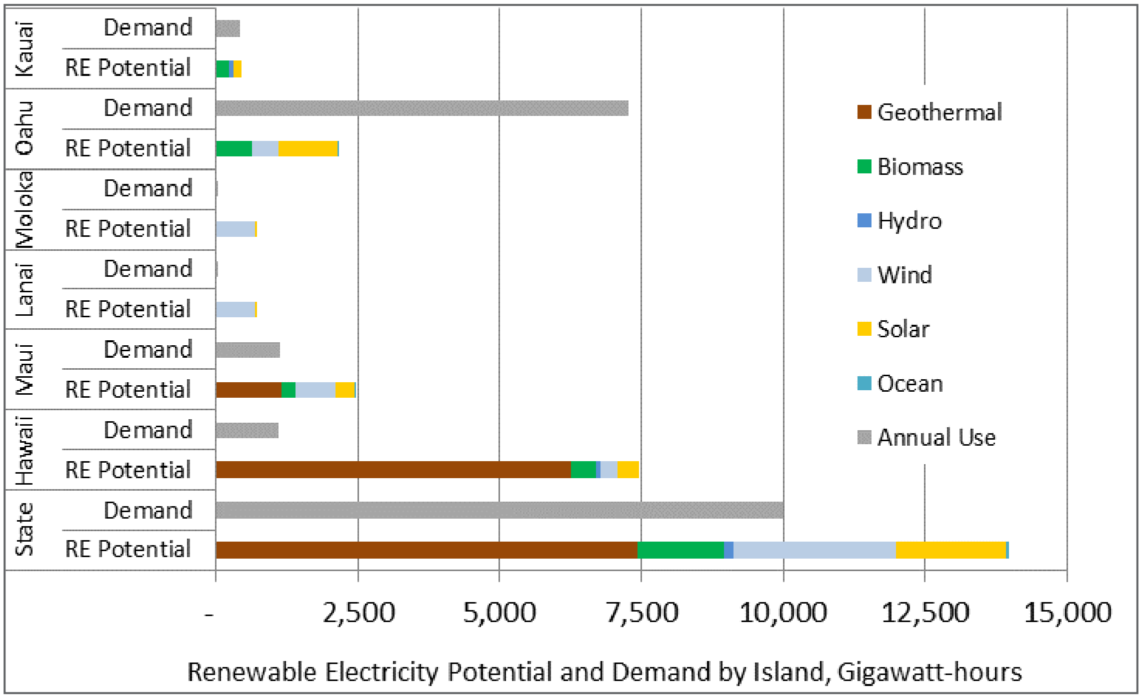
Renewable Energy[31] is energy from:

- Sun (i.e. solar)
- Wind
- Falling water (i.e. hydropower)
- Bioenergy, including biomass (e.g. crops, agricultural and animal residues, municipal and other solid waste); biofuels, and biogas
- Geothermal
- Ocean water, including ocean thermal energy conversion (OTEC) and wave energy
- Hydrogen produced from renewable energy sources

In 2015, approximately 23.4% of Hawaii's electricity was generated from renewable sources, where the primary sources were solar PV, wind, and biomass.[32]



Renewable resource potential, statewide, is greater than current electricity demand.[33]



Renewable Energy

Electricity must be used, transmitted, or stored at the instant it is produced. If renewable energy is not used when it's produced, it is usually curtailed.

Firm generation (capacity) is available for production which can be (and in many cases must be) guaranteed to be available at a given time. Firm energy refers to the actual energy guaranteed to be available.

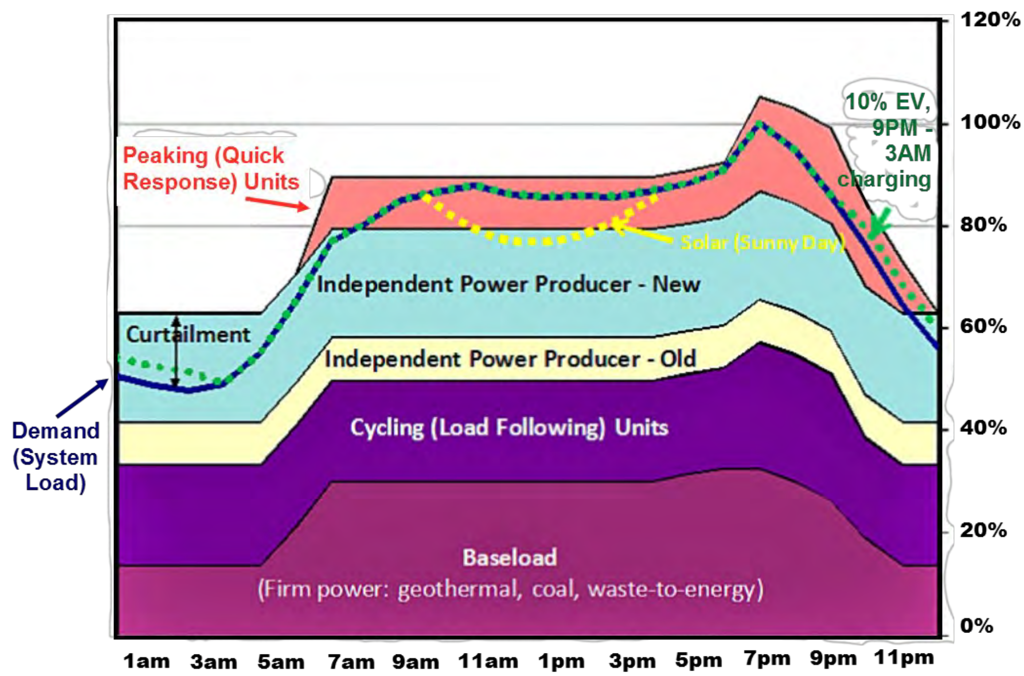
Baseload generation facilities produce energy at a constant rate. They generally do not react (ramp up or ramp down) quickly.

Dispatchable (cycling and peaking) units produce power when called upon by the utility, to fill gaps between production and load; they can ramp up and down quickly.

Independent power producer contracts may govern which units are brought on-line (dispatched) first when load is increasing, and which are taken off-line first, when load is decreasing. A new facility generally will not displace an older facility's place in the dispatch order, unless there is a technical reason for the utility to do so.

Intermittent (as-available) energy, such as from photovoltaic and wind independent power producers, may be curtailed at times of low load. The yellow line in the graph shows solar systems, on a sunny day, reducing mid-day demand for electricity from other sources.

If managed properly, energy storage systems and electric vehicle charging can provide grid support at times of low load by utilizing energy that otherwise may have been curtailed.

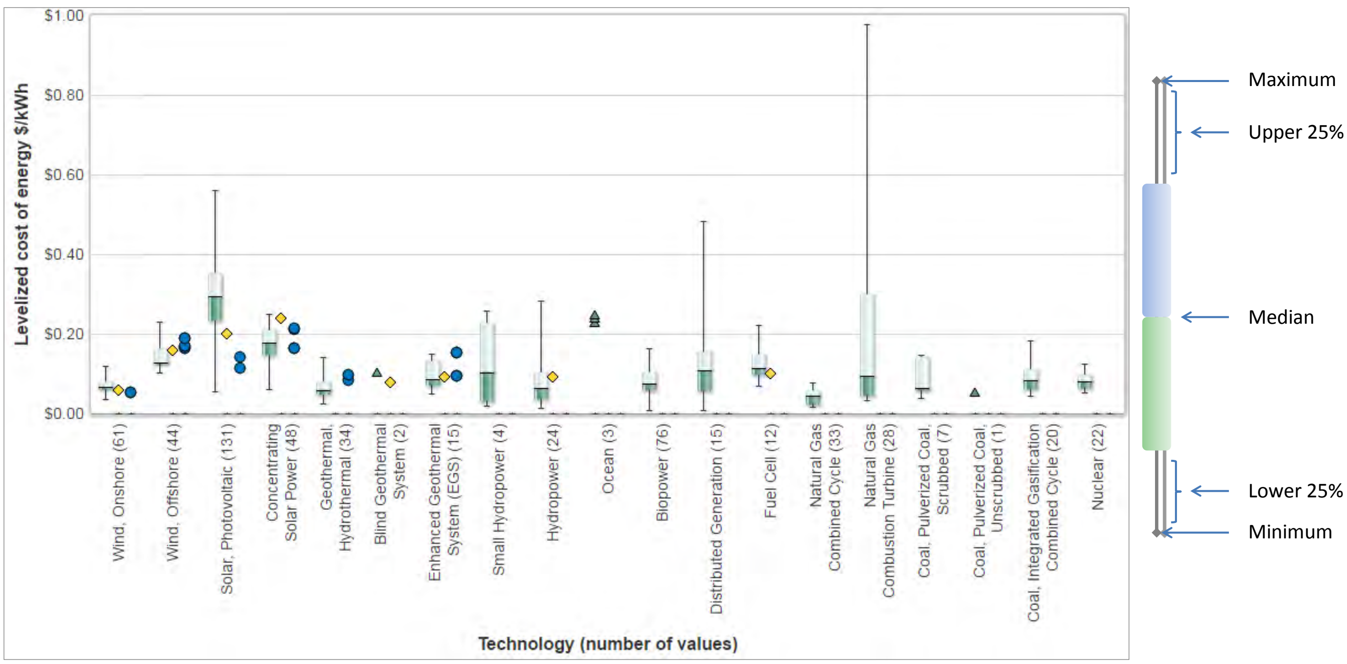


Renewable generation required (i.e. Renewable Portfolio Standard, "RPS") by 12/31/2020[34]	**30%**	Renewable generation required (RPS) by 12/31/2030	**40%**
Renewable generation required (RPS) by 12/31/2040	**70%**	Renewable generation required (RPS) by 12/31/2045	**100%**

Renewable Energy

"Levelized Cost of Energy" is the price per kilowatt-hour required for an energy project to break even; it does not include risk or return on investment. Costs (land, construction, labor) are different for every project.

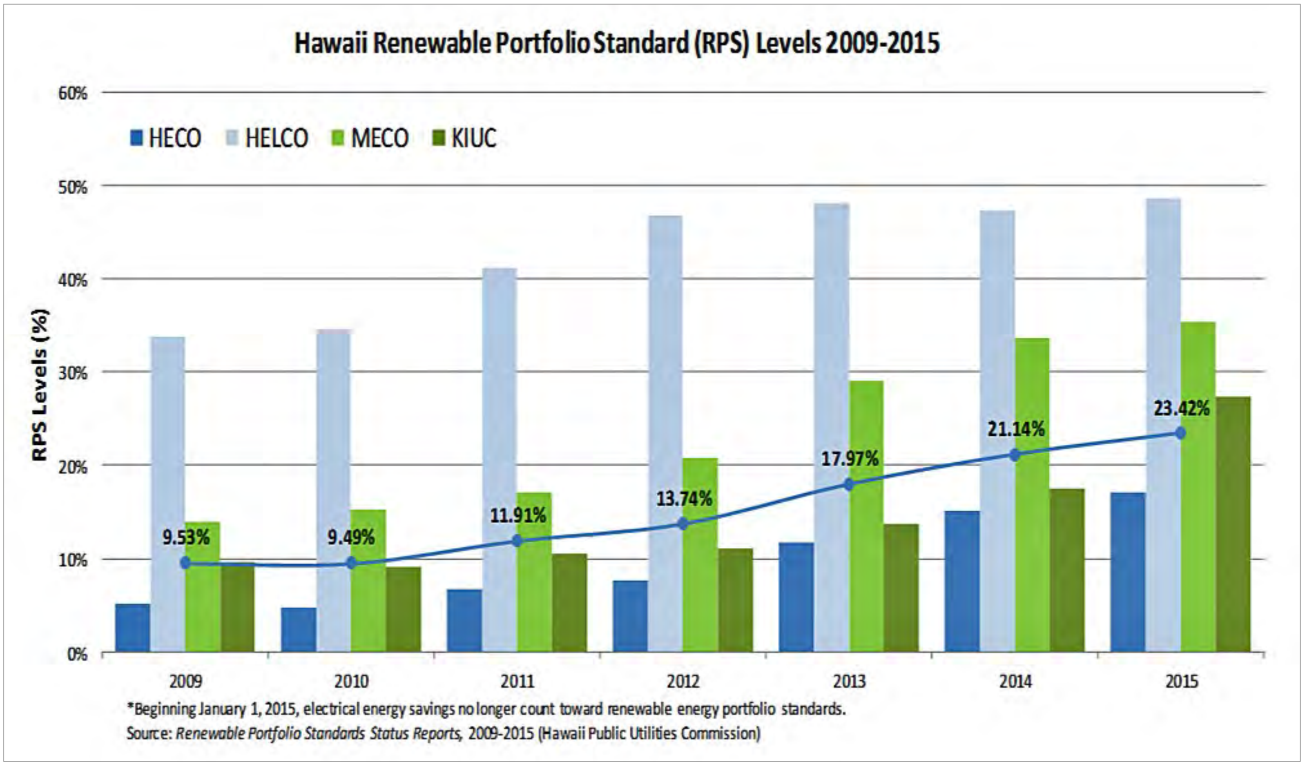
The Transparent Cost Database[35] compiles cost information from studies and projects across the United States. The box and whisker chart below shows the 2009-2015 data distribution using five numbers: The minimum (bottom of the whisker), lowest 25% (below green box), median, highest 25% (above blue box), and maximum point (top of the whisker). Where fewer than three data points are available, the individual data points (green diamonds) are shown. Yellow diamonds are U.S. Department of Energy estimates.



Renewable Energy: RPS

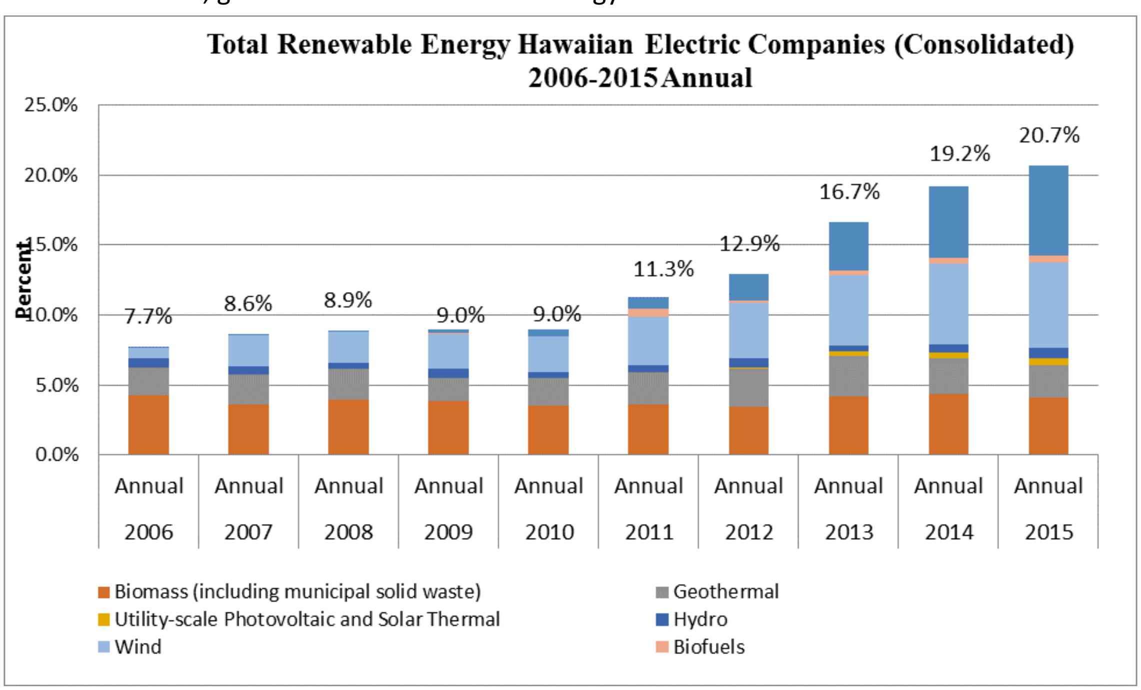
Renewable Portfolio Standards (RPS) Compliance[36]

The Hawaiian Electric Companies and Kauai Island Utility Cooperative are required to annually file their RPS status report which calculates the RPS as a percentage of electrical energy sales that is represented by renewable electrical energy.[37] Beginning January 1, 2015, renewable electrical energy generated by the utility, independent power producers, and customer-sited, grid-connected sources are counted towards the RPS. While electrical savings from energy efficiency and solar water heating will not be counted towards achievement of RPS compliance.[38]



Total Renewable Energy (Total RE)[39]

The Hawaiian Electric Companies file updates for their Total Renewable Energy metric on a quarterly basis, which 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.[40]



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.[41] In June 2016, fuel oil averaged $45.21/bbl, diesel fuel averaged $64.61/bbl, and biodiesel averaged $121.09/bbl.[42]

Fuel ethanol could be blended with petroleum-based fuels. Hawaii's energy consumption estimates for major energy sources in 2013 are shown below:

Hawaii's Energy Consumption Estimates[43]

Coal (Thousand Short Tons)	753
Natural Gas (Billion cubic feet)	3
Petroleum (Thousand Barrels)	41,626
Hydroelectric Power (Million Kilowatt-Hours)	78
Fuel Ethanol (Million Gallons)	29

Crops may be cultivated to produce biomass materials (oils, fiber, sugar) usable for electricity or fuel production.

Studies conducted in 2010 indicate that 136,000 suitable acres could be available without displacing current farming in Hawaii; with biomass production of 10-20 tons of fiber per acre per year, potential would be about 1.4-2.7 million tons of biomass per year.[44] As a reference, two million tons of biomass, if burned in conventional biomass combustion processes, would generate energy equivalent to two million barrels (84 million gallons) of oil.[45]

Algae has also been receiving attention, due to high yields per acre and potential use of CO_2. The 8.3 million tons[46] of CO_2 produced by large energy facilities (power plants and refineries) in Hawaii could theoretically support the production of over 0.56 million gallons of oil per year.

Waste materials (such as used cooking oil) and by-products from food, feed, or fiber production, although limited in quantity, are often the first bioenergy feedstocks due to their relatively low cost and the need for reduced waste management costs.

Bioenergy

Bioenergy facilities[47]

Technology	Project Name	Developer(s)	Capacity	Island	Location	Status
Biofuel	Aina Koa Pono Kau Renewable Fuel Facility	Aina Koa Pono	16-24 MGY	Hawaii	Kau	Planning
Biofuel	Big Island Biodiesel	Pacific Biodiesel Technologies, LLC.	5 MGY	Hawaii	Keaau	Active/Ongoing
Biofuel	Campbell Industrial Park Synthetic Natural Gas Facility	Hawaii Gas	100 kW	Oahu	Kapolei	Active/Ongoing
Biofuel	Cellana Algae Kona Demonstration Facility	Cellana LLC	Demonstration MGY	Hawaii	Kailua-Kona	Active/Ongoing
Biofuel	Hawaii BioEnergy Integrated Biorefinery Facility	Hawaii BioEnergy	10-20 MGY	Kauai	Kauai/Hawaii	Planning
Biofuel	Hawaii Pure Plant Oil	Hawaii Pure Plant Oil	Demonstration	Hawaii	Keaau	Active/Ongoing
Biofuel	HECO Campbell Industrial Park Generating Station	HECO	110 MW	Oahu	Kapolei	Active/Ongoing
Biofuel	Honolulu International Airport Dispatchable Standby Generation Project	Hawaii Department of Transportation, HECO	10 MW	Oahu	Honolulu	Active/Ongoing
Biofuel	Kauai Algae Farm	Hawaii BioEnergy	Microalgae	Kauai	Lihue	Active/Ongoing
Biofuel	Maui Energy Park (Mahinahina Energy Park)	Anaergia Services	5 MW	Maui	Lahaina	Planning
Biofuel	Pacific Biodiesel Honolulu Plant	Pacific Biodiesel	1 MGY Capacity	Oahu	Honolulu	Active/Ongoing
Biofuel	Phycal Algae Pilot Project	Phycal, Inc.	150,000 GAL/Yr	Oahu	Wahiawa	Planning
Biofuel	Schofield Generating Station	Hawaiian Electric Company (HECO), US Army	50 MW	Oahu	Wahiawa	Planning
Biomass	Green Energy Biomass-to-Energy Facility	Green Energy Team, LLC	6.7 MW	Kauai	Koloa	Active/Ongoing
Biomass	HC&S Co-Generation Facility	Hawaiian Commercial & Sugar (HC&S), Alexander & Baldwin	16 MW	Maui	Puunene	Active/Ongoing
Biomass	Hu Honua Bioenergy Facility	Hu Honua Bioenergy, LLC	21.5 MW	Hawaii	Pepeekeo	Planning
Biomass	Kauai Biodigestion Project	Pacific Light & Power, Konohiki Hydro Power	4.5 MW	Kauai	Kekaha	Planning
Waste-to-Energy	HPOWER	City & County of Honolulu, Covanta Energy	88 MW	Oahu	Kapolei (Campbell Industrial Park)	Active/Ongoing
Waste-to-Energy	Maui County Integrated Waste Conversion and Energy Project	County of Maui, Anaergia Services (Maui Resource Recovery)	15 MW	Maui	Puunene	Planning
Waste-to-Energy	Pelatron Q Biomass Project	Pelatron Q	2.4 - 8 MW	Kauai	TBD	Planning
Waste-to-Energy	PVT Bioconversion Feedstock Processing Facility	PVT Land Company	Feedstock MW	Oahu	Nanakuli	Active/Ongoing
Waste-to-Energy	Waste-to-Enregy System at Joint Base Pearl Harbor-Hickam	Hawaii Air National Guard, Hawaii Center for Advanced Transportation Technologies (HCATT), Biomass Energy Systems, Inc	Demonstration MW	Oahu	Joint Base Pearl Harbor-Hickam	Active/Ongoing

Hawaii's current use of petroleum-based fuels (million gallons/yr)	1,800	Algae oil yields demonstrated on Kauai[48]	2000 gal/ acre
Hawaii's current cost per gallon of biofuels[49]	$2.90	Hawaii's potential liquid biofuel waste production (mil gal/yr)[50]	97
Hawaii's current cost per kWh for biofuel generated[51]	40¢/kWh	Hawaii's potential ethanol production from energy crops[52]	1,202

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.[53] This is expected to improve as renewable energy increases in Hawaii.

Registered EVs[54] and Public Charging Stations[55] in Hawaii

County	Electric Vehicles	Level 2[56] Charging Station Ports	Level 3[57] Charging Station Ports	Total Ports
Oahu	3,742	306	15	321
Maui	742	78	43	121
Hawaii	221	44	4	48
Kauai	161	31	1	32
Total statewide	**4,866**	**459**	**63**	**522**

Fuel Cost Comparison

Vehicle	2015 Nissan Versa	2015 Honda Civic	2015 Nissan LEAF[58]
Fuel Type	Gasoline	Gasoline	Electricity
Miles Per Gallon (MPG)	35 mpg combined 324 miles total range	33 mpg combined 462 miles total range	114 combined MPG 84 miles total range
Fuel Costs	$2.50/gallon	$2.50/gallon	Electricity: $ 0.36/kWh
Cost to Drive 25 Miles	$1.74	$1.85	$0.96
Fuel Cost per Year[59]	$627.03	$666.67	$345.95

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	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	Electric Smart Car
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	-	-
State of Hawaii	**6**	**6**	**7**	**6**	**1**	**1**	**1**	**1**	**7**	**1**	**1**

Electric Vehicles

Hawaii's electric vehicle laws and incentives include:

- 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.[60]	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.[61]	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.[62]

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[63] 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.

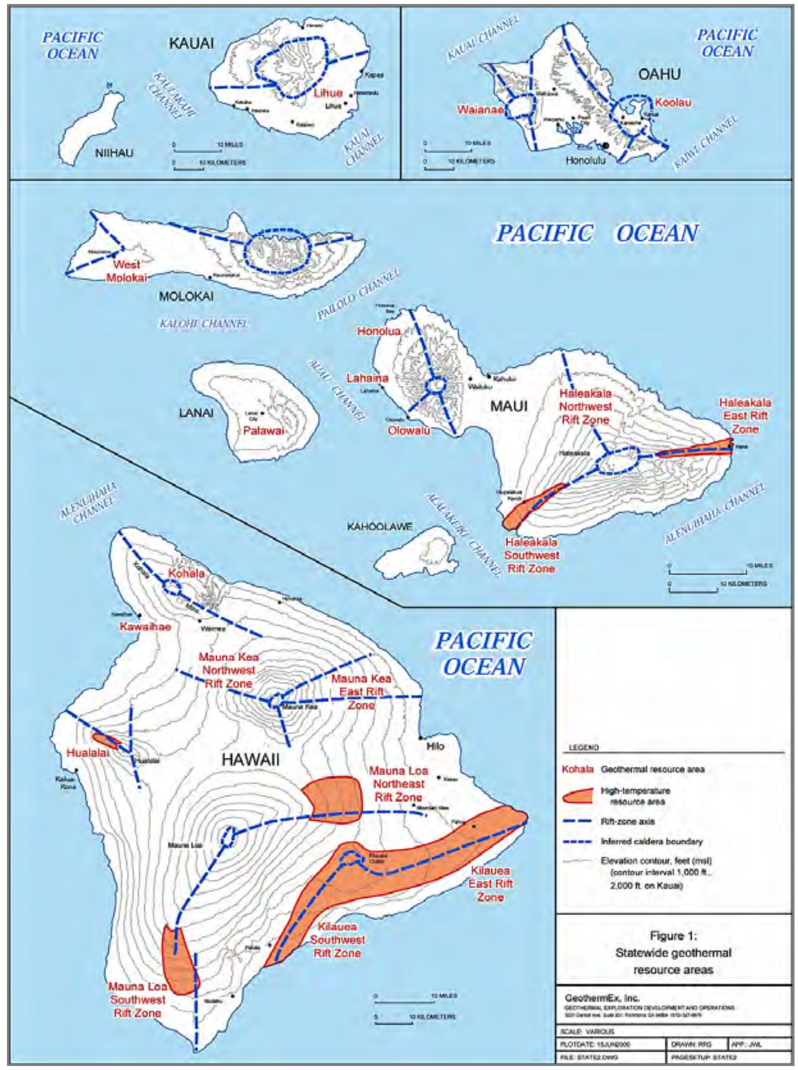
Geothermal

CURRENT PRODUCTION

Hawaii's single geothermal power plant, Ormat's Puna Geothermal Venture (PGV) facility located on the Island of Hawaii, produced 230.5 gigawatt-hours (GWh) in 2015; approximately 22% of the total electricity distributed on Hawaii Island in 2015.[64] 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.

STATUS OF COMPETTIVE SOLICITATION

In May 2012, the Hawaii Electric Light Company (HELCO) initiated a competitive bidding procedure seeking 50 MW of dispatchable geothermal firm capacity generation by opening a docket with the Hawaii Public Utilities Commission (PUC).[65] In February 2015, HELCO announced it had selected Ormat Nevada, Inc. on behalf of PGV II (Ormat) to provide HELCO with 25 MW of new geothermal power on the East side of Hawaii Island (Moana Geothermal Project). In February 2016, HELCO notified the PUC and all other parties that power purchase agreement negotiations with Ormat had concluded unsuccessfully based on Ormat's determination the project would not be economically and financially viable. HELCO also provided the PUC with a record of the unsuccessful competitive bidding process and HELCO's perspective on the key issues that impacted the final result. In March 2016, the Independent Observer assigned to this proceeding filed its report on the results of the process, including its final findings and recommendations moving forward. In February 2016, another prospective geothermal developer, Huena Power, filed a petition with the PUC questioning HELCO's process resulting in Ormat's selection and asking for its own geothermal project to be considered; this docket remains open.[66]



Map of Geothermal Resource Areas (Source: GeothermEx, 2005)

Geothermal

RESOURCE PLANNING

In April 2016, the Hawaiian Electric Companies (HECO, MECO, and HELCO) filed their updated draft Power Supply Improvement Plans, which included the 'Preferred Plans' for each utility forecasting 40 MW of geothermal development on Maui by the year 2040 and 40 additional MW of geothermal on Hawaii Island by the year 2030.[67]

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).[68] 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.[69] 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.[70] In essence, this will provide the first statewide geothermal resource assessment conducted since the late 1970s. Results from Phase I of this effort will also indicate areas warranting additional geothermal resource exploration.

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. However, estimates from exploration efforts in the 1970s and '80s indicate that there may be more than 1,000 MW of geothermal reserves[71] (recoverable heat at drillable depths) on Maui and Hawaii islands, which would be sufficient to collectively power Maui, Hawaii Island, and about one quarter of Oahu or, alternatively, about 60% of Oahu's energy needs. Reaching that level of production would require interconnection of the islands' grids.

Geothermal electricity is cheaper than that produced from petroleum fuels in Hawaii, and also generally cheaper than other forms of renewable electricity.

Current geothermal production capacity in Hawaii	38 MW	Contracted price for first 25 MW of electricity from PGV	18.8¢ on peak 15.9¢ off peak per kilowatt-hour (kWh)
Estimated probable reserves, Maui & Hawaii	1,000 MW	Contracted price for next 5 MW of electricity from PGV	11.8¢ / kWh
Median levelized cost of geothermal energy, U.S.[72]	6¢ kWh	Contracted price for next 8 MW of electricity from PGV	9¢ / kWh

Hydropower

Hydroelectricity was the first renewable energy technology used to generate electricity in Hawaii; plants date back to 1888.[73] 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.

The technology is fully commercial and reliable but is limited by fluctuating water levels in Hawaii's streams and irrigation ditches. Due to our geology, run-of-the-river and run-of-the-ditch systems, which have no dams, are used. Both small, home-scale plants and utility-scale facilities are in operation in Hawaii.

Hawaii currently has about 30 megawatts (MW) of installed hydroelectricity capacity statewide, and about 50 MW of hydroelectric projects proposed or under development.[74] In 2015, hydropower accounted for approximately 1.3% of the total energy distributed by Hawaii's electric utilities statewide.[75]

1.1-MW Waiau Hydro Power Plant on the Wailuku River, Hilo

Hydro is an important part of the energy portfolio on Kauai, where it represented about 8% of the electricity sold in 2015, and on the island of Hawaii, where it represented 5.9% of the island's total electrical sales in 2015.[76] 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.[77]

Hawaii Hydropower Assessments

As part of the Oak Ridge National Laboratory's National New Stream Development project, approximately 145 MW of undeveloped hydroelectric potential from 47 hydro sites have been identified in Hawaii in reconnaissance and feasibility reports.[78] Most of the potential sites are small run-of-the-river projects.[79] The U.S. Army Corps of Engineers (USACOE) also conducted a Hydroelectric Power Assessment for the State of Hawaii in 2011.[80] This feasibility study 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.

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,[81] which was one of the four project sites of focus in the 2011 USACOE Hydropower Assessment.

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.

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

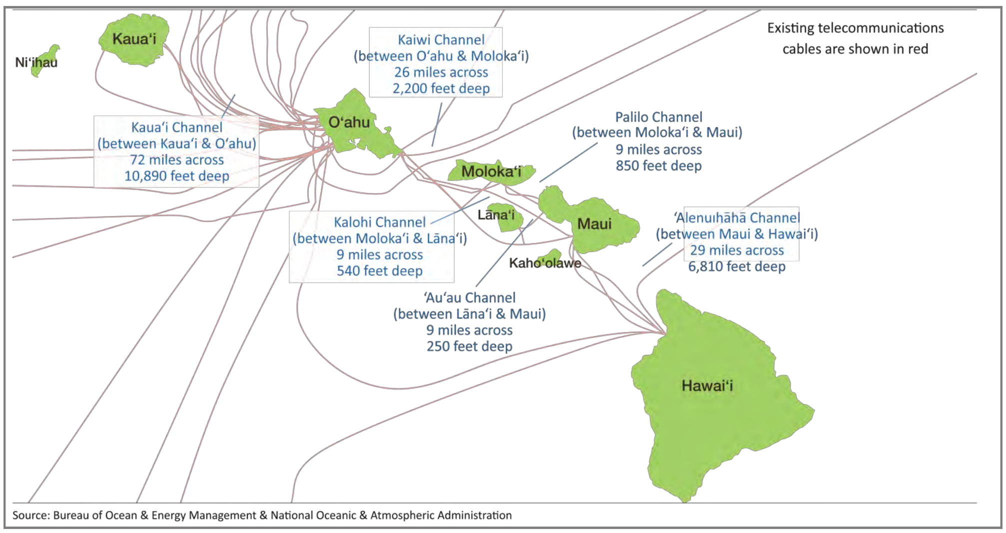
Hawaii County Dept. of Water Supply's 45-kW in-line hydro plan in Kona

MW of hydroelectric capacity installed statewide	**37**[82]	Capacity of Wailuku River hydroelectric plant, the state's largest	**12.1**[83] MW
Year that Puueo hydro power plant, still in operation, began generating	**1910**[84]	Combined power Wailuku River, Waiau, and Puueo Hydro in 2013[85]	**16.45** MW

Oahu-Maui Grid Tie

The Interisland Cable Grid-Tie Project (a.k.a., the Oahu-Maui Interisland Transmission System) is an investigation (Docket No. 2013-0169) by the Hawaii Public Utilities Commission (PUC) into the viability of connecting the electricity grids of Maui and Oahu with a 200 MW High Voltage Direct Current (HVDC) cable. DBEDT is still awaiting a determination by the PUC on whether a grid-tie between Oahu and Maui is in the public interest. 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 a means to utilize our best natural resources at a scale that will reduce electricity costs and improve overall system efficiency. The main point here is that our communities need to be a key part of this discussion as we balance economic, technical, environmental and cultural considerations.

The type of system being proposed is a two-way "grid-tie" (not the one-way "gen-tie" transmission cable that was proposed earlier). This system would allow Oahu and Maui to coordinate operation of their respective electric grids, and provide flexibility to significantly add more clean, renewable energy generation in the most economical and equitable manner.



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

The 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.

In its analysis of the Oahu-Maui Grid Tie under Docket No. 2013-0169, DBEDT estimated the overall savings on both islands at up to $423 million (2020-2050) before taking into consideration the environmental benefits. Taking into account the reduction of greenhouse gases and other emissions, the net benefit would rise to $551 million. These figures include fuels savings of approximately $1 billion. Other significant benefits include: [86]

Economic
- Lower and more uniform electricity prices for Maui and Oahu;
- Lower fuel costs and less exposure to price volatility;
- Increased capacity factors for wind generation;
- Greater utilization of lower cost generation resources;
- Reduced curtailment of intermittent renewable energy;
- Reduced environmental compliance costs; and
- Lower operating reserve requirements.

Environmental
- Lower nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM), and carbon dioxide (CO_2) emissions;
- Higher penetration of renewable energy generation; and
- Increased flexibility in siting new renewable generation.

Public Policy
- Helps the state meet RPS requirements and the objectives of the Hawaii Clean Energy Initiative (HCEI), i.e., 100% renewable energy by 2045;
- Reduced dependence on fossil fuels; and
- A model for potentially connecting with Hawaii Island in the future.

Oahu-Maui Grid Tie

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 April 2016, the Hawaiian Electric Companies filed their updated power supply improvement plan (PSIP) with the Public Utilities Commission (Docket No. 2014-0183). In their PSIP they acknowledge that it appears Oahu will need a substantial amount of off-island renewable resources in order to meet the 100 percent renewable energy goal in 2045. HECO plans to reassess the scope and requirement of an interisland cable. As a follow-up action to their April 2016 filling, HECO plans to use E3 (contractor) to "develop a theoretical least-cost plan for Oahu, Maui, and Hawaii Island without any interconnection. Then [E3] will develop theoretical least-cost plans (that is, no transmission line restrictions) for interisland connections between (1) Oahu and Maui, (2) Oahu and Hawaii Island, and (3) Oahu, Maui, and Hawaii Island. The difference between the theoretical least-cost plan cost and the combined cost of the theoretical least-cost plans of the individual islands will be the breakeven cost of the interconnection cable configuration."[87]

Longest undersea power cable	360 miles	Deepest undersea power cable	5,380 feet
Highest capacity undersea HVDC system	2,000 MW	Estimated installed cost of Oahu to Maui grid tie[88]	$526 million
Year of installation, first HVDC undersea power cable	1954	Estimated net benefit of Oahu-Maui grid tie, (including social costs of carbon)[89]	$551 million
Expected undersea transmission cable life in years	30-50	2012 legislation: regulatory structure for inter-island power cables	Act 165

Ocean

Surrounded by the Pacific Ocean, Hawaii is rich in ocean renewable energy resources. Ocean 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, ocean current and tidal resources are not as promising with presently-envisioned technologies in Hawaii due to its relatively mild tidal shifts compared to other parts of the world.

Ocean energy research, development and demonstration projects are taking place in Hawaii and elsewhere in the world. 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.

OPT's PB40 PowerBuoy in Kaneohe Bay, Oahu

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. [90]

The Azura buoy is the fourth wave buoy attached to the 30 m 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.[91]

Ocean


OTEC heat exchanger test facility at NELHA

The Natural Energy Laboratory of Hawaii Authority (NELHA) at Keahole Point, Kona, is among the world's premier OTEC research centers.[92] 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. 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 one 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.

Number of berths expected at Kaneohe WETS	**3**	Projected Levelized Cost of Electricity (LCOE) for commercial ocean energy[93]	**23¢-25¢/kWh**
Energy potential of trade wind waves in Hawaiian waters[94]	**10-15 kW/meter**	Temperature of cold, deep seawater at NELHA[95]	**6°C (43°F)**
Number of operating hours achieved by OPT PowerBuoy PB40 at Kaneohe Bay[96]	**>5,600 hours**	Temperature range of warm surface seawater at NELHA[97]	**24° – 28.5°C (75° – 83°F)**

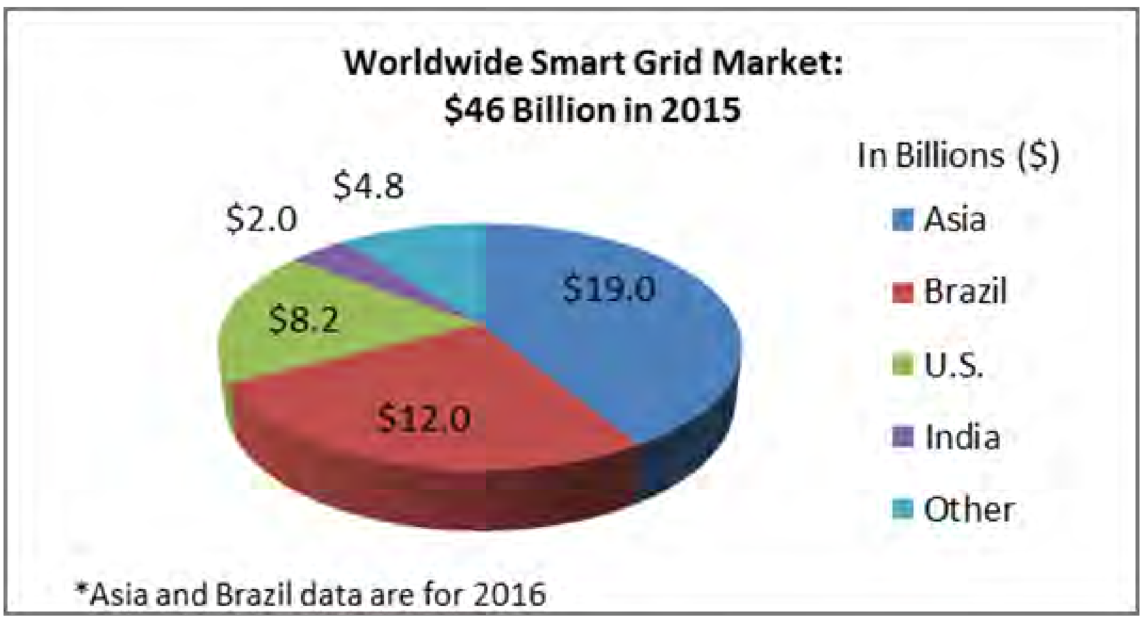
Smart Grid

What is Smart Grid?[98]

The electric "grid" is a network of transmission 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") Meters
  - Provide timely and detailed energy use information for customers
  - Allow for time of use rates
- Sensors, controls, and forecasting
  - Monitor conditions in real time
  - Allow higher penetration of renewables
- Energy Storage (batteries, capacitors, flywheels, pumped hydro, hydrogen)
  - Allow for 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[99]

Smart Grid Market is Large[100]



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,[101] and tens of thousands of commercial and government buildings statewide, can take advantage of smart grid technologies.
- Over $57 million has been invested in Smart Grid demonstration projects in Hawaii.[102]

Smart Grid

Existing Smart Grid Projects in Hawaii

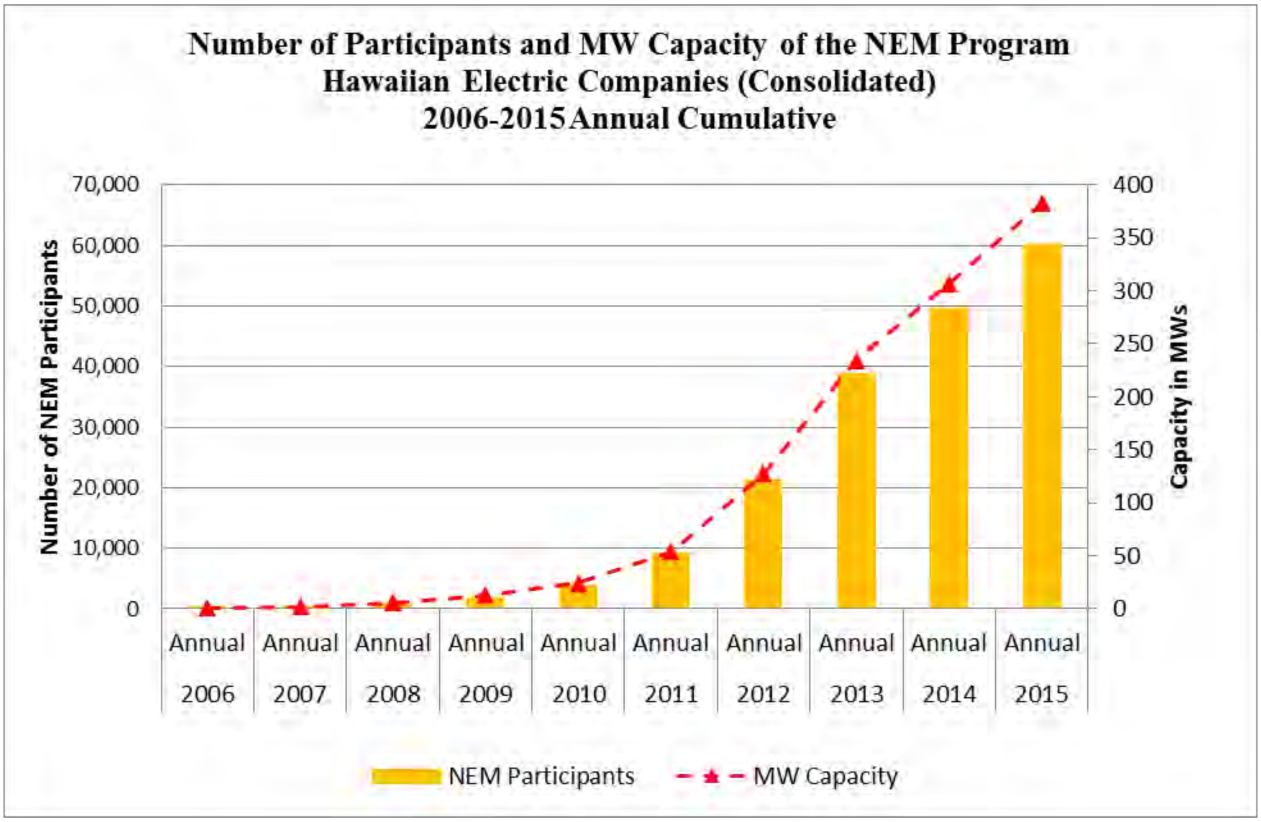
Name	Description	Key Companies	Location
HECO Smart Grid and Smart Meter Initial Phase	First phase for an island wide rollout of smart grid technology and smart meters, pending approval by the Public Utilities Commission. During the initial phase, about 5,200 smart meters will be installed in homes and businesses.[103]	HECO, Silver Spring Networks, Blue Planet Foundation, Hawaii Energy	Moanalua Valley, parts of Pearl City, Kaimuki, Kahala, Diamond Head and Waikiki, Oahu
DOE Renewable and Distributed Systems Integration (RDSI) Maui Smart Grid Demonstration Project	Develop a distribution management system that aggregates distributed generation, energy storage, and demand response technologies with $7 million in DOE funds and $8 million in industry funds.[104]	HNEI, HECO/MECO, General Electric, First Wind	Maui Meadows and Wailea, Maui
JUMPSmart Maui Project	Develop advanced technologies that automate EV charging and demand response to allow more renewable energy on the grid. NEDO will invest $37 million in the project.[105]	NEDO, Hitachi, Mizuho, Cyber-Defense, US DOE, NREL, HECO/MECO, HNEI, MEDB, Maui County & DBEDT	Kihei, Maui
KIUC Smart Grid Demonstration	Installation of advanced metering infrastructure (AMI) and other smart grid technologies for grid management and energy efficiency information. Total cost of around $11 million for 33,000 meters in five years.[106]	KIUC, USDOE	Kauai
Honeywell Fast Demand Response	Industrial and Commercial programs available for designating non-essential facilities that can be turned off during critical energy situations with ten minutes' notice or less.[107]	HECO, Honeywell	Oahu
Sustainable and Holistic Integration of Energy Storage and Solar PV (SHINES)	Deploy distributed photovoltaics (PV), energy storage, and dynamic load control systems that show the system-level benefits of enhanced utility visibility and control of distribution system/edge-of-network electricity resources.[108]	HECO, U.S. DOE, Siemens, Alstom , DNV GL, AWS Truepower, Referentia Systems, Apparent, and Stem	Honolulu, HI

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").[109] The SGF project is currently pending the PUC's review and decision.

Solar

Due to Hawaii's extremely high energy prices, superior solar resource, and progressive energy policies, the state has experienced unprecedented growth in solar generation. From 2007-2013, solar capacity nearly doubled annually. However since 2013, and due to new utility interconnection requirements, total solar capacity growth has slowed down.

The majority of photovoltaic systems have been installed under the utilities' net energy metering (NEM) program. Since its inception in 2001 over 60,000 customers installed systems under the NEM program in the Hawaiian Electric, Maui Electric, and Hawaii Electric Light service territories. The rapid growth of PV in Hawaii also garnered national and international attention from other utilities, the solar industry, and the National Renewable Energy Laboratory who benefited in seeing how Hawaii have met the challenges of installing so much distributed generation on the utilities' grids.[110]



On October 12, 2014, under Docket No. 2014-0192 (Decision & Order No. 33258), the PUC effectively ended the Hawaiian Electric Companies' NEM program, and created two new programs, customer grid-supply (CGS) and customer self-supply (CSS). Under the CGS program, the PUC established capacity limits for each service. The following table shows the total capacity of CGS systems that have passed completeness review as of April 5, 2016.[111]

Island	Total Capacity MWac	Current Level MWac*	Remaining MWac
Hawaiian Electric	25.0	7.5	17.5
Maui Electric**	5.0	0.6	4.4
Hawaii Electric Light	5.0	1.2	3.8

* Includes all applications that have passed completeness review
** Includes Maui, Molokai, and Lanai

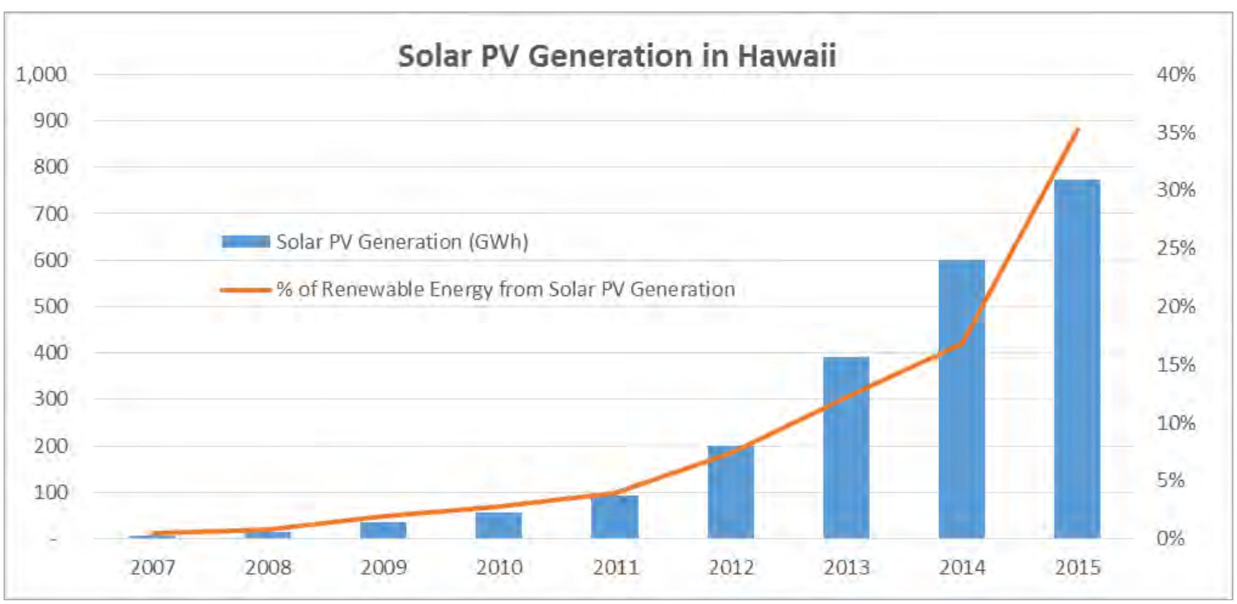
Solar

The CSS program currently does not have any established capacity limits. As of April 5, 2016, the Hawaiian Electric Companies have received five applications for Oahu, and seven for Maui---only one application has passed the completeness review.[112]

Beyond distributed solar energy, utility scale solar energy has been an important component of the state of Hawaii's energy portfolio. The following table lists the existing active utility scale solar projects.[113]

Name	Capacity	Island	Location
Anahola Solar	12 MW	Kauai	Anahola
Cyanotech Solar Array	500 kW	Hawaii	Kailua-Kona
Dole Plantation Solar Array	500 kW	Oahu	Wahiawa
Hawaii FIT Forty, LLC	570 kW	Oahu	Waianae
Hawaii FIT Two	596.7 kW	Oahu	Waianae
Holaniku Test Facility	500 kW	Hawaii	Keahole Point
Kalaeloa Renewable Energy Park	5 MW	Oahu	Kalaeloa
Kalaeloa Solar Power II	5 MW	Oahu	Kalaeloa
Kapaa Solar Project	1 MW	Kauai	Kapaa
Kapolei Sustainable Energy Park	1.1 MW	Oahu	Kapolei
Koloa (KRS2) Solar Farm	12 MW	Kauai	Koloa
La Ola Solar Farm	1.2 MW	Lanai	Lanai City
MP2 Solar Project	300 kW	Kauai	Lawai
Pearl City Peninsula PV	1.23 MW	Oahu	Pearl Harbor
Port Allen Solar Facility	6 MW	Kauai	Eleele
Waianae PV-2 Solar Farm	500 kW	Oahu	Waianae
Waimea Research Center PV Facility	300 kW	Kauai	Waimea Research Center
Wilcox Memorial Hospital Solar Photovoltaic Farm	500 kW	Kauai	Lihue

In 2015, solar PV generation provided 35% of Hawaii's renewable energy. The graph below shows annual solar PV generation and solar PV generation as a percentage of total renewable energy generation in Hawaii.[114]



Solar

The integration of large amounts of solar generation has proven to be a challenge for the utility due to the rapid growth of the solar industry, the intermittent nature of solar power, and the condition of Hawaii's islanded, centralized electric grid infrastructure. Potential solutions include advanced inverter settings, battery storage, and interconnecting the island grids. To this end, the Hawaii State Energy Office has provided input in various technical and regulatory investigative proceedings designed to clear the current backlog of PV systems awaiting interconnection by the HECO Companies as well as modernizing the electric utility system to allow for greater renewable penetration and transparency, network interoperability, and distributed intelligence.[115]

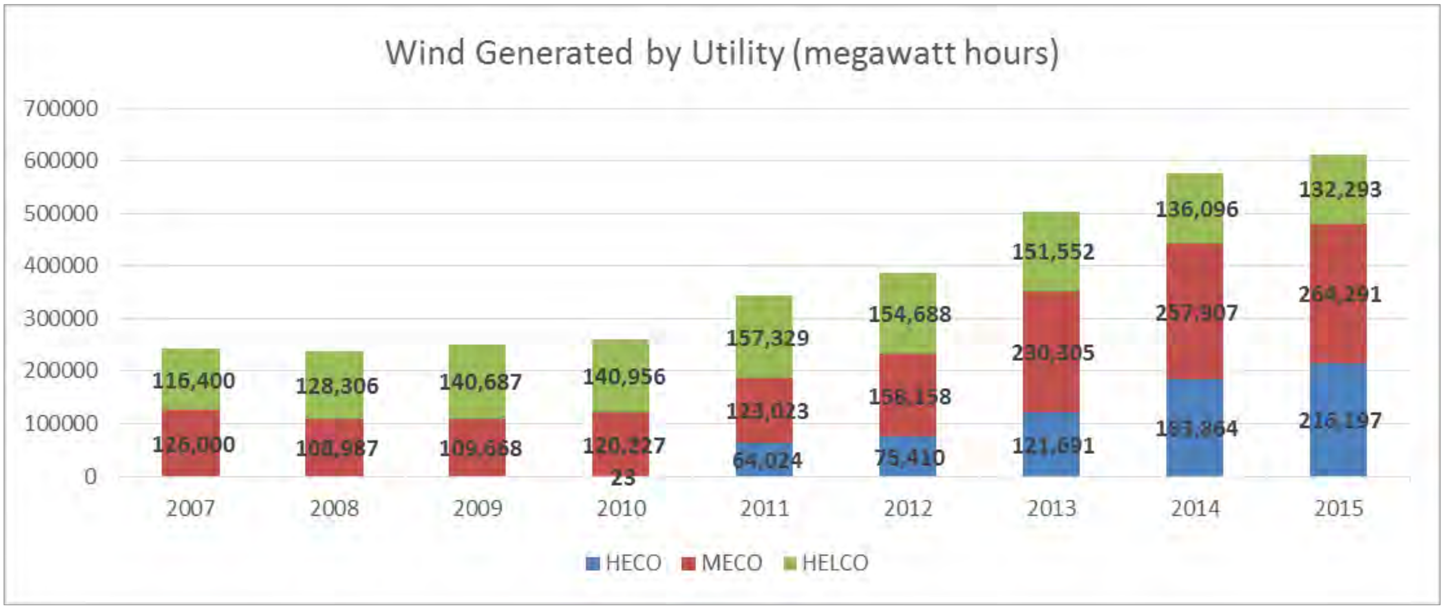
Percentage of electricity generated by solar, 2015 statewide[116]	8%	Nationwide rank of cumulative installed PV capacity per capita, 2014[117]	1st
Power density of PV array[118]	11-19 watts per square foot	Levelized cost of PV, Hawaii utility scale[119]	~13-14.5¢ /kWh
Installed cost, U.S., residential[120]	\$3.29/W	Installed cost, U.S., utility-scale[121]	\$1.80/W
Statewide 2014 construction expenditures attributed to solar[122]	7.4%	Acres per megawatt (Hawaii, utility-scale)[123]	3.3 – 7.2 acres/MW

At the end of 2015, Honolulu led all cities in the nation in total solar PV capacity installed per capita, with 417 W-DC.[124]

Wind

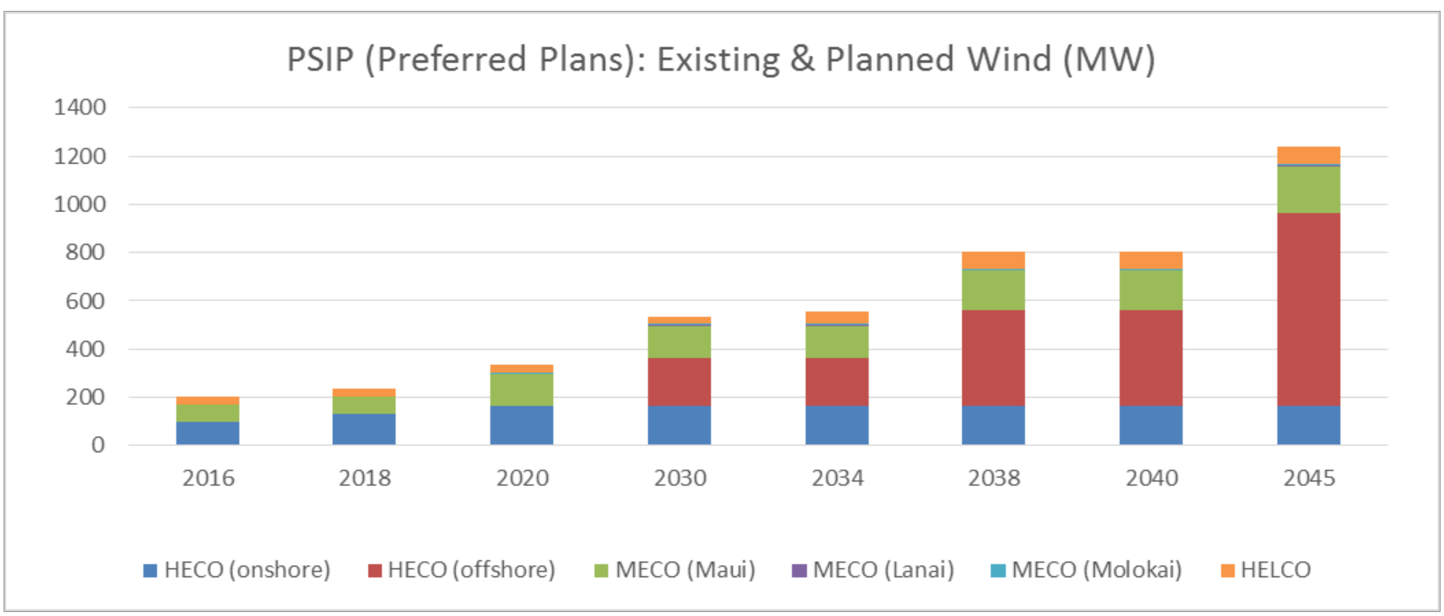
Onshore Wind

Wind energy is Hawaii's second most utilized renewable energy resource, accounting for about 28% of Hawaii's total renewable energy portfolio in 2015, which equates to 6.5% of the total energy sold and distributed by Hawaii's electric utilities in 2015.[125]



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 capacity factor of the Pakini Nui Wind Farm on the Big Island was 65%; Kaheawa Wind Power I on Maui was 47%; and, the Hawi Renewables Wind Farm on the Big Island was 45%.[126]

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. For example, the April 1, 2016, Power Supply Improvement Plans (PSIPs) Update Report filed by the Hawaiian Electric Companies includes up to 530 MW of onshore wind and 800 MW of offshore wind total, consolidated across its three service areas: Oahu (HECO), Maui County (MECO), and Hawaii Island (HELCO).[127] The Hawaiian Electric Companies estimate 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

These utility plans are subject to stakeholder review and approval by the Hawaii Public Utilities Commission and do not guarantee any of the proposed MW will be installed, but they do provide options for planning consideration.

There are currently seven (7) 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;[128] 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.[129]

Existing Utility Scale Wind Projects

Project Name	Year Installed	Island	Developer	Capacity (MW)	Acres	Acres per MW
Hawi Renewable Development[130]	2006	Hawaii	Hawi Renewables	10.5	250	23.8
Kaheawa I Wind Farm[131]	2006	Maui	First Wind/ Sun Edison	30	200	6.7
Pakini Nui Wind Farm[132]	2007	Hawaii	Tawhiri Power	20.5	67	3.3
Kahuku Wind Farm[133]	2011	Oahu	First Wind/ Sun Edison	30	578	19.3
Kawailoa Wind Farm[134]	2012	Oahu	First Wind/ Sun Edison	69	650	9.4
Kaheawa II Wind Farm[135]	2012	Maui	First Wind/ Sun Edison	21	143	6.8
Auwahi Wind[136]	2012	Maui	Sempra Generation	21	68	3.2

Additional facts and figures pertaining to wind energy development in Hawaii:

Current installed wind in Hawaii (capacity)[137]	**202 MW**	Average land area per MW (wind in HI)	**9.7 acres**
Levelized cost of wind energy[138]	**7¢ per kWh**	Average height of a 2.3 MW turbine[139]	**456 ft.**

Challenges Facing Wind Energy Development in Hawaii

- Endangered avian 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.
- 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; with developers working closely with local communities.

Offshore Wind

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 3 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.

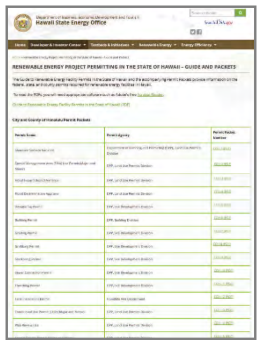
Attention to offshore wind in Hawaii has increased following notice of multiple unsolicited applications received by the U.S. Bureau of Ocean Energy Management (BOEM) for seafloor lease applications for wind farms off-shore of Oahu; currently, still undergoing BOEM review.[140]

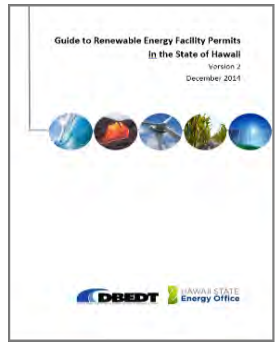
Permitting

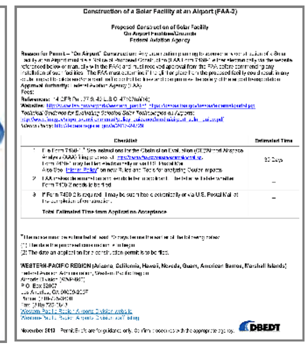
Permitting any large project in Hawaii, including a utility-scale renewable energy project, requires a thorough understanding of local processes, issues, and stakeholders. The tools described below provide information on these topics, as well as guidance to assist appropriate project siting and due diligence. 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.[141] Many local federal, state, and county agencies contributed to the development to these tools. Some of these tools were featured by the National Association of State Energy Officials (NASEO) as a best-practice other state energy offices could use to abate soft costs associated with renewable energy permitting processes.[142]

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. (energy.hawaii.gov/developer-investor/project-permitting-assistance-and-resources)



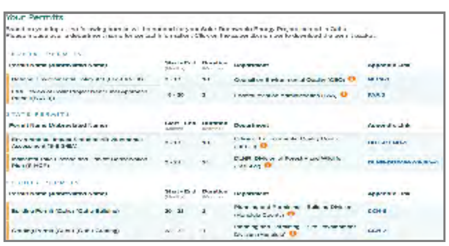


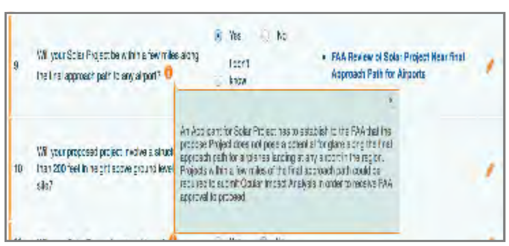


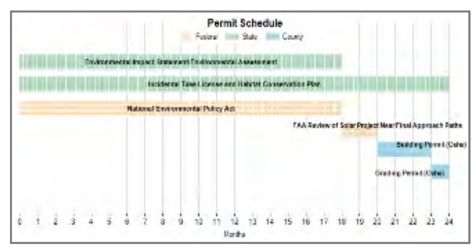
In addition to these resources, the Center provides lists of environmental consultants familiar with planning and permitting in Hawaii. While not exhaustive, this list identifies numerous firms with experience permitting and siting renewable energy projects in Hawaii.

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. (wizard.hawaiicleanenergyinitiative.org/)

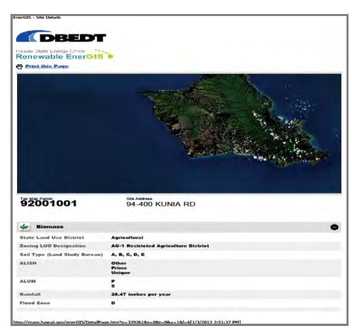






Renewable EnerGIS Mapping Tool (Hawaii State Energy Office, Office of Planning)

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 this tool. (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. (energy.hawaii.gov/testbeds-initiatives/hawaii-clean-energy-peis)

Permitting

Electronic permitting is another effective method of streamlining the permit review process without removing any of the environmental or community safeguards in place.[143] 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. (eha-cloud.doh.hawaii.gov/epermit/)

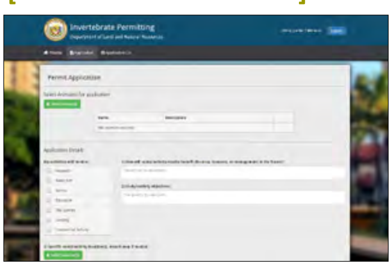
Online Building Permits (City and County of Honolulu/CCH)

CCH'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. (http://dppweb.honolulu.gov/DPPWeb/Default.aspx?PossePresentation=OnlineBuildingPermit&PosseObjectDef=j_OnlineBP)

Electronic Plan Review 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. (kauai.gov/Government/Departments/PublicWorks/BuildingDivision/ElectronicPlanReview/tabid/392/Default.aspx)

[UNDER DEVELOPMENT] Online Permitting (Department of Land and Natural Resources)



DBEDT and DLNR are currently developing new online permitting tools for DLNR's Engineering Division and Division of Forestry and Wildlife. These tools are scheduled for public release in late 2016 or early 2017.

Facts about permitting renewable energy projects in Hawaii

- Permitting costs in Hawaii can range from 1% to 20% of overall project construction costs.[144]
- Large energy projects in Hawaii average 15 federal, state, and county permits.
- It can take 1-5 years to permit a large renewable energy project in Hawaii.
- Hawaii's Energy Policy: Balance technical, economic, environmental, and cultural considerations.

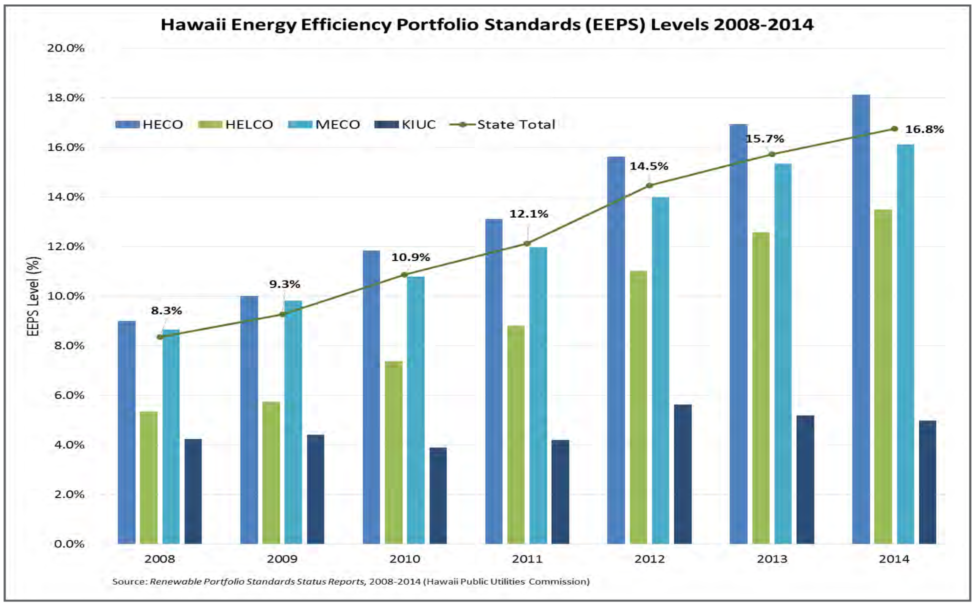
Common solutions to renewable energy permitting issues in Hawaii

- Know the requirements and processes - retain professionals with experience in Hawaii.
- Meaningful community participation - engage public early in the project design process.
- Engage all stakeholders - identify and address all issues early in the process.
- Site projects appropriately - minimize environmental impacts, seek compatible areas.
- 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.

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 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 stakeholder meetings in the fall of 2016 to discuss the status of EEPS.



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. For the program year ending June 30, 2016, the program invested over $36 million to deliver more than 1.5 billion kWh in lifetime customer-level energy savings at a cost of 2.2 cents per kwh. This is the equivalent to building a 90 MW solar farm, enough to power 245,000 homes for a year. In addition, this has saved Hawaii's families and businesses $30 million for the first year and more than $331 million over the lifetime of the energy efficiency equipment installed while reducing greenhouse gas emissions by 1.4 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.

Energy Performance Contracting

Race to the Top Award

For the fifth year in a row, the Energy Services Coalition* (ESC) ranked Hawaii first in the nation in government energy performance contracting (EPC) for 2016. Hawaii's $325.25 per capita investment beat out second place Kentucky ($172.84), third place Delaware ($154.47) and far outpaced the national average ($53.93).

Energy Services Coalition Ranking			
State	**Population**	**Performance Contracting**	**Dollars per Capita**
1. Hawaii	1,360,301	$442,432,189.00	$325.25
2. Kentucky	4,339,367	$750,000,000.00	$172.84
3. Delaware	897,934	$138,707,463.00	$154.47
4. Massachusetts	6,547,629	$865,349,091.00	$132.16
5. Ohio	11,536,504	$1,252,683,627.00	$108.58

The award recognizes Hawaii for its outstanding achievements in energy efficiency, environmental stewardship and economic development through EPC. Since HSEO started the performance contracting program in 1996, state and local government agencies have signed a total of over $442.4 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 368,426 homes for one year. The projects comprise over 96 million square feet in 225 buildings or facilities.

**ESC is a national nonprofit organization of experts working together to increase energy efficiency and building upgrades through 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. As of summer 2016, HSEO had led Hawaii to nearly 95 percent of the target, working with agencies to sign over $283.98 million in performance contracts. As additional performance contract projects are under discussion, there is a good chance the state will exceed HSEO's goal.

The largest single performance contract in the nation is worth $158 million, signed by the Hawaii Department of Transportation – Airports. Using EPC, 12 of the state's 15 airports statewide will be updated with the latest in energy efficient and green technology. The project is projected to reduce energy use overall by 49 percent.

Improvements will include:

- Replacing 74,500 light fixtures and 372 transformers
- Installing 9,100 solar photovoltaic panels (about 2.7 MW)
- Upgrading and replacing chilled water and air conditioning systems
- Installing smart controls
- Addressing deferred maintenance such as roof repairs to accommodate the upgrades

Energy Performance Contracting

At signing, the projected economic benefits over the two-year construction period and eighteen-year performance period included:

- Over $518 million guaranteed savings in energy costs; actual savings realized are now estimated to be 8 percent higher.
- $20.3 million in tax revenues (in 2015 dollars).*
- $153.1 million in income to households (in 2015 dollars).*
- 867 jobs generated or supported each year during the first two years of construction and installation and an average of 63 jobs generated or supported each year during the following 18 years of the performance period.*

*Source: DBEDT Research & Economic Analysis Division

State and County Energy Performance Contracting

The chart below illustrates the number of EPC projects conducted by state and county agencies from 1996 through 2016. 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	2013-2035	$244,804,887	$730,027,690
Honolulu Board of Water Supply	2016-2036	$33,125,398	$56,173,154
	Total	**$442,432,189**	**$1,120,298,730**

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

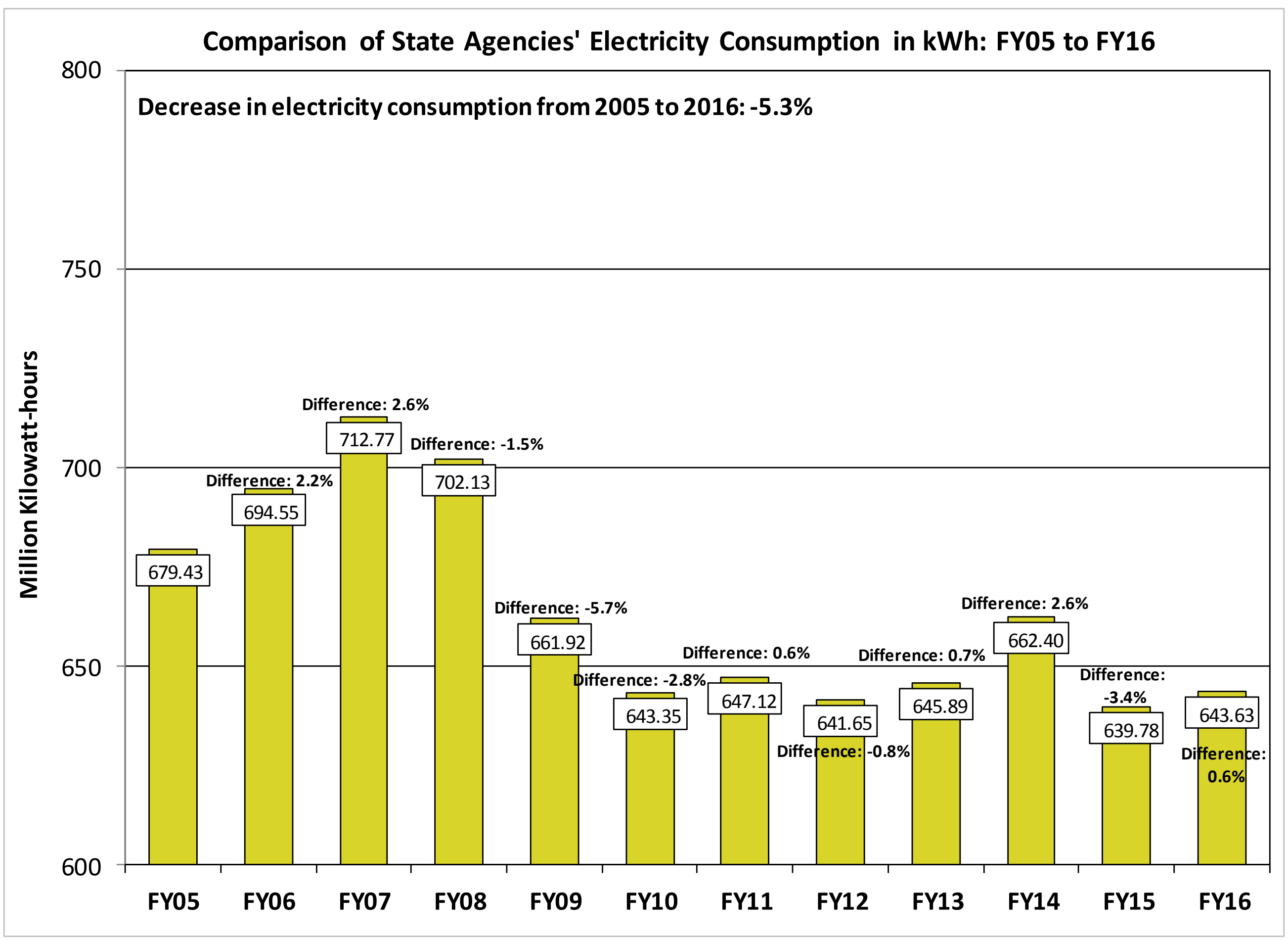
Energy Performance Contracting

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

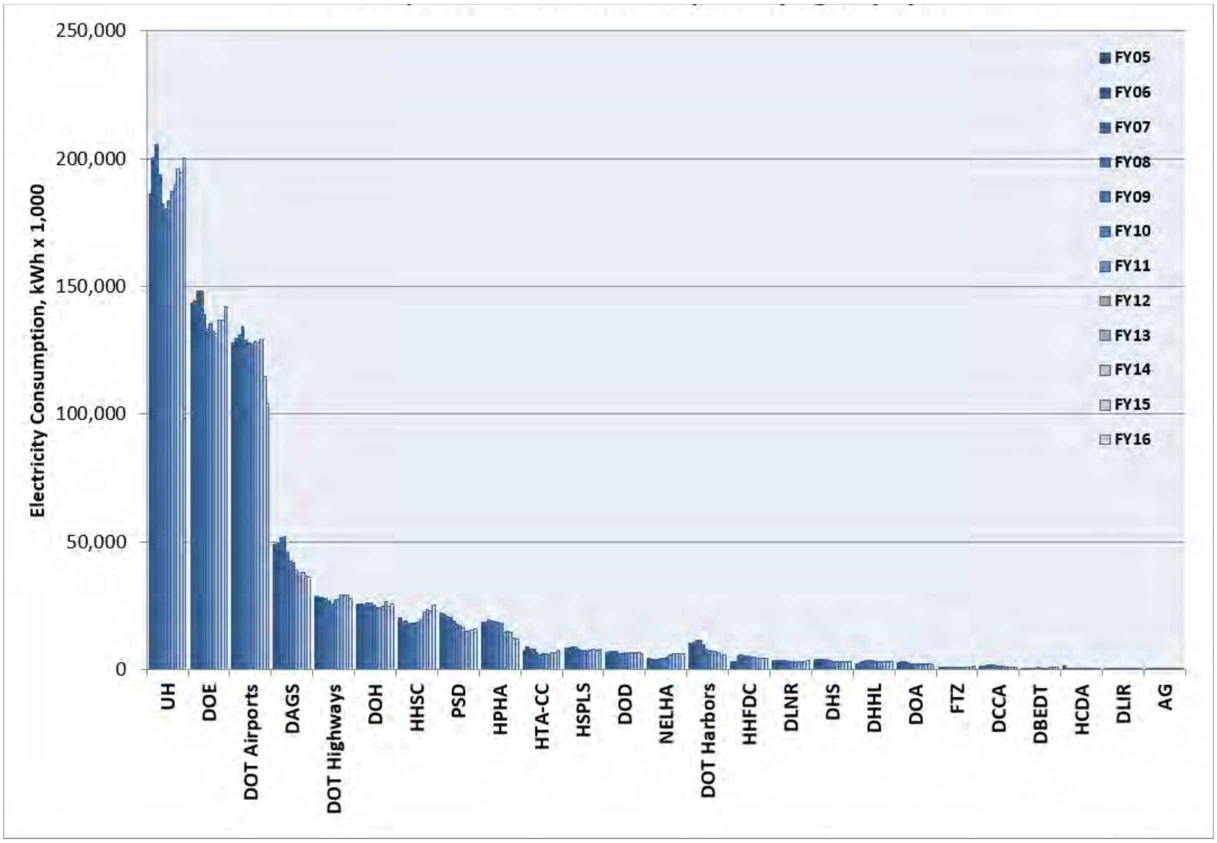
State of Hawaii Agencies Lead By Example

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.



State of Hawaii Agencies Lead By Example

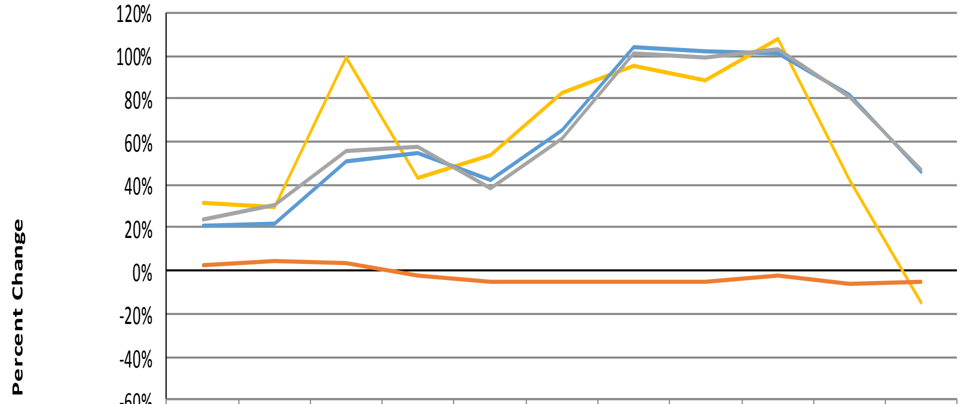
Comparison of kWh Consumption by Agency by Year



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
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%
Total State Avg Retail Price (All Sectors; $/KWH)	20.9%	22.1%	50.5%	54.5%	41.8%	65.5%	104.6%	102.5%	101.5%	81.5%	46.3%
Total SOH Building Electricity Cost ($)	23.7%	30.3%	55.4%	57.3%	38.2%	62.0%	101.3%	99.5%	103.4%	81.1%	47.2%
KWH	2.2%	4.9%	3.3%	-2.6%	-5.3%	-4.8%	-5.6%	-4.9%	-2.5%	-5.8%	-5.3%

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).

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

Since 1996 state agencies have received more than $11.15 million in efficiency rebates from Hawaii Energy, the Hawaiian Electric Company and its subsidiaries. Combined, these rebates have resulted in more than $196.68 million estimated cumulative dollar savings and 1.1 billion Kwh electricity savings. Over the life of the equipment, the savings would be enough to power approximately 172,086 households for a year. In 2016 state agencies received $1.59 million in rebates.

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.

HSEO serves on the SBCC, which was established by statute to update building codes. With the unanimous adoption of the IECC 2015, HSEO developed Hawaii Administrative Rules to codify the IECC 2015. HSEO provided IECC 2015 technical assistance and staff training for over 300 private and public sector design professionals and county building officials. HSEO will also 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 1 to 3 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 March 2016, Hawaii has 152 LEED certified projects and 239 registered projects. This totals 391 total projects for a gross square footage of over 45 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 Buildings 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. The proposed project will:

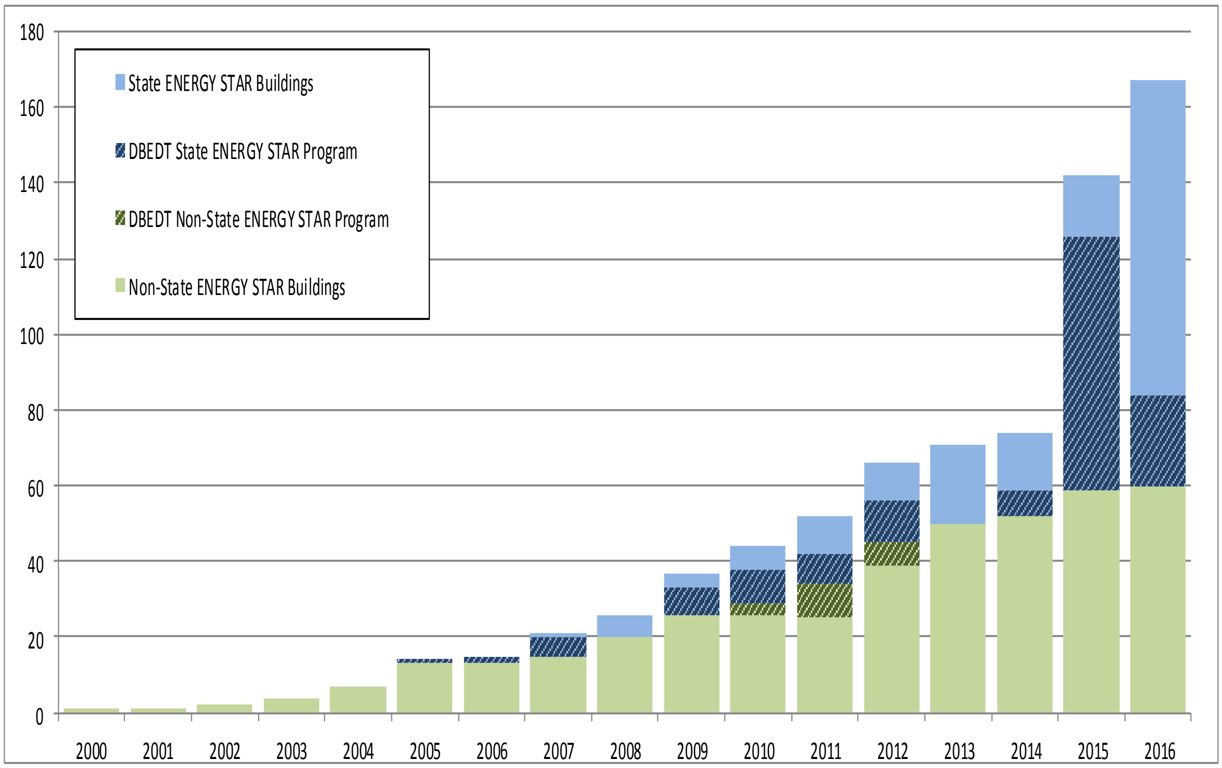
- Benchmark buildings under the U.S. Environmental Protection Agency's Energy Star Portfolio Program Manager guidelines
- Train state building managers to benchmark buildings and implement energy efficiency best practices
- Conduct a gap analysis of energy efficiency opportunities
- Present a showcase project to represent Hawaii
- Develop an implementation model for benchmarking and data baselining
- Score 65 buildings according to the USDOE's Asset Scoring Tool

As of mid-2016, through this competitive award, HSEO has doubled the number of ENERGY STAR buildings in Hawaii, including 83 school campuses' ENERGY STAR certifications. The project has allowed HSEO to gather as much data as possible to benchmark nearly 300 properties with over 900 buildings.

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 chart below 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 DOH, 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 2009-2016, 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:

- 18.532 million kWh of energy (equivalent to powering 2,886 homes for one year in Hawaii)
- 94.4 million gallons of water
- $4.967 million in energy costs

For more information on the Hawaii Green Business Program, visit energy.hawaii.gov/green-business-program

IUCN World Conservation Congress, Hawaii 2016

In preparation for the International Union for Conservation of Nature's (IUCN) 2016 World Conservation Congress in Hawaii, the Hawaii Green Business Program team worked with the Hawaii Lodging and Tourism Association, the IUCN's Green Team and the Sustainability Working Group in Hawaii, to ensure that the event's lodging partners were properties participating in the Hawaii Green Business Program or the IUCN's Green Hotels Initiative.

A total of 16 entities were recognized in the Hawaii Green Business Program Governor's Award ceremonies in 2016, achieving the IUCN's Green Hotels Initiative level one, two or three designation by completing the Green Hotel Checklist, participating in a verification site visit, committing to mentoring at least one other business and presenting at the Annual Green Hotel Forum.

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 204 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 204 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 CO2 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 4,650 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

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[2] DBEDT's Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends/. (Please note 2015 data for Hawaii includes data from 1/2015 to 7/2015.)

[3] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_a. Table 5.6A Average Retail Price of Electricity to Ultimate Customers by End-use Sector—located at http://www.eia.gov/electricity/monthly/

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[5] DBEDT's Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends/

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[7] DBEDT's Monthly Energy Trends, http://dbedt.hawaii.gov/economic/data_reports/energy-trends-2/. Data from 7/2015 to 6/2016.

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[9] 1 barrel = 42 U.S. gallons.

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[13] The State of Hawaii Data Book 2015 Tables 17.07 and 17.10 & Hawaiian Electric Industries 2014 Annual Report, "Generation Statistics".

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[17] Residential electricity use, rates, and average bill calculated using data from DBEDT's State of Hawaii Data Book, 2011-2015, Table 17.10. http://dbedt.hawaii.gov/economic/databook/

[18] The FIT queue was closed pursuant to Docket No. 2013-0194, Order No. 32499.

[19] HECO, http://www.heco.com/fit/

[20] The FIT queue joint plan was accepted by the PUC on December 5, 2014 under Docket No. 2013-0194, Order No. 32499.

[21] Source: PUC Docket No: 2014-0192 filed by Hawaiian Electric Industries on 1/21/15, Page 1, first bullet point under "Summary of This Filing".

[22] The DER docket proceeding was formally initiated on March 31, 2015 in PUC Order No. 32737, and calls for the utilities and other docket interveners from government, industry and advocacy groups to develop joint recommendations to 1) revise interconnection rules to allow for new distributed functions and capabilities such as energy storage or other grid-supportive services, 2) transition the current net energy metering (NEM) program, if necessary, and 3) create new market choices for non-exporting and "smart" exporting distributed energy systems. On October 12, 2015, the PUC issued Decision & Order (D&O) No. 33258 relative to the DER docket and contained three (3) major elements: (1) "Streamlines the interconnection process for customers by adopting new technical standards for advanced inverters and energy storage systems that utilize grid-supportive features; (2) Caps the {NEM} program at existing levels, including current NEM customers and those with applications pending in the queue at [the] time of this D&O; [and] (3) creates 3 new options for customers who wish to invest in rooftop solar and other distributed energy resources. These options include": self- and grid- supply systems and time-of-use tariff. Full details of the D&O can be found under Docket No. 2014-0192 D&O No. 33258.

[23] Phase I issues included: submitting the CSS and CGS tariffs; updating Rule 14H tariffs; updating the HECO Companies' "Advanced Inverter Interconnection Requirements for Inverter-Based Distributed Energy Resources;" a proposed system level hosting capacity analysis; an Advanced Inverter Test Plan; and submitting a proposed TOU tariff and establishing an interim TOU program.

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[25] Hawaiian Electric Company, Customer Grid Supply and Self Supply Programs. https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-grid-supply-and-self-supply-programs

[26] PUC Docket No. 2014-0192, Order No. 32737.

[27] Hawaiian Electric Company Weekly Report 2016-09-20. Pursuant to Order No. 32737 issued March 31, 2015, in the subject docket, please find enclosed the Companies' weekly interconnection queue. Consistent with Order No. 32737, the Companies have developed this format and weekly distribution process with Commission staff. In addition, pursuant to Decision and Order No. 33258 issued October 12, 2015, in the subject docket, the Companies' weekly report has been expanded to include, among other things, reporting on self-supply and grid-supply options.

[28] Hawaiian Electric Company, Customer Grid Supply and Self Supply Programs. https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-grid-supply-and-self-supply-programs

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[31] Hawaii Revised Statutes, Chapter 269-91.

[32] Source: 2007-2015 Annual RPS Reports to the Hawaii PUC. http://dms.puc.hawaii.gov/dms/. RPS Docket Number: 2007-0008.

[33] National Renewable Energy Laboratory, Hawaii Clean Energy Initiative Scenario Analysis, 2012; and DBEDT.

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[38] Hawaii Revised Statutes, Chapter 269-92.

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[40] Total Renewable Energy Metric. Docket No. 2013-0141 Hawaiian Electric Companies Reply Statement of Position, Exhibit 3, Attachment 3. Jan 7, 2014.

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[46] EPA Facility Level Information on Greenhouse Gases Tool, http://ghgdata.epa.gov/ghgp/main.do

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[56] 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.
[57] 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.
[58] 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.
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[77] Kauai Island Utility Cooperative 2015 RPS Report. RPS Docket Number: 2007-0008: http://dms.puc.hawaii.gov/dms/.
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