Hawaii
Economic Issues
Periodic research and data reports on issues of current interest
State of Hawaii - Department of Business, Economic Development & Tourism
Research & Economic Analysis Division

Hawaii's Electricity Industry: 2015 Analysis and Recent Trends

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Executive Summary

This report analyzes the generation, consumption, and cost of Hawaii's electricity using data from the U.S. Energy Information Administration (EIA) and the monthly financial reports (MFR) of Hawaii's electric utilities. The following is a summary of the results and trends identified in this report:

- The importance of Hawaii's non-utility electricity producers has increased over time. The utility companies (HECO, MECO, HELCO, and KIUC) generated 53.7 percent of the total electricity in 2015 and purchased the remainder from IPPs and CHPs. This was a 28.7 percentage point decrease from 1990, when utilities generated 82.4 percent of the total electricity sold in Hawaii. This has also contributed to the increase in the share of electricity generation from renewable sources, because non-utility producers in Hawaii use more renewable energy and less petroleum.
- Hawaii's dependence on petroleum for electricity generation has decreased over time. According to the most recent data from EIA, about 67.9 percent of the electricity was generated from petroleum fuel in 2014, and this represented a 22.1 percentage point decrease from the 1990 figure of 90.0 percent. In 2015, electricity generated from renewable sources accounted for 16.2 percent of the total electricity sold.
- In spite of a significant price decrease in 2015, the quantity of electricity sold in Hawaii remained about the same, suggesting that Hawaii's electricity demand is inelastic with respect to price. Total electricity sold by Hawaii's utilities decreased 0.2 percent or 18 GWH from 9,406 GWH in 2014 to 9,389 GWH in 2015. A large portion of this decrease was due to an increase in consumer-generated-electricity, mainly the customer rooftop photovoltaic systems.
- The average price of electricity in 2015 was 26.3 cents/KWH statewide. Kauai consumers paid the highest electricity rate at 33.1 cents/KWH, followed by Big Island consumers at 32.3 cents/KWH, Maui consumers at 30.2 cents/KWH, and Oahu consumers at 24.2 cents/KWH.
- Hawaii's residential electricity consumption decreased more than the other sectors. From 2005 to 2015, electricity sold to the residential sector decreased 2.1 percent per year. Over the same period, electricity sold to the commercial sector and the industrial sector only decreased an average 1.0 percent and 0.6 percent per year, respectively. In 2015, 39.3 percent of the

electricity was consumed by the industrial sector, 33.5 percent by the commercial sector, and 27.2 percent by the residential sector.

- Total electricity demand in Hawaii was an estimated 12,794 GWH in 2015. Of this amount, 2,344 GWH or 18.3 percent was generated from customer rooftop photovoltaic systems, solar water heating (SWH), and demand-side-management (DSM) such as using energy star appliances. Total electricity generated by utilities, independent power producers (IPP), and combined heat and power (CHP) firms totaled 10,450 GWH. Electricity station use and transmission and distribution loss accounted for 10.2 percent, or 1,061 GWH of the total electricity generated.
- From 2005 to 2015, total electricity demand in Hawaii increased an average 0.4 percent per year, from 12,280 GWH to 12,794 GWH. Electricity generation by the electric power industry decreased 1.2 percent per year from 11,755 GWH to 10,450 GWH, electricity generated by user owned PV systems increased 75.3 percent per year from 2 GWH to 665 GWH; electricity replaced by SWH increased 6.7 percent per year from 84 GWH to 160 GWH; and electricity replaced by DSM programs increased 13.2 percent per year from 439 GWH to 1,518 GWH.

1. Introduction

Electricity plays an important role in Hawaii's economy. Hawaii's total expenditures on electricity reached a peak of about $3.3 billion in 2012 due to the state's heavy reliance on imported petroleum and the rapid increase in petroleum prices until late 2014. From 2005 to 2014, total electricity expenditures in Hawaii increased from $1.9 billion to $3.2 billion, an average annual increase of 5.6 percent. It is important to note that this increase was much higher than the 3.0 percent CPI increase during the same period, which indicates that energy expenditure growth outpaced inflation. In 2015, total electricity expenditures decreased 23.1 percent due to decreased petroleum prices and increased electricity generation from the customer-sited solar systems. Due to decreased petroleum prices, the total fuel and purchased power cost of Hawaii's utilities decreased 32.6 percent, and the average revenue per kWh of electricity sold decreased 21.6 percent in 2015. However, reduced electricity prices did not lead to increased electricity sales; total electricity sold decreased 0.2 percent in 2015.

In 2013, the Research and Economic Analysis Division of DBEDT conducted a study to examine Hawaii's electric power industry based on data up to 2012. As a third follow up to the 2013 study, this study intends to answer the following research questions:

- Who produces electricity in Hawaii?
- What type of fuels are used to generate electricity in Hawaii?
- What are the main factors that affect electricity prices in Hawaii?
- How have the factors affecting electricity prices changed over time?
- What role does renewable energy play in electricity generation?
- What factors impact the production cost of electricity?
- Who consumes electricity in Hawaii?
- What are the recent trends in electricity consumption by types of consumers?
- What is the performance of the electricity industry in 2015?

The data provided in this report were primarily from two major sources. The first source was publicly available state level energy data from the U.S. Energy Information Administration (EIA); the second source of data was each respective Hawaii electric utility's Monthly Financial Reports (MFR). The MFR data provided both annual and monthly data by county utility.

2. Electricity Generation by Producers

Electricity consumed in Hawaii is mainly sold by the four electric utility companies: Hawaiian Electric Company (HECO), serving the island of Oahu; Maui Electric Company (MECO), serving the islands of Maui, Lanai, and Molokai; Hawaii Electric Light Company (HELCO), serving the island of Hawaii; and Kauai Island Utility Cooperative (KIUC), serving the island of Kauai. MECO and HELCO are whole owned subsidiaries of HECO, which is in turn a wholly owned subsidiary of Hawaii Electric Industries, Inc.

Table 1. Total Electricity Generation by Producer

	State Total Generation 1/	% of Total Generation Units: %				
				CHP		
Year	GWh	Utility	IPP	Electric	Industry	Commercial
1990	9,703	82.4	4.0	5.6	8.0	-
1991	8,703	84.3	4.3	1.7	9.7	-
1992	9,844	69.7	4.1	17.9	8.3	-
1993	9,944	61.2	5.2	26.0	7.7	-
1994	10,109	59.9	6.2	26.8	7.1	-
1995	10,304	60.1	6.2	27.3	6.4	-
1996	10,628	60.4	5.7	27.6	6.3	-
1997	10,312	60.2	6.4	27.8	5.6	-
1998	10,228	61.6	6.3	27.3	4.8	-
1999	10,404	62.0	5.8	26.7	5.4	-
2000	10,593	61.7	6.2	27.0	5.1	-
2001	10,633	60.0	4.9	30.3	4.7	-
2002	11,663	64.4	3.4	28.2	4.0	-
2003	10,976	59.2	5.0	33.2	2.7	-
2004	11,410	61.2	2.3	31.3	2.3	2.9
2005	11,523	60.0	2.4	32.7	2.3	2.5
2006	11,559	60.9	3.0	30.9	2.3	2.9
2007	11,533	60.1	4.4	30.6	2.3	2.6
2008	11,376	58.9	7.9	28.0	2.2	2.9
2009	11,011	59.1	7.3	28.4	2.3	2.9
2010	10,836	59.2	7.0	27.2	3.7	2.9
2011	10,723	59.5	7.5	26.4	3.7	3.0
2012	10,469	57.4	8.6	27.0	4.1	2.9
2013	10,267	56.0	9.6	27.2	3.8	3.5
2014	10,204	54.1	10.4	27.4	4.4	3.7
2015*	10,194	53.7	10.5	27.6	4.5	3.8

* Estimated based on Hawaii Electric Utility Monthly Financial Reports.

1/ Total generation from EIA is based on survey of electricity producers' net generation (excluding station use).

Source: Energy Information Administration, State Energy Data System

Electricity consumed in Hawaii is generated mainly by the electric utilities and non-utility electricity producers. Non-utility producers include independent power producers (IPP), combined heat and power (CHP)-Electric Power, CHP-Industrial Power, and CHP-Commercial Power. In 2015, electric utilities accounted for about 53.7 percent of the 10,194 GWH of electricity generation by the electric power industry, and the four types of non-utility producers accounted for about 46.3 percent of total generation (Table 1). From 1990 to 2015, the electric utilities' share of total generation decreased from 82.4 percent to 53.7 percent. Electricity generated by utilities and the four types of non-utility producers are defined as the electricity generated by the electric power industry in the EIA data.

In addition to the electricity generated by the electric power industry, some consumers also generated electricity, such as electricity generated from the photovoltaic (PV) systems owned by residential or commercial users. Electricity generated by consumers and directly used without being sold to the utility systems is not included in the total generation and consumption data.

Electricity generation data provided by the EIA and the utility MFR are not exactly comparable. According to the MFR, electricity sold by the four utilities includes net generation of the utilities and purchased electricity minus electricity lost in the utility systems (including a small portion of electricity used but not paid for by electricity users). The net electricity generation of the utilities is the total electricity generated minus the total usage by the utility owned power stations. The purchased electricity is the total generation of non-utility producers minus their station use. Since the usage data of non-utility producers is not available, total generation by the non-utility producers is also not available. In 2014, total utility generation (including station use) and purchased electricity in Hawaii was 10,211 GWH based on the utility MFR, slightly higher than the total electricity generation from the EIA data (10,204 GWH). It appears that the station use of non-utility producers is not included in the total electricity generation data provided by EIA.

Total electricity sold by the utilities includes utility net generation plus electricity purchased from non-utility producers minus utility loss. Utility net generation is the utility total generation minus utility station use. In general, total utility generation has been decreasing in recent years. As shown in Table 2, the four electric utilities in Hawaii generated (including station use) about 5,799 GWH of electricity in 2015, decreased 0.7 percent or 41 GWH from the previous year. From 2005 to 2015, utility total generation decreased about 2.3 percent per year on average.

Both total generation and station use decreased over time, but station use decreased less than that of the total generation on average. In 2015, station use for the state accounted for about 5.5 percent or 317 GWH of utility total generation. From 2005 to 2015, utility station use decreased 2.0 percent per year, which was less than the 2.3 percent decrease of total generation. As a result, the share of station use increased from 5.3 percent in 2005 to 5.5 percent in 2015 for the state. The share of station use was the highest at HECO, followed by HELCO, MECO, and KIUC. From 2005 to 2015, utility net generation decreased 2.3 percent per year on average, from 6,920 GWH in 2005 to 5,482 GWH in 2015. About 68.1 percent of Hawaii's utility net generation in 2015 was produced by HECO, 16.0 percent by MECO, 9.3 percent by HELCO, and 6.5 percent by KIUC.

Table 2. Hawaii Net Electricity Generation by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total utility generation										
State Total	GWh	7,309	7,328	6,889	6,818	6,100	5,840	5,799	-0.7%	-2.3%
HECO	GWh	5,021	5,153	4,779	4,699	4,170	3,970	3,977	0.2%	-2.3%
HELCO	GWh	561	516	546	586	571	573	536	-6.6%	-0.5%
MECO	GWh	1,279	1,184	1,126	1,104	945	903	917	1.5%	-3.3%
KIUC	GWh	448	475	438	429	415	394	369	-6.1%	-1.9%
Utility station use										
State Total	GWh	389	388	371	379	345	327	317	-3.2%	-2.0%
HECO	GWh	300	302	284	293	263	247	243	-1.8%	-2.1%
HELCO	GWh	31	27	30	31	30	28	24	-14.7%	-2.6%
MECO	GWh	45	45	45	43	40	40	38	-3.4%	-1.6%
KIUC	GWh	13	13	12	13	12	12	12	-3.5%	-0.9%
Utility net generation										
State Total	GWh	6,920	6,941	6,518	6,439	5,755	5,513	5,482	-0.6%	-2.3%
HECO	GWh	4,721	4,851	4,495	4,406	3,907	3,723	3,734	0.3%	-2.3%
HELCO	GWh	530	490	516	555	540	546	512	-6.1%	-0.3%
MECO	GWh	1,234	1,138	1,081	1,060	905	863	878	1.7%	-3.3%
KIUC	GWh	435	462	426	417	403	381	358	-6.2%	-1.9%
Utility share of net generation										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	68.2%	69.9%	69.0%	68.4%	67.9%	67.5%	68.1%		
HELCO	%	7.7%	7.1%	7.9%	8.6%	9.4%	9.9%	9.3%		
MECO	%	17.8%	16.4%	16.6%	16.5%	15.7%	15.7%	16.0%		
KIUC	%	6.3%	6.7%	6.5%	6.5%	7.0%	6.9%	6.5%		
% of station use of utility generation										
State Total	%	5.3%	5.3%	5.4%	5.6%	5.7%	5.6%	5.5%		
HECO	%	6.0%	5.9%	5.9%	6.2%	6.3%	6.2%	6.1%		
HELCO	%	5.5%	5.1%	5.5%	5.2%	5.3%	4.8%	4.4%		
MECO	%	3.5%	3.8%	4.0%	3.9%	4.3%	4.4%	4.2%		
KIUC	%	2.9%	2.8%	2.6%	2.9%	2.8%	3.1%	3.2%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 3 shows that electricity purchased by the utilities increased from 4,202 GWH in 2005 to 4,402 GWH in 2015, an increase of 200 GWH. This increase is in contrast to the 1,438 GWH decrease in net utility generation during the same period. Electricity purchased decreased from 2005 to 2011 and then increased from 2011 to 2015. In 2015, electricity purchased increased 0.7 percent or 31 GWH, over the previous year. Electricity purchased plus utility net generation is the electricity net to system. The share of purchased electricity, as a percentage of the total net to system, increased from 37.8 percent in 2005 to 44.5 percent in 2015.

Table 3. Hawaii Electricity Sales by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Electricity purchased										
State Total	GWh	4,202	4,255	4,154	4,046	4,244	4,371	4,402	0.7%	0.5%
HECO	GWh	3,383	3,238	3,267	3,187	3,281	3,379	3,352	-0.8%	-0.1%
HELCO	GWh	688	769	669	631	619	595	631	6.2%	-0.9%
MECO	GWh	97	221	185	191	296	333	325	-2.4%	12.8%
KIUC	GWh	35	27	34	37	49	65	94	45.7%	10.4%
Electricity net to system										
State Total	GWh	11,122	11,195	10,672	10,485	9,999	9,884	9,884	0.0%	-1.2%
HECO	GWh	8,104	8,089	7,762	7,594	7,187	7,102	7,086	-0.2%	-1.3%
HELCO	GWh	1,217	1,259	1,184	1,187	1,159	1,140	1,143	0.3%	-0.6%
MECO	GWh	1,331	1,359	1,266	1,252	1,201	1,196	1,203	0.6%	-1.0%
KIUC	GWh	470	489	460	453	452	446	452	1.3%	-0.4%
Utility loss										
State Total	GWh	584	610	546	524	498	478	496	3.7%	-1.6%
HECO	GWh	383	414	384	352	329	320	332	3.7%	-1.4%
HELCO	GWh	101	96	64	83	83	78	79	1.1%	-2.5%
MECO	GWh	79	79	74	70	66	64	66	2.0%	-1.8%
KIUC	GWh	21	22	24	19	20	16	19	22.9%	-0.7%
Total electricity sold										
State Total	GWh	10,539	10,585	10,126	9,962	9,501	9,406	9,389	-0.2%	-1.1%
HECO	GWh	7,721	7,675	7,378	7,242	6,859	6,782	6,754	-0.4%	-1.3%
HELCO	GWh	1,116	1,163	1,120	1,104	1,076	1,063	1,065	0.2%	-0.5%
MECO	GWh	1,252	1,280	1,192	1,181	1,135	1,132	1,138	0.5%	-1.0%
KIUC	GWh	449	467	437	435	431	430	432	0.5%	-0.4%
Share of purchased of net to system										
State Total	%	37.8%	38.0%	38.9%	38.6%	42.4%	44.2%	44.5%		
HECO	%	41.7%	40.0%	42.1%	42.0%	45.6%	47.6%	47.3%		
HELCO	%	56.5%	61.1%	56.5%	53.2%	53.4%	52.1%	55.2%		
MECO	%	7.3%	16.2%	14.6%	15.3%	24.7%	27.8%	27.0%		
KIUC	%	7.4%	5.5%	7.5%	8.1%	10.8%	14.5%	20.8%		
Share of loss of net to system										
State Total	%	5.2%	5.5%	5.1%	5.0%	5.0%	4.8%	5.0%		
HECO	%	4.7%	5.1%	4.9%	4.6%	4.6%	4.5%	4.7%		
HELCO	%	8.3%	7.6%	5.4%	7.0%	7.2%	6.8%	6.9%		
MECO	%	5.9%	5.8%	5.8%	5.6%	5.5%	5.4%	5.5%		
KIUC	%	4.5%	4.5%	5.2%	4.1%	4.5%	3.6%	4.3%		

Source: Hawaii Electric Utility Monthly Financial Reports.

It is important to note that not all the electricity sent to the utility systems was sold to consumers, some electricity was lost during the process of transmission and distribution. In Hawaii, about 5.0 percent of the electricity sent to the system was lost in 2015. The percent of loss was highest in the HELCO system (6.9 percent), followed by MECO (5.5 percent), HECO (4.7 percent), and KIUC (4.3 percent). Total electricity sold is electricity net to system minus electricity lost. From 2005 to 2015, total electricity sold decreased 1.1 percent per year on average from 10,539 GWH to 9,389 GWH. The system loss share of electricity net to system decreased from 5.2 percent to 5.0 percent for the state over this period.

Table 4 shows that utility station use and loss decreased from 972 GWH in 2005 to 812 GWH in 2015, a decrease of 1.8 percent per year on average. The share of utility station usage and loss as a percentage of total utility generation and purchased electricity decreased from 8.4 percent in 2005 to 8.0 percent in 2015.

Table 4. Share of Utility Station Usage and Loss of Total Electricity Production

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total utility generation and purchased 1/										
State Total	GWh	11,511	11,583	11,043	10,864	10,344	10,211	10,201	-0.1%	-1.2%
HECO	GWh	8,404	8,392	8,046	7,886	7,450	7,349	7,329	-0.3%	-1.4%
HELCO	GWh	1,248	1,285	1,214	1,217	1,189	1,168	1,167	-0.1%	-0.7%
MECO	GWh	1,376	1,404	1,311	1,295	1,241	1,236	1,242	0.4%	-1.0%
KIUC	GWh	482	502	472	466	463	458	463	1.2%	-0.4%
Station use and loss										
State Total	GWh	972	998	916	903	843	805	812	0.9%	-1.8%
HECO	GWh	683	716	668	644	592	568	575	1.3%	-1.7%
HELCO	GWh	132	123	94	114	113	105	102	-3.1%	-2.5%
MECO	GWh	124	124	118	114	106	104	104	0.0%	-1.7%
KIUC	GWh	34	35	35	31	32	28	31	11.4%	-0.8%
% of station use and loss										
State Total	%	8.4%	8.6%	8.3%	8.3%	8.1%	7.9%	8.0%	1.0%	-0.6%
HECO	%	8.1%	8.5%	8.3%	8.2%	7.9%	7.7%	7.8%	1.6%	-0.4%
HELCO	%	10.5%	9.5%	7.8%	9.3%	9.5%	9.0%	8.8%	-3.0%	-1.9%
MECO	%	9.0%	8.8%	9.0%	8.8%	8.6%	8.4%	8.4%	-0.5%	-0.7%
KIUC	%	7.0%	7.0%	7.5%	6.7%	6.9%	6.2%	6.8%	10.1%	-0.4%

1/ Excluding station use of non-utility producers.
Source: Hawaii Electric Utility Monthly Financial Reports.

Since data for the station use of non-utility producers is not available, the percentage of station use and loss calculated above underestimates the actual share of station use and loss as a percentage of the whole electric system of Hawaii. If we assume that the station use share of the non-utility producers as a percentage of purchased electricity is similar to that of the utility station use share of net generation as shown in Table 5, the share of total station use and loss in gross generation would be about 10.2 percent for 2015.

Hawaii's gross electricity generation in 2015 was estimated to be about 10,450 GWH. In 2015, about 72 percent of the gross generation was produced by the HECO system (including both utility and non-utility producers). HELCO accounted for about 11 percent of gross generation, MECO about 12 percent, and KIUC about 4 percent. From 2005 to 2015, each respective county utility's share of gross generation remained fairly stable.

Table 5. Share of Total Station Usage and Loss of Total Electricity Production

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Station use of non-utility										
State Total	GWh	244	239	239	240	254	256	249	-2.7%	0.2%
HECO	GWh	202	190	194	198	207	211	205	-2.8%	0.1%
HELCO	GWh	38	40	37	33	33	29	28	-3.1%	-3.0%
MECO	GWh	3	8	7	8	13	15	14	-7.0%	14.8%
KIUC	GWh	1	1	1	1	1	2	3	49.8%	11.6%
Total gross generation 1/										
State Total	GWh	11,755	11,822	11,282	11,104	10,598	10,467	10,450	-0.2%	-1.2%
HECO	GWh	8,606	8,582	8,240	8,085	7,657	7,560	7,534	-0.3%	-1.3%
HELCO	GWh	1,286	1,325	1,251	1,250	1,222	1,197	1,195	-0.2%	-0.7%
MECO	GWh	1,379	1,413	1,318	1,302	1,254	1,251	1,255	0.4%	-0.9%
KIUC	GWh	484	503	473	467	465	460	466	1.4%	-0.4%
Share of gross generation										
State Total	%	100%	100%	100%	100%	100%	100%	100%	0.0%	0.0%
HECO	%	73%	73%	73%	73%	72%	72%	72%	-0.2%	-0.2%
HELCO	%	11%	11%	11%	11%	12%	11%	11%	0.0%	0.4%
MECO	%	12%	12%	12%	12%	12%	12%	12%	0.5%	0.2%
KIUC	%	4%	4%	4%	4%	4%	4%	4%	1.5%	0.8%
Total station use and loss										
State Total	GWh	1,217	1,237	1,156	1,143	1,097	1,061	1,061	0.0%	-1.4%
HECO	GWh	885	906	863	842	799	778	780	0.2%	-1.3%
HELCO	GWh	169	162	131	147	146	134	130	-3.1%	-2.6%
MECO	GWh	127	133	126	121	119	119	118	-0.9%	-0.8%
KIUC	GWh	35	36	36	32	33	30	34	13.9%	-0.1%
% of station use and loss										
State Total	%	10.3%	10.5%	10.2%	10.3%	10.3%	10.1%	10.2%	0.2%	-0.2%
HECO	%	10.3%	10.6%	10.5%	10.4%	10.4%	10.3%	10.3%	0.5%	0.1%
HELCO	%	13.2%	12.2%	10.5%	11.7%	12.0%	11.2%	10.9%	-2.9%	-1.9%
MECO	%	9.2%	9.4%	9.5%	9.3%	9.5%	9.5%	9.4%	-1.2%	0.2%
KIUC	%	7.2%	7.1%	7.7%	6.9%	7.2%	6.6%	7.4%	12.4%	0.2%

1/ Including station use of non-utility producers. Estimated by DBEDT

Source: Hawaii Electric Utility Monthly Financial Reports.

3. Electricity Generation by Sources

Hawaii's electricity generation depends heavily on imported petroleum as the major fuel source. Before 1990, Hawaii's electricity was almost all generated from petroleum products. However, since 1990, electricity generated from waste, coal, wind, and geothermal energy became more significant. Nevertheless, petroleum remains the dominant fuel in Hawaii's electricity generation and is the primary driver for the changes of electricity prices in Hawaii.

Table 6. Electricity Generation by Source: Total Electric Power Industry

	Total Electricity Generation	% of Total Electricity Generation									
Year	GWH	Petroleum	Coal	Other Gases 1/	Biomass	Wood	Geothermal	Hydro	Wind	Solar 2/	Other
1990	9,703	90.0	0.0	0.2	8.7	-	-	0.8	0.3	-	-
1991	8,703	88.6	0.1	0.6	9.5	-	-	0.8	0.4	-	-
1992	9,844	84.7	5.7	0.6	8.2	0.0	0.0	0.6	0.2	-	-
1993	9,944	74.4	14.9	0.6	7.8	0.0	1.5	0.6	0.2	-	-
1994	10,109	75.6	13.1	0.7	7.2	0.0	1.8	1.4	0.2	-	-
1995	10,304	74.5	15.2	0.7	6.2	0.0	2.3	0.9	0.2	-	0.0
1996	10,628	74.9	15.5	0.6	5.6	0.0	2.3	1.0	0.2	-	-
1997	10,312	74.6	15.3	0.6	5.9	0.0	2.4	1.1	0.2	-	-
1998	10,228	76.8	14.0	0.6	4.9	-	2.3	1.2	0.2	-	-
1999	10,404	76.8	13.8	0.5	5.5	-	2.0	1.1	0.2	-	-
2000	10,593	76.0	14.9	0.4	5.1	-	2.5	1.0	0.2	-	-
2001	10,633	77.3	15.1	0.4	2.7	-	1.9	0.9	0.0	-	1.6
2002	11,663	81.2	13.3	0.3	2.5	-	0.6	0.8	0.0	-	1.2
2003	10,976	77.5	15.0	0.4	3.2	-	1.6	0.8	0.0	-	1.6
2004	11,410	78.4	14.1	0.4	2.9	-	1.9	0.8	0.1	-	1.5
2005	11,523	78.7	14.2	0.4	2.7	-	1.9	0.8	0.1	-	1.3
2006	11,559	78.3	13.4	0.4	2.8	-	1.8	1.0	0.7	-	1.5
2007	11,533	77.3	13.7	0.4	2.5	-	2.0	0.8	2.1	-	1.3
2008	11,376	76.2	14.5	0.3	2.7	-	2.1	0.7	2.1	0.00	1.4
2009	11,011	75.3	13.6	0.2	2.6	-	1.5	1.0	2.3	0.01	3.5
2010	10,836	74.6	14.3	0.2	2.6	0.0	1.9	0.6	2.4	0.02	3.4
2011	10,723	73.9	13.3	0.3	2.9	-	2.1	0.9	3.2	0.03	3.4
2012	10,469	71.5	14.7	0.4	2.7	-	2.5	1.1	3.6	0.04	3.5
2013	10,267	70.3	13.7	0.4	3.2	-	2.7	0.8	4.9	0.19	3.8
2014	10,204	67.9	14.8	0.6	3.3	-	2.5	0.9	5.7	0.38	4.0

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
2/ Does not include customer-sited solar.
Source: Energy Information Administration, State Energy Data System

From 1990 to 2014, the share of petroleum generated electricity in Hawaii (including both utility and non-utility producers) decreased from 90.0 percent to 67.9 percent; the share of coal generated electricity increased from 0.0 percent to 14.8 percent; the share of wind generated electricity increased from 0.3 percent to 5.9 percent; the share of geothermal electricity increased from 0.0 to 2.5 percent; and the share of biomass decreased from 8.7 percent to 3.3 percent (Table 6). In 2014, total renewable electricity (excluding customer-sited solar) accounted for about 12.7 percent of total electricity generation.

Since most of the non-petroleum generated electricity was produced by non-utility producers, the petroleum price fluctuations had less of an impact on the average cost of purchased electricity compared with utility generated electricity. As shown in Table 7, almost all electricity generated from the utilities was from petroleum fuel. From 1990 to 2014, the petroleum generated electricity share of total utility generated electricity decreased from 99.6 percent to 94.9 percent. Over the same period, the utility petroleum generated electricity share of total petroleum generated electricity decreased from 91.2 percent to 75.6 percent.

Table 7. Electricity Generation by Source: Electric Utilities

	Total Electricity Generation	% of Total Electricity Generation									
Year	GWH	Petroleum	Coal	Other Gases 1/	Biomass	Wood	Geothermal	Hydro	Wind	Solar 2/	Other
1990	7,996	99.6	-	-	0.1	-	-	0.3	-	-	-
1991	7,333	99.7	-	-	-	-	-	0.3	-	-	-
1992	6,861	99.9	-	-	-	-	-	0.1	-	-	-
1993	6,084	99.8	-	-	-	-	-	0.2	-	-	-
1994	6,055	99.7	-	-	-	-	-	0.3	-	-	-
1995	6,191	99.7	-	-	-	-	-	0.3	-	-	-
1996	6,420	99.7	-	-	-	-	-	0.3	-	-	-
1997	6,213	99.7	-	-	-	-	-	0.3	-	-	-
1998	6,301	99.8	-	-	-	-	-	0.2	0.00	-	-
1999	6,452	99.6	-	-	-	-	-	0.3	0.06	-	-
2000	6,535	99.7	-	-	-	-	-	0.2	0.04	-	-
2001	6,383	99.7	-	-	-	-	-	0.3	0.03	-	-
2002	7,513	99.9	-	-	-	-	-	0.1	0.02	-	-
2003	6,493	99.9	-	-	-	-	-	0.0	0.02	-	-
2004	6,982	99.8	-	-	-	-	-	0.1	0.02	-	-
2005	6,915	99.8	-	-	-	-	-	0.1	0.02	-	-
2006	7,040	99.7	-	-	-	-	-	0.3	0.01	-	-
2007	6,928	99.8	-	-	-	-	-	0.2	0.01	-	-
2008	6,701	99.7	-	-	-	-	-	0.3	0.00	-	-
2009	6,510	96.2	-	-	0.1	-	-	0.4	0.00	-	3.3
2010	6,416	96.3	-	-	0.0	-	-	0.3	-	-	3.4
2011	6,376	95.8	-	-	0.6	-	-	0.3	-	-	3.3
2012	6,013	95.6	-	-	0.4	-	-	0.5	-	-	3.6
2013	5,748	95.6	-	-	0.5	-	-	0.3	-	-	3.6
2014	5,517	94.9	-	-	0.7	-	-	0.4	-	0.2	3.8

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

2/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

From 1990 to 2014, the petroleum generated electricity share of non-utility generated electricity decreased from 45.0 percent to 36.1 percent; the share of coal generated electricity increased from 0.1 percent to 32.2 percent; the share of wind generated electricity increased from 1.7 percent to 12.3 percent; the share of geothermal electricity increased from 0.0 to 5.4 percent; and the share of biomass decreased from 48.9 percent to 6.3 percent.

The increased share of non-petroleum generated electricity, especially coal-fired electricity, kept the growth rate of purchased electricity costs low. For example, the average cost of coal-fired electricity purchased by HECO was only about 10 cents per kWh and this was substantially below the average price of HECO electricity.

Table 8. Electricity Generation by Source: IPP & CHP

Year	Total Electricity Generation GWH	% of Total Electricity Generation									
		Petroleum	Coal	Other Gases 1/	Biomass	Wood	Geothermal	Hydro	Wind	Solar 2/	Other
1990	1,707	45.0	0.1	0.9	48.9	-	-	3.3	1.7	-	-
1991	1,370	29.3	0.6	3.8	60.1	-	-	3.7	2.6	-	-
1992	2,983	49.7	18.7	2.1	27.0	0.0	0.1	1.7	0.8	-	-
1993	3,860	34.3	38.3	1.6	20.1	0.0	3.9	1.1	0.6	-	-
1994	4,054	39.6	32.7	1.6	18.0	0.0	4.6	3.0	0.5	-	-
1995	4,113	36.6	38.0	1.7	15.5	0.0	5.7	2.0	0.5	-	0.1
1996	4,208	37.1	39.0	1.4	14.1	0.0	5.8	2.0	0.5	-	-
1997	4,100	36.5	38.4	1.6	14.8	0.0	6.0	2.4	0.4	-	-
1998	3,927	39.8	36.5	1.5	12.8	-	6.0	2.7	0.5	-	-
1999	3,952	39.6	36.4	1.3	14.6	-	5.3	2.4	0.3	-	-
2000	4,059	37.8	38.9	1.0	13.3	-	6.5	2.2	0.4	-	-
2001	4,250	43.8	37.8	0.9	6.8	-	4.9	1.9	0.0	-	4.0
2002	4,150	47.3	37.2	1.0	7.1	-	1.8	2.1	0.0	-	3.5
2003	4,483	44.9	36.7	0.9	7.7	-	4.0	2.0	0.0	-	3.8
2004	4,428	44.6	36.2	1.1	7.4	-	4.8	1.9	0.1	-	3.9
2005	4,608	47.0	35.4	0.9	6.7	-	4.8	1.9	0.1	-	3.2
2006	4,519	45.1	34.3	0.9	7.2	-	4.7	2.1	1.7	-	3.9
2007	4,605	43.5	34.3	1.0	6.2	-	5.0	1.7	5.2	-	3.2
2008	4,676	42.5	35.2	0.8	6.5	-	5.0	1.4	5.1	0.00	3.4
2009	4,501	45.0	33.3	0.5	6.2	-	3.7	1.9	5.6	0.03	3.7
2010	4,420	43.2	35.0	0.5	6.4	0.0	4.5	1.2	5.9	0.04	3.3
2011	4,347	41.8	32.8	0.8	6.3	-	5.2	1.7	7.8	0.08	3.6
2012	4,457	39.0	34.5	1.1	5.8	-	5.9	1.9	8.5	0.10	3.3
2013	4,519	38.2	31.1	0.9	6.7	-	6.1	1.3	11.1	0.43	4.2
2014	4,687	36.1	32.2	1.3	6.3	-	5.4	1.5	12.3	0.62	4.1

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
2/ Does not include customer-sited solar.
Source: Energy Information Administration, State Energy Data System

Based on the most recent data available from EIA, the generating capacity for Hawaii's total electric power industry increased from 1,976 MW in 1990 to 2,924 MW in 2014, an increase of 1.6 percent per year on average. Coal-fired capacity increased from 24 MW to 203 MW or 9.3 percent per year over the period, wind capacity increased from 23 MW to 206 MW or 9.5 percent per year on average, petroleum generation capacity increased from 1,692 MW to 2,081 MW or an average of 0.9 percent over the period, and biomass capacity increased from 211 MW to 257 MW or a 0.9 percent average per year (Table 9).

Table 9. Power Generating Capacity by Source: Total Electric Power Industry

	Power Generating Capacity Units: MW									
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Other	Total
1990	1,692	24	9	211	-	18	23	-	-	1,976
1991	1,910	24	9	204	-	18	23	-	-	2,187
1992	1,947	228	9	230	30	18	23	-	-	2,484
1993	1,976	228	9	222	30	18	23	-	-	2,505
1994	1,976	228	9	206	30	28	23	-	-	2,498
1995	1,976	228	9	193	35	29	22	-	-	2,491
1996	1,984	228	9	193	35	29	22	-	-	2,500
1997	1,972	228	9	178	35	29	20	-	-	2,471
1998	1,997	228	9	164	35	29	20	-	-	2,482
1999	2,007	228	9	156	35	28	9	-	-	2,473
2000	2,091	228	9	155	35	27	12	-	-	2,557
2001	2,093	227	9	151	35	26	11	-	-	2,552
2002	2,093	227	9	110	35	25	11	-	-	2,510
2003	2,089	227	9	114	35	23	11	-	-	2,508
2004	2,178	203	9	114	35	23	11	-	-	2,573
2005	2,192	203	9	114	35	25	11	-	-	2,589
2006	2,220	203	9	114	35	25	43	-	-	2,649
2007	2,224	203	9	114	35	25	64	-	-	2,674
2008	2,224	203	9	114	35	25	64	1	-	2,675
2009	2,242	203	9	227	35	25	64	1	-	2,806
2010	2,214	203	9	227	35	25	62	2	-	2,777
2011	2,214	203	12	227	35	25	92	2	-	2,810
2012	2,181	203	6	227	51	26	206	7	75	2,982
2013	2,181	203	6	260	51	26	206	15	60	3,008
2014	2,081	203	7	257	51	26	206	32	60	2,924

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

Table 10 shows that the generating capacity of the utilities increased from 1,542 MW in 1990 to 1,857 MW in 2014, an increase of 0.8 percent per year on average. The generating capacity added by the utilities from 1990 to 2014 was mainly petroleum and biomass-fired (utilizing biodiesel) capacity. In 2015, the average cost of biodiesel for HECO was about 45 cents per kWh, slightly higher than the HECO average cost of diesel at about 43 cents per kWh.

Table 10. Power Generating Capacity by Source: Electric Utilities

	Power Generating Capacity Units: MW									
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Other	Total
1990	1,538	-	-	-	-	3	-	-	-	1,542
1991	1,574	-	-	-	-	3	-	-	-	1,577
1992	1,617	-	-	-	-	3	-	-	-	1,621
1993	1,655	-	-	-	-	3	-	-	-	1,659
1994	1,655	-	-	-	-	3	-	-	-	1,659
1995	1,655	-	-	-	-	3	-	-	-	1,659
1996	1,664	-	-	-	-	3	-	-	-	1,667
1997	1,652	-	-	-	-	3	-	-	-	1,655
1998	1,677	-	-	-	-	3	-	-	-	1,680
1999	1,687	-	-	-	-	3	-	-	-	1,690
2000	1,705	-	-	-	-	3	2	-	-	1,710
2001	1,703	-	-	-	-	3	2	-	-	1,708
2002	1,702	-	-	-	-	2	2	-	-	1,706
2003	1,702	-	-	-	-	2	2	-	-	1,706
2004	1,791	-	-	-	-	2	2	-	-	1,795
2005	1,806	-	-	-	-	4	2	-	-	1,812
2006	1,833	-	-	-	-	4	2	-	-	1,839
2007	1,838	-	-	-	-	4	2	-	-	1,844
2008	1,838	-	-	-	-	4	2	-	-	1,844
2009	1,856	-	-	113	-	4	2	-	-	1,975
2010	1,827	-	-	113	-	4	-	-	-	1,944
2011	1,827	-	-	113	-	4	-	-	-	1,945
2012	1,788	-	-	113	-	4	-	-	39	1,945
2013	1,788	-	-	113	-	4	-	-	39	1,945
2014	1,688	-	-	113	-	4	-	12	39	1,857

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

Table 11 shows that the generating capacity of the non-utility producers in Hawaii increased from 435 MW in 1990 to 1,067 MW in 2014, an increase of 3.8 percent per year on average. The growth rate of wind capacity was the highest during this period at 9.5 percent on average per year. Wind was followed by coal-fired capacity at 9.3 percent per year and petroleum capacity at 4.0 percent per year. Geothermal capacity increased from zero to 51 MW, but the biomass capacity decreased from 211 MW to 144 MW over the period. The figures do not include electricity generation from the customer-sited solar systems.

Table 11. Power Generating Capacity by Source: IPP and CHP

	Power Generating Capacity Units: MW									
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Other	Total
1990	154	24	9	211	-	15	23	-	-	435
1991	337	24	9	204	-	15	23	-	-	610
1992	329	228	9	230	30	15	23	-	-	863
1993	320	228	9	222	30	15	23	-	-	846
1994	320	228	9	206	30	24	23	-	-	839
1995	320	228	9	193	35	26	22	-	-	832
1996	320	228	9	193	35	26	22	-	-	833
1997	320	228	9	178	35	26	20	-	-	816
1998	320	228	9	164	35	26	20	-	-	802
1999	320	228	9	156	35	25	9	-	-	782
2000	386	228	9	155	35	24	10	-	-	847
2001	390	227	9	151	35	23	9	-	-	844
2002	391	227	9	110	35	23	9	-	-	804
2003	387	227	9	114	35	21	9	-	-	802
2004	387	203	9	114	35	21	9	-	-	778
2005	386	203	9	114	35	21	9	-	-	777
2006	387	203	9	114	35	21	41	-	-	810
2007	386	203	9	114	35	21	62	-	-	830
2008	386	203	9	114	35	21	62	1	-	831
2009	386	203	9	114	35	21	62	1	-	831
2010	387	203	9	114	35	21	62	2	-	833
2011	386	203	12	114	35	21	92	2	-	865
2012	393	203	6	114	51	22	206	7	36	1,037
2013	393	203	6	147	51	22	206	15	21	1,064
2014	393	203	7	144	51	22	206	20	21	1,067

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

The detailed power generating capacity by county in 2016 is provided in Table 12. Currently, the state of Hawaii has about 2,408.8 MW firm capacity (guaranteed available at a given time); 1,726.5 MW in Honolulu, 278.9 MW in Hawaii County, 278.1 MW in Maui County, and 125.3 MW in Kauai County. About 83.0 percent of the firm capacity use petroleum, 7.5 percent use coal, and 8.0 percent use biofuel or waste.

The state also installed about 267.0 MW non-firm capacity, mostly by non-utility producers; 138.1 MW in Honolulu, 47.5 MW in Hawaii County, 73.7 MW in Maui County, and 7.7 MW in Kauai County. Wind accounted for about 75.7 percent of the non-firm capacity; followed by hydro at 9.2 percent, petroleum at 6.9 percent, and solar at 4.6 percent. In addition, about 491.4 MW customer-sited solar was installed in Hawaii; 332.0 MW in Honolulu, 70.1 MW in Hawaii County, 72.4 MW in Maui County, and 16.9 MW in Kauai County. Most of the electricity generated by these systems were directly consumed by the consumers and not included in the utility electricity sales.

Table 12. Power Generating Capacity by Type in 2016

	Petroleum	Coal	Other Gases	Biofuel Waste	Geothermal	Hydro	Wind	Solar	Total
State Total MW	2,018.9	180.0	9.6	192.5	34.6	26.0	202.1	12.2	2,675.8
State Total Firm MW	2,000.4	180.0	-	192.5	34.6	1.3	-	-	2,408.8
State Total Non-Firm MW	18.5	-	9.6	-	-	24.7	202.1	12.2	267.0
State Total Customer-Sited Solar	-	-	-	-	-	-	-	491.4	491.4
State Total MW	2,018.9	180.0	9.6	192.5	34.6	26.0	202.1	12.2	2,675.8
Honolulu	1,376.5	180.0	9.6	188.5	-	-	99.0	11.0	1,864.6
Hawaii	244.3	-	-	-	34.6	16.5	31.1	-	326.4
Maui	274.1	-	-	4.0	-	0.5	72.0	1.2	351.8
Kauai	124.0	-	-	-	-	9.0	-	-	133.0
State Total Firm MW	2,000.4	180.0	-	192.5	34.6	1.3	-	-	2,408.8
Honolulu	1,358.0	180.0	-	188.5	-	-	-	-	1,726.5
Hawaii	244.3	-	-	-	34.6	-	-	-	278.9
Maui	274.1	-	-	4.0	-	-	-	-	278.1
Kauai	124.0	-	-	-	-	1.3	-	-	125.3
State Total Non-Firm MW	18.5	-	9.6	-	-	24.7	202.1	12.2	267.0
Honolulu	18.5	-	9.6	-	-	-	99.0	11.0	138.1
Hawaii	-	-	-	-	-	16.5	31.1	-	47.5
Maui	-	-	-	-	-	0.5	72.0	1.2	73.7
Kauai	-	-	-	-	-	7.7	-	-	7.7
State Total Customer-Sited Solar	-	-	-	-	-	-	-	491.4	491.4
Honolulu	-	-	-	-	-	-	-	332.0	332.0
Hawaii	-	-	-	-	-	-	-	70.1	70.1
Maui	-	-	-	-	-	-	-	72.4	72.4
Kauai	-	-	-	-	-	-	-	16.9	16.9

Source: Power Facts provided by HECO and KIUC.

The generating units in the electric power industry have multiple functions. Some generating units are used to serve base load needs, while others are used to serve peak loads. Units serving the base load needs have more average operating hours per year, and the average cost per kWh is normally lower than the average cost of the units serving peak loads.

Table 13. Average Operating Hours: Total Electric Power Industry

	Average Operating Hours Units: Hours/Year								
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Total
1990	5,163	100	1,796	3,990	-	4,418	1,245	-	4,909
1991	4,038	320	5,720	4,044	-	3,944	1,580	-	3,979
1992	4,281	2,443	6,933	3,508	71	3,396	1,006	-	3,964
1993	3,743	6,493	7,008	3,500	5,075	3,125	973	-	3,970
1994	3,868	5,824	7,302	3,553	6,177	5,052	902	-	4,047
1995	3,887	6,853	7,701	3,308	6,701	3,384	932	-	4,136
1996	4,014	7,213	6,707	3,066	6,914	3,600	1,023	-	4,252
1997	3,899	6,913	7,265	3,403	7,011	3,950	792	-	4,173
1998	3,931	6,299	6,716	3,073	6,774	4,196	952	-	4,121
1999	3,983	6,322	5,501	3,696	6,024	4,046	1,783	-	4,208
2000	3,851	6,924	4,686	3,473	7,487	3,832	1,417	-	4,143
2001	3,929	7,069	4,206	1,905	5,903	3,875	193	-	4,167
2002	4,523	6,810	4,535	2,696	2,079	3,803	147	-	4,647
2003	4,070	7,243	4,472	3,045	5,094	3,935	143	-	4,377
2004	4,107	7,900	5,323	2,884	6,094	4,083	681	-	4,435
2005	4,137	8,034	4,570	2,717	6,331	3,848	603	-	4,451
2006	4,079	7,629	4,751	2,857	6,065	4,803	1,853	-	4,364
2007	4,008	7,778	5,025	2,502	6,568	3,694	3,722	-	4,313
2008	3,898	8,116	4,286	2,653	6,695	3,374	3,750	18	4,253
2009	3,697	7,390	2,483	1,253	4,788	4,506	3,929	1,390	3,924
2010	3,653	7,613	2,435	1,249	5,731	2,817	4,212	885	3,902
2011	3,579	7,015	2,889	1,378	6,397	3,741	3,721	1,633	3,817
2012	3,431	7,573	7,839	1,239	5,118	4,373	1,840	640	3,511
2013	3,312	6,915	6,888	1,265	5,389	2,988	2,448	1,281	3,413
2014	3,328	7,444	8,639	1,298	4,977	3,591	2,814	1,219	3,490

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

For the total electric power industry in 2014, other gases-fueled units had the highest average operating hours at 8,639 hours per year, followed by coal-fired units at 7,444 hours per year, and geothermal units at 4,977 hours per year (Table 13). The coal and geothermal units were used to serve base load needs. Hydro and petroleum units have average operating hours of around 3,300-3,600 hours per year, similar to the average operating hours of all units at 3,490 hours per year. Biomass units have relatively low average operating hours because the biodiesel units at HECO are used to serve peak loads. The low average operating hours of solar units is due to the lower daily solar generating window.

Table 14. Average Operating Hours: Electric Utilities

	Average Operating Hours Units: Hours/Year								
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Total
1990	5,180	-	-	-	-	6,789	-	-	5,187
1991	4,647	-	-	-	-	6,090	-	-	4,650
1992	4,236	-	-	-	-	2,932	-	-	4,233
1993	3,667	-	-	-	-	4,105	-	-	3,668
1994	3,646	-	-	-	-	5,613	-	-	3,650
1995	3,730	-	-	-	-	4,763	-	-	3,732
1996	3,848	-	-	-	-	5,333	-	-	3,851
1997	3,749	-	-	-	-	5,609	-	-	3,753
1998	3,749	-	-	-	-	4,104	-	-	3,750
1999	3,811	-	-	-	-	5,625	-	-	3,817
2000	3,822	-	-	-	-	5,038	1,325	-	3,821
2001	3,736	-	-	-	-	6,044	1,055	-	3,737
2002	4,408	-	-	-	-	4,267	803	-	4,404
2003	3,813	-	-	-	-	1,039	781	-	3,806
2004	3,892	-	-	-	-	4,862	743	-	3,890
2005	3,823	-	-	-	-	2,292	849	-	3,816
2006	3,828	-	-	-	-	5,914	420	-	3,828
2007	3,761	-	-	-	-	3,682	219	-	3,757
2008	3,636	-	-	-	-	4,468	86	-	3,634
2009	3,374	-	-	29	-	7,152	43	-	3,296
2010	3,382	-	-	14	-	4,180	-	-	3,300
2011	3,342	-	-	343	-	4,878	-	-	3,279
2012	3,213	-	-	191	-	7,059	-	-	3,092
2013	3,073	-	-	252	1	4,625	-	-	2,956
2014	3,101	-	-	324	2	5,742	-	-	2,972

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

Table 14 and Table 15 compare the average operating hours of utility generating units and non-utility generating units. For all generating capacity, the average operating hours of utility-based units decreased from 5,187 hours per year in 1990 to 2,972 hours per year in 2014, a decrease of 2.3 percent per year on average. In contrast, the average operating hours of non-utility units increased from 3,925 hours per year in 1990 to 4,392 hours per year in 2014, an increase of 0.5 percent per year on average.

Table 15. Average Operating Hours: IPP and CHP

	Average Operating Hours Units: Hours/Year								
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar 1/	Total
1990	5,000	100	1,796	3,962	-	3,875	1,245	-	3,925
1991	1,193	320	5,720	4,044	-	3,453	1,580	-	2,245
1992	4,503	2,443	6,933	3,508	71	3,502	1,006	-	3,458
1993	4,134	6,493	7,008	3,500	5,075	2,900	973	-	4,561
1994	5,011	5,824	7,302	3,553	6,177	4,974	902	-	4,830
1995	4,697	6,853	7,701	3,308	6,701	3,204	932	-	4,941
1996	4,874	7,213	6,707	3,066	6,914	3,372	1,023	-	5,054
1997	4,669	6,913	7,265	3,403	7,011	3,735	792	-	5,023
1998	4,884	6,299	6,716	3,073	6,774	4,208	937	-	4,897
1999	4,890	6,322	5,501	3,696	6,024	3,835	1,373	-	5,051
2000	3,976	6,924	4,686	3,473	7,487	3,681	1,435	-	4,792
2001	4,772	7,069	4,206	1,905	5,903	3,592	1	-	5,036
2002	5,023	6,810	4,535	2,696	2,079	3,762	1	-	5,162
2003	5,202	7,243	4,472	3,045	5,094	4,211	1	-	5,590
2004	5,099	7,900	5,323	2,884	6,094	4,008	668	-	5,691
2005	5,604	8,034	4,570	2,717	6,331	4,144	548	-	5,930
2006	5,267	7,629	4,751	2,857	6,065	4,592	1,923	-	5,579
2007	5,184	7,778	5,025	2,502	6,568	3,696	3,835	-	5,548
2008	5,149	8,116	4,286	2,653	6,695	3,165	3,869	18	5,627
2009	5,251	7,390	2,483	2,466	4,788	4,002	4,054	1,390	5,416
2010	4,932	7,613	2,435	2,472	5,731	2,557	4,212	885	5,306
2011	4,703	7,015	2,889	2,407	6,397	3,516	3,721	1,633	5,025
2012	4,423	7,573	7,839	2,279	5,118	3,875	1,840	640	4,296
2013	4,400	6,915	6,888	2,041	5,389	2,685	2,448	1,281	4,247
2014	4,304	7,444	8,639	2,060	4,977	3,192	2,814	1,428	4,392

1/ Does not include customer-sited solar.

Source: Energy Information Administration, State Energy Data System

For petroleum generating capacity, the average operating hours of utility-based units decreased from 5,180 hours per year in 1990 to 3,101 hours per year in 2014, an average decrease of 2.1 percent per year. The average operating hours of non-utility units decreased from 5,000 hours per year in 1990 to 4,304 hours per year in 2014, an average decrease of 0.6 percent per year.

Table 16. Fossil Fuel Consumption by All Electricity Producers

	Consumption			Consumption Per MWH		
Year	Petroleum BBL	Coal ST	Other Gases Billion BTU	Petroleum BBL	Coal ST	Other Gases Billion BTU
1990	16,033,262	2,013	211	1.84	0.85	0.01
1993	12,605,395	603,669	1,044	1.70	0.41	0.02
1994	12,933,103	596,431	913	1.69	0.45	0.01
1995	13,034,983	688,499	663	1.70	0.44	0.01
1996	13,451,479	742,026	1,027	1.69	0.45	0.02
1997	13,226,872	754,453	622	1.72	0.48	0.01
1998	13,262,910	638,057	811	1.69	0.44	0.01
1999	13,544,370	646,215	447	1.69	0.45	0.01
2000	13,754,387	691,513	388	1.71	0.44	0.01
2001	13,661,310	717,290	315	1.66	0.45	0.01
2002	15,661,770	706,734	325	1.65	0.46	0.01
2003	13,133,452	751,987	361	1.54	0.46	0.01
2004	13,995,473	702,545	269	1.56	0.44	0.01
2005	14,131,327	703,865	231	1.56	0.43	0.01
2006	14,211,287	674,909	240	1.57	0.44	0.01
2007	13,943,232	689,627	254	1.56	0.44	0.01
2008	13,407,277	746,642	213	1.55	0.45	0.01
2009	12,739,777	663,171	126	1.54	0.44	0.01
2010	12,334,599	733,480	123	1.53	0.47	0.01
2011	12,089,799	709,440	198	1.53	0.50	0.01
2012	11,199,945	756,726	265	1.50	0.49	0.01
2013	10,765,251	701,013	228	1.49	0.50	0.01
2014	10,388,099	743,893	350	1.50	0.49	0.01

Source: Energy Information Administration, State Energy Data System

Fossil fuels used to generate electricity in Hawaii consist mainly of petroleum and coal. As shown in Table 16, for the whole electric power industry, total petroleum used for electricity generation decreased from about 16.0 million barrels (BBLs) in 1990 to 10.4 million BBLs in 2014, an average decrease of 1.8 percent per year. Decreased petroleum consumption for electricity generation was due to both a reduction in electricity generated by petroleum and a reduction in petroleum consumption per kWh of electricity generated. From 1990 to 2014, total electricity generated by petroleum decreased an average of 1.0 percent per year and petroleum consumption per MWH of electricity decreased 0.8 percent per year, from 1.84 BBL per MWH in 1990 to 1.50 BBL per MWH in 2014.

Coal used for electricity generation in Hawaii was very limited before 1993. From 1993 to 2014, total coal used for electricity generation increased from 603,669 short tons (STs) to 743,893 STs, an average increase of 1.0 percent per year. During this period, total coal generated electricity increased 0.1 percent per year, and coal consumption per MWH generated increased 0.9 percent per year on average from 0.41 ST per MWH to 0.49 ST per MWH.

The utilities accounted for about 86 percent of the petroleum used to generate electricity in Hawaii. As shown in Table 17, petroleum consumption per MWH was fairly stable over the period analyzed for utility units. From 1990 to 2014, petroleum consumption per MWH decreased only slightly from 1.73 BBL per MWH to 1.70 BBL per MWH.

For non-utility producers, petroleum consumption per MWH produced decreased significantly over time. From 1990 to 2014, petroleum consumption per MWH decreased an average of 4.9 percent per year from 2.95 BBL to 0.89 BBL. In 2014, the per unit petroleum consumption for non-utility producers was only about 52 percent of the unit consumption by utility producers.

Table 17. Fossil Fuel Consumption by Electric Utility

	Consumption			Consumption Per MWH		
Year	Petroleum BBL	Coal ST	Other Gases Billion BTU	Petroleum BBL	Coal ST	Other Gases Billion BTU
1990	13,769,448	-	-	1.73	-	-
1995	10,712,608	-	-	1.73	-	-
1996	10,980,227	-	-	1.72	-	-
1997	10,792,923	-	-	1.74	-	-
1998	10,864,385	-	-	1.73	-	-
1999	11,195,221	-	-	1.74	-	-
2000	11,439,206	-	-	1.76	-	-
2001	11,055,880	-	-	1.74	-	-
2002	12,825,449	-	-	1.71	-	-
2003	11,099,634	-	-	1.71	-	-
2004	12,046,236	-	-	1.73	-	-
2005	12,039,252	-	-	1.74	-	-
2006	12,238,861	-	-	1.74	-	-
2007	12,027,927	-	-	1.74	-	-
2008	11,516,852	-	-	1.72	-	-
2009	10,859,417	-	-	1.73	-	-
2010	10,601,260	-	-	1.72	-	-
2011	10,471,897	-	-	1.71	-	-
2012	9,646,276	-	-	1.68	-	-
2013	9,267,226	-	-	1.69	-	-
2014	8,892,659	-	-	1.70	-	-

Source: Energy Information Administration, State Energy Data System

Table 18. Fossil Fuel Consumption by IPP and CHP

	Consumption			Consumption Per MWH		
Year	Petroleum BBL	Coal ST	Other Gases Billion BTU	Petroleum BBL	Coal ST	Other Gases Billion BTU
1990	2,263,814	2,013	211	2.95	0.85	0.01
1993	1,949,294	603,669	1,044	1.47	0.41	0.02
1994	2,524,020	596,431	913	1.57	0.45	0.01
1995	2,322,375	688,499	663	1.54	0.44	0.01
1996	2,471,252	742,026	1,027	1.58	0.45	0.02
1997	2,433,949	754,453	622	1.63	0.48	0.01
1998	2,398,525	638,057	811	1.53	0.44	0.01
1999	2,349,149	646,215	447	1.50	0.45	0.01
2000	2,315,181	691,513	388	1.51	0.44	0.01
2001	2,605,430	717,290	315	1.40	0.45	0.01
2002	2,836,321	706,734	325	1.44	0.46	0.01
2003	2,033,818	751,987	361	1.01	0.46	0.01
2004	1,949,237	702,545	269	0.99	0.44	0.01
2005	2,092,075	703,865	231	0.97	0.43	0.01
2006	1,972,426	674,909	240	0.97	0.44	0.01
2007	1,915,305	689,627	254	0.96	0.44	0.01
2008	1,890,425	746,642	213	0.95	0.45	0.01
2009	1,880,360	663,171	126	0.93	0.44	0.01
2010	1,733,339	733,480	123	0.91	0.47	0.01
2011	1,617,902	709,440	198	0.89	0.50	0.01
2012	1,553,669	756,726	265	0.89	0.49	0.01
2013	1,498,025	701,013	228	0.87	0.50	0.01
2014	1,495,440	743,893	350	0.89	0.49	0.01

Source: Energy Information Administration, State Energy Data System

Fuel consumption data provided by the EIA is only available at the state level, and the most recent data available is for 2014. Conversely, data available from the utility MFR includes fuel consumption by individual utility producers, and the average price of fuel data is available up to 2015. The fuel cost of non-utility producers, however, is not available in the utility MFR.

As shown in Table 19, from 2005 to 2015, total petroleum consumption by the four electric utilities in Hawaii decreased an average 2.6 percent per year from about 12.0 million BBLs to about 9.2 million BBLs; fuel oil consumption decreased an average 2.9 percent per year from 9.1 million BBLs to 6.8 million BBLs; diesel oil (excluding biodiesel) consumption decreased an average 1.7 percent per year from 2.9 million BBLs to 2.5 million BBLs. In 2015, petroleum consumption by the utilities decreased 0.4 percent from the previous year; fuel oil decreased 1.5 percent, while diesel increased 2.6 percent.

Table 19. Hawaii Utility Fuel Consumption

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Petroleum										
State Total	BBL	12,046,758	12,045,419	11,244,809	10,873,734	9,633,073	9,265,797	9,228,096	-0.4%	-2.6%
HECO	BBL	7,993,010	8,195,607	7,555,082	7,312,962	6,408,203	6,167,276	6,213,113	0.7%	-2.5%
HELCO	BBL	1,136,268	1,067,210	1,089,738	1,031,711	997,659	965,542	909,157	-5.8%	-2.2%
MECO	BBL	2,170,554	1,959,432	1,869,575	1,806,667	1,539,175	1,480,580	1,477,603	-0.2%	-3.8%
KIUC	BBL	746,926	823,170	730,414	722,394	688,036	652,399	628,223	-3.7%	-1.7%
Fuel Oil										
State Total	BBL	9,120,687	9,358,136	8,617,627	8,263,907	7,207,891	6,867,426	6,766,206	-1.5%	-2.9%
HECO	BBL	7,874,530	8,098,475	7,411,899	7,285,178	6,391,243	6,112,576	6,139,949	0.4%	-2.5%
HELCO	BBL	726,866	787,051	734,535	577,107	533,483	458,212	387,475	-15.4%	-6.1%
MECO	BBL	519,291	472,610	471,193	401,622	283,165	296,638	238,782	-19.5%	-7.5%
KIUC	BBL	-	-	-	-	-	-	-		
Diesel										
State Total	BBL	2,926,071	2,687,283	2,627,182	2,609,827	2,425,182	2,398,371	2,461,890	2.6%	-1.7%
HECO	BBL	118,480	97,132	143,183	27,784	16,960	54,700	73,164	33.8%	-4.7%
HELCO	BBL	409,402	280,159	355,203	454,604	464,176	507,330	521,682	2.8%	2.5%
MECO	BBL	1,651,263	1,486,822	1,398,382	1,405,045	1,256,010	1,183,942	1,238,821	4.6%	-2.8%
KIUC	BBL	746,926	823,170	730,414	722,394	688,036	652,399	628,223	-3.7%	-1.7%
% of Fuel Oil										
State Total	%	75.7%	77.7%	76.6%	76.0%	74.8%	74.1%	73.3%		
HECO	%	98.5%	98.8%	98.1%	99.6%	99.7%	99.1%	98.8%		
HELCO	%	64.0%	73.7%	67.4%	55.9%	53.5%	47.5%	42.6%		
MECO	%	23.9%	24.1%	25.2%	22.2%	18.4%	20.0%	16.2%		
KIUC	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
County % of Fuel Oil										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	86.3%	86.5%	86.0%	88.2%	88.7%	89.0%	90.7%		
HELCO	%	8.0%	8.4%	8.5%	7.0%	7.4%	6.7%	5.7%		
MECO	%	5.7%	5.1%	5.5%	4.9%	3.9%	4.3%	3.5%		
KIUC	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
County % of Diesel										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	4.0%	3.6%	5.5%	1.1%	0.7%	2.3%	3.0%		
HELCO	%	14.0%	10.4%	13.5%	17.4%	19.1%	21.2%	21.2%		
MECO	%	56.4%	55.3%	53.2%	53.8%	51.8%	49.4%	50.3%		
KIUC	%	25.5%	30.6%	27.8%	27.7%	28.4%	27.2%	25.5%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 19 also shows that the fuel oil share of total petroleum consumption for electricity production decreased from 75.7 percent in 2005 to 73.3 percent in 2015. For HECO, almost all the petroleum consumed was fuel oil. Fuel oil also accounted for about 42.6 percent of total petroleum consumption at HELCO in 2015. Fuel oil only accounted for about 16.2 percent of total petroleum consumption at MECO and all petroleum consumed at KIUC was diesel.

From 2005 to 2012, both total fuel oil cost and total diesel oil cost paid by the utilities in Hawaii increased significantly, although consumption of both fuels decreased. The growth rate of fuel oil costs was significantly higher than the growth rate of diesel costs.

Table 20. Hawaii Utility Fuel Cost

		2005	2007	2009	2011	2012	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Petroleum											
State Total	$M	694	850	724	1,339	1,373	1,259	1,193	682	-42.8%	-0.2%
HECO	$M	421	526	460	892	926	833	798	434	-45.5%	0.3%
HELCO	$M	65	75	74	122	117	126	117	72	-38.7%	1.0%
MECO	$M	154	174	137	234	235	209	193	125	-35.5%	-2.1%
KIUC	$M	54	76	52	91	94	92	84	51	-39.6%	-0.6%
Fuel Oil											
State Total	$M	467	592	519	993	1,033	922	868	465	-46.5%	-0.1%
HECO	$M	412	516	447	889	924	831	790	428	-45.9%	0.4%
HELCO	$M	33	48	44	62	65	60	48	24	-50.7%	-3.4%
MECO	$M	22	28	28	42	44	31	30	13	-55.0%	-5.0%
KIUC	$M	-	-	-	-	-	-	-	-		
Diesel											
State Total	$M	226	258	205	346	339	338	325	217	-33.1%	-0.4%
HECO	$M	9	9	13	3	2	2	7	7	-8.6%	-2.9%
HELCO	$M	32	27	30	60	52	66	69	48	-30.4%	4.2%
MECO	$M	132	145	110	192	191	178	164	111	-31.9%	-1.7%
KIUC	$M	54	76	52	91	94	92	84	51	-39.6%	-0.6%
% of Fuel Oil											
State Total	%	67.4%	69.6%	71.7%	74.2%	75.3%	73.2%	72.8%	68.1%		
HECO	%	97.9%	98.2%	97.2%	99.7%	99.8%	99.7%	99.1%	98.4%		
HELCO	%	51.2%	63.5%	59.1%	50.6%	55.4%	47.5%	40.8%	32.8%		
MECO	%	14.5%	16.2%	20.3%	18.0%	18.7%	14.7%	15.3%	10.7%		
KIUC	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Source: Hawaii Electric Utility Monthly Financial Reports.

From 2005 to 2012, total petroleum costs for Hawaii's utilities increased an average 10.2 percent per year from $694 million to $1,373 million; fuel oil costs increased an average 12.0 percent per year from $467 million to $1,033 million; diesel oil costs increased an average 6.0 percent per year from $226 million to $339 million (Table 20). Due to the faster growth of fuel oil expenditures, the fuel oil share of total utility petroleum expenditures increased from 67.4 percent in 2005 to 75.3 percent in 2012, an increase of 7.9 percentage points.

Since 2012, however, the costs of fuel oil and diesel both decreased from the previous year. In 2015, the cost of utility petroleum decreased 42.8 percent or $517 million from the previous year; the cost of fuel oil decreased 46.5 percent or $403.3 million, and the cost of diesel decreased 33.1 percent or $ 107.4 million. The decrease in fuel costs for 2015 was mainly driven by the decrease in petroleum prices.

The average unit cost of petroleum used for utility electricity generation increased rapidly from 2005 to 2012, with the growth rate being significantly higher than the growth rate of crude oil prices. In this period before the decline in oil prices, from 2005 to 2012, the average unit petroleum cost for the four electric utilities in Hawaii increased an average of 13.2 percent per year from $57.57 per BBL to $136.88 per BBL (Table 21). Fuel oil costs increased an average 14.9 percent per year from $51.22 per BBL to $135.72 per BBL, and diesel oil (excluding biodiesel) costs increased an average 8.9 percent per year from $77.36 per BBL to $140.52 per BBL. In comparison, the average crude oil price increased an average 7.6 percent per year during the same period. The unit fuel oil cost decreased 5.8 percent in 2013 and 1.2 percent in 2014 from the previous year, and the unit diesel cost also decreased. In 2015, the unit fuel oil cost decreased 45.7 percent, and the unit diesel cost decreased 34.8 percent from the previous year. In 2015, the unit fuel oil costs were highest at HECO, followed by HELCO and MECO. Unit diesel costs were highest at HELCO, followed by HECO, MECO, and KIUC.

Table 21. Hawaii Utility Average Fuel Cost

		2005	2007	2009	2011	2012	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Petroleum											
State Total	$/BBL	57.57	70.60	64.38	123.11	136.88	130.73	128.71	73.89	-42.6%	2.5%
HECO	$/BBL	52.61	64.13	60.90	121.99	137.86	130.05	129.35	69.92	-45.9%	2.9%
HELCO	$/BBL	57.44	70.24	68.28	118.09	129.27	125.81	121.40	79.03	-34.9%	3.2%
MECO	$/BBL	70.88	88.60	73.54	129.58	138.60	135.57	130.51	84.38	-35.3%	1.8%
KIUC	$/BBL	72.19	92.64	71.13	125.40	133.12	133.37	129.37	81.09	-37.3%	1.2%
Fuel Oil											
State Total	$/BBL	51.22	63.27	60.24	120.15	135.72	127.85	126.38	68.67	-45.7%	3.0%
HECO	$/BBL	52.26	63.75	60.34	122.03	137.88	130.04	129.30	69.65	-46.1%	2.9%
HELCO	$/BBL	45.96	60.50	59.89	106.84	121.43	111.80	104.45	60.89	-41.7%	2.9%
MECO	$/BBL	42.93	59.63	59.24	105.17	117.39	108.67	99.99	55.92	-44.1%	2.7%
KIUC	$/BBL										
Diesel											
State Total	$/BBL	77.36	96.13	77.96	132.48	140.52	139.28	135.38	88.25	-34.8%	1.3%
HECO	$/BBL	76.07	95.67	89.82	112.16	128.37	132.18	134.92	92.15	-31.7%	1.9%
HELCO	$/BBL	77.84	97.63	85.63	132.38	140.56	141.92	136.71	92.51	-32.3%	1.7%
MECO	$/BBL	79.67	97.80	78.36	136.56	144.61	141.64	138.15	89.87	-35.0%	1.2%
KIUC	$/BBL	72.19	92.64	71.13	125.40	133.12	133.37	129.37	81.09	-37.3%	1.2%

Source: Hawaii Electric Utility Monthly Financial Reports.

In recent years, electricity generated from renewable sources has increased significantly. Based on the most recent data provided by the utility Renewable Portfolio Standard Status Reports, from 2005 to 2015, total renewable electricity generated by the electric power industry (excluding customer generated electricity) increased 7.8 percent per year on average, from 714 GWH to 1,518 GWH (Table 22). The renewable electricity share of total electricity sales increased from 6.8 percent to 16.2 percent during this period.

Table 22. Renewable Electricity Generation in Hawaii

	Renewable Electricity Generation (GWH)						
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	PV&Solar 1/
2005	714	403	0	221	82	7	-
2006	861	470	0	212	97	82	-
2007	938	392	1	230	72	242	-
2008	963	413	2	234	78	237	-
2009	930	399	5	168	107	250	1
2010	897	359	3	202	70	261	2
2011	1,096	365	59	233	90	344	4
2012	1,134	342	23	266	104	388	12
2013	1,352	416	30	281	74	504	48
2014	1,457	433	37	255	85	578	68
2015	1,518	422	53	230	107	613	92
Growth 05-15	7.8%	0.5%	87.4%	0.4%	2.6%	56.4%	
	% in Renewable Electricity Generation						
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	PV&Solar 1/
2005	100.0	56.5	0.0	31.0	11.6	1.0	-
2006	100.0	54.6	0.0	24.6	11.3	9.5	-
2007	100.0	41.8	0.1	24.5	7.7	25.9	-
2008	100.0	42.8	0.2	24.3	8.1	24.6	-
2009	100.0	42.9	0.5	18.0	11.5	26.9	0.1
2010	100.0	40.0	0.4	22.5	7.8	29.1	0.2
2011	100.0	33.3	5.4	21.3	8.3	31.4	0.3
2012	100.0	30.1	2.0	23.5	9.2	34.2	1.0
2013	100.0	30.7	2.2	20.8	5.4	37.2	3.6
2014	100.0	29.7	2.5	17.5	5.9	39.7	4.7
2015	100.0	27.8	3.5	15.2	7.0	40.4	6.1

1/ Does not include customer-sited solar.

Source: HECO and KIUC Renewable Portfolio Standard Status Report.

In 2015, 40.4 percent of Hawaii's renewable electricity was generated from wind, 27.8 percent from biomass, 15.2 percent from geothermal, 7.0 percent from hydro, 3.5 percent from biofuels, and 6.1 percent from PV and solar thermal (does not include customer-sited PV solar systems).

Table 23 shows renewable electricity generation by county. From 2005 to 2015, Honolulu renewable electricity generation increased the most at 362 GWH or 7.6 percent per year. This was followed by Maui at 239 GWH or 15.4 percent per year, Hawaii County at 161 GWH or 4.8 percent per year, and Kauai at 42 GWH or 7.8 percent per year. In 2015, renewable electricity accounted for about 40.3 percent of electricity sales in Hawaii County. Hawaii County was followed by Maui at about 27.6 percent, Kauai at 18.5 percent, and Honolulu at 10.3 percent.

Table 23. Hawaii Renewable Electricity Generation by County

Table 23. Hawaii Renewable Electricity Generation by County

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Renewable Generation State	GWH	714	938	930	1,096	1,352	1,457	1,518	4.2%	7.8%
Honolulu	GWH	333	326	364	431	552	647	695	7.4%	7.6%
Hawaii	GWH	268	389	368	436	470	436	429	-1.6%	4.8%
Maui	GWH	75	196	161	189	283	315	314	-0.5%	15.4%
Kauai	GWH	37	26	37	40	48	58	80	36.7%	7.8%
Biomass State	GWH	403	392	399	365	416	433	422	-2.5%	0.5%
Honolulu	GWH	333	326	360	322	375	390	386	-1.1%	1.5%
Hawaii	GWH	-	-	-	-	-	-	-		
Maui	GWH	70	66	38	44	41	43	31	-28.5%	-7.9%
Kauai	GWH	-	-	-	-	-	-	5		
Biofuels State	GWH	0	1	5	59	30	37	53	44.0%	87.4%
Honolulu	GWH	-	-	3	45	29	36	52	44.9%	
Hawaii	GWH	-	-	-	-	-	-	-		
Maui	GWH	0	1	2	15	1	1	1	7.6%	25.7%
Kauai	GWH	-	-	-	-	-	-	-		
Geothermal State	GWH	221	230	168	233	281	255	230	-9.6%	0.4%
Honolulu	GWH	-	-	-	-	-	-	-		
Hawaii	GWH	221	230	168	233	281	255	230	-9.6%	0.4%
Maui	GWH	-	-	-	-	-	-	-		
Kauai	GWH	-	-	-	-	-	-	-		
Hydroelectricity State	GWH	82	72	107	90	74	85	107	24.9%	2.6%
Honolulu	GWH	-	-	-	-	-	-	-		
Hawaii	GWH	40	42	60	45	35	43	63	47.1%	4.7%
Maui	GWH	5	3	10	6	5	8	10	20.5%	7.0%
Kauai	GWH	37	26	37	39	33	34	34	-1.8%	-1.1%
Wind State	GWH	7	242	250	344	504	578	613	6.0%	56.4%
Honolulu	GWH	-	-	-	64	122	184	216	17.6%	
Hawaii	GWH	7	116	141	157	152	136	132	-2.8%	34.2%
Maui	GWH	-	126	110	123	230	258	264	2.5%	
Kauai	GWH	-	-	-	-	-	-	-		
Photovoltaic and Solar State	GWH	-	-	1	4	48	68	92	34.4%	
Honolulu	GWH	-	-	-	0	27	37	41	9.1%	
Hawaii	GWH	-	-	-	0	2	2	3	63.1%	
Maui	GWH	-	-	1	2	5	5	8	48.5%	
Kauai	GWH	-	-	-	1	14	24	41	68.7%	
Electricity Sold State	GWH	10,539	10,585	10,126	9,962	9,501	9,406	9,389	-0.2%	-1.1%
Honolulu	GWH	7,721	7,675	7,378	7,242	6,859	6,782	6,754	-0.4%	-1.3%
Hawaii	GWH	1,116	1,163	1,120	1,104	1,076	1,063	1,065	0.2%	-0.5%
Maui	GWH	1,252	1,280	1,192	1,181	1,135	1,132	1,138	0.5%	-1.0%
Kauai	GWH	449	467	437	435	431	430	432	0.5%	-0.4%
% of Renewable State	%	6.8	8.9	9.2	11.0	14.2	15.5	16.2		
Honolulu	%	4.3	4.2	4.9	5.9	8.0	9.5	10.3		
Hawaii	%	24.0	33.4	32.9	39.5	43.7	41.0	40.3		
Maui	%	6.0	15.3	13.5	16.0	24.9	27.9	27.6		
Kauai	%	8.4	5.7	8.5	9.3	11.0	13.6	18.5		

Source: HECO and KIUC Renewable Portfolio Standard Status Report.

4. Factors Affecting Electricity Prices in Hawaii

Hawaii's electricity prices and total revenue from electricity sales are affected by the expenses associated with electricity generation, mainly the fuel and purchased power costs. In 2015, due to sharp a decrease in fuel and purchased power costs, the 9,389 GWH of electricity sold in Hawaii produced a total revenue of about $2.5 billion, a decrease of 21.7 percent from the previous year. Total electricity sold decreased only 0.2 percent or 18 GWH, but total revenue from electricity sales decreased 21.8 percent or $687.5 million in 2015 from the previous year. The total revenue for the utilities, which reflects the total cost of electricity for customers, increased an average of 5.6 percent per year from $1.9 billion in 2005 to $3.2 billion in 2014. Revenue from electricity sales increased an average of 7.9 percent per year from 2005 to 2012; then decreased 3.9 percent in 2013. In 2014, revenue from electricity sales remained about the same from the previous year, although GWH sales decreased 1.0 percent. Total GWH sold has been decreasing in recent years in Hawaii. From 2005 to 2007, total GWH sold in Hawaii increased only slightly. However, since 2007, total GWH sold has decreased each year.

Since the consumption of electricity has been relatively stable over time, the fluctuation of the total electricity cost for customers was mainly due to fluctuations in the average price of electricity. As shown in Table 24, the average revenue per kWh sold in Hawaii increased almost every year from 18.3 cents in 2005 to 33.5 cents in 2014, an increase of 7.0 percent per year over this period. In 2015, however, the average revenue from electricity sales decreased 21.6 percent, from 33.5 cents per kWh in 2014 to 26.3 cents per kWh in 2015. The average electricity revenue in 2015 was the highest at KIUC at about 33.1 cents per kWh. This was followed by HELCO at 32.3 cents per kWh, MECO at 30.2 cents per kWh, and HECO at 24.2 cents per kWh. From 2005 to 2015, the average cost of electricity increased the most at HECO at 4.5 percent per year; followed by MECO at 2.3 percent per year, HELCO at 2.1 percent per year, and KIUC at 1.3 percent per year.

Table 24. Hawaii Average Revenue of Electricity by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Revenue from electricity sales										
State Total	$M	1,927	2,253	2,148	3,147	3,153	3,154	2,467	-21.8%	2.5%
HECO	$M	1,201	1,381	1,379	2,104	2,116	2,134	1,636	-23.3%	3.1%
HELCO	$M	294	361	343	443	430	421	344	-18.3%	1.6%
MECO	$M	302	349	296	417	422	421	344	-18.3%	1.3%
KIUC	$M	130	163	130	182	184	179	143	-20.0%	0.9%
Total electricity sold										
State Total	GWh	10,539	10,585	10,126	9,962	9,501	9,406	9,389	-0.2%	-1.1%
HECO	GWh	7,721	7,675	7,378	7,242	6,859	6,782	6,754	-0.4%	-1.3%
HELCO	GWh	1,116	1,163	1,120	1,104	1,076	1,063	1,065	0.2%	-0.5%
MECO	GWh	1,252	1,280	1,192	1,181	1,135	1,132	1,138	0.5%	-1.0%
KIUC	GWh	449	467	437	435	431	430	432	0.5%	-0.4%
Average revenue/kWh sold										
State Total	$/kWh	0.183	0.213	0.212	0.316	0.332	0.335	0.263	-21.6%	3.7%
HECO	$/kWh	0.156	0.180	0.187	0.290	0.309	0.315	0.242	-23.0%	4.5%
HELCO	$/kWh	0.263	0.310	0.306	0.402	0.400	0.396	0.323	-18.4%	2.1%
MECO	$/kWh	0.241	0.273	0.249	0.353	0.372	0.372	0.302	-18.7%	2.3%
KIUC	$/kWh	0.291	0.349	0.297	0.420	0.428	0.416	0.331	-20.4%	1.3%

Source: Hawaii Electric Utility Monthly Financial Reports.

The total cost of electricity in Hawaii was mainly affected by two factors, the fuel cost and purchased power cost. The cost of utility fuel and the cost of purchased power were both impacted by fluctuations in petroleum prices. Before 2015, the fuel and purchased power costs accounted for more than 60 percent of the total electricity costs for almost every year. However, in 2015 the fuel and purchased power share of the total electricity cost decreased to 53.3 percent as a result of lower petroleum prices.

In 2015, the total fuel cost of the utilities and the cost of purchased electricity decreased 32.6 percent, from about $1.95 billion in 2014 to $1.31 billion in 2015; the utility fuel cost decreased 42.0 percent from $1,216 million to $706 million and the purchased power cost decreased 17.1 percent from $734 million to $608 million (Table 25). The fuel and purchased power cost decreased the most at HECO at 33.8 percent. HECO was followed by KIUC at 32.2 percent, HELCO at 29.6 percent, and MECO at 29.1 percent.

In comparison, from 2005 to 2014, the total fuel cost of the utilities and the cost of purchased electricity increased 6.0 percent per year, from about $1.16 billion in 2005 to $1.95 billion in 2014. From 2005 to 2014, the utility fuel cost increased from $694 million to $1,216 million and the purchased power cost increased from $463 million to $734 million.

Table 25. Hawaii Average Cost of Fuel and Purchased Power by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Fuel and purchased power cost										
State Total	$M	1,157	1,392	1,228	2,053	1,998	1,950	1,314	-32.6%	1.3%
HECO	$M	760	894	827	1,432	1,379	1,359	899	-33.8%	1.7%
HELCO	$M	168	210	187	259	254	240	169	-29.6%	0.1%
MECO	$M	170	207	158	264	263	254	180	-29.1%	0.6%
KIUC	$M	59	81	56	98	101	96	65	-32.2%	1.0%
Utility fuel cost										
State Total	$M	694	850	724	1,356	1,277	1,216	706	-42.0%	0.2%
HECO	$M	421	526	460	909	851	821	458	-44.2%	0.9%
HELCO	$M	65	75	74	122	126	117	72	-38.7%	1.0%
MECO	$M	154	174	137	234	209	193	125	-35.5%	-2.1%
KIUC	$M	54	76	52	91	92	84	51	-39.6%	-0.6%
Purchased power cost										
State Total	$M	463	542	504	697	720	734	608	-17.1%	2.8%
HECO	$M	339	369	367	523	528	538	441	-18.0%	2.7%
HELCO	$M	103	135	113	137	128	123	98	-20.9%	-0.5%
MECO	$M	16	33	20	30	54	61	56	-8.8%	13.1%
KIUC	$M	5	5	4	8	10	12	14	20.9%	11.1%
Average fuel and purchased power cost										
State Total	$/kWh	0.110	0.132	0.121	0.206	0.210	0.207	0.140	-32.5%	2.5%
HECO	$/kWh	0.098	0.117	0.112	0.198	0.201	0.200	0.133	-33.6%	3.1%
HELCO	$/kWh	0.150	0.181	0.167	0.235	0.236	0.226	0.159	-29.7%	0.6%
MECO	$/kWh	0.136	0.162	0.132	0.223	0.232	0.225	0.158	-29.4%	1.6%
KIUC	$/kWh	0.131	0.173	0.128	0.226	0.235	0.224	0.151	-32.5%	1.4%
Share of fuel and purchased power cost										
State Total	%	60.0%	61.8%	57.1%	65.2%	63.4%	61.8%	53.3%	-13.8%	-1.2%
HECO	%	63.2%	64.8%	60.0%	68.0%	65.2%	63.7%	54.9%	-13.7%	-1.4%
HELCO	%	57.2%	58.2%	54.5%	58.5%	59.0%	57.2%	49.3%	-13.8%	-1.5%
MECO	%	56.4%	59.3%	53.1%	63.2%	62.3%	60.4%	52.5%	-13.2%	-0.7%
KIUC	%	45.2%	49.7%	43.1%	53.9%	54.9%	53.8%	45.7%	-15.2%	0.1%

Source: Hawaii Electric Utility Monthly Financial Reports.

In 2015, the average fuel and purchased electricity cost per kWh decreased 32.5 percent from 20.7 cents to 14.0 cents. The fuel and purchased power cost share, as a percentage of the total cost of electricity sold, decreased from 61.8 percent in 2014 to 53.3 percent in 2015. In 2015, the share of fuel and purchased power cost was the highest for HECO at 54.9 percent, followed by MECO at 52.5 percent, HELCO at 49.3 percent, and KIUC at 45.7 percent.

In comparison, from 2005 to 2014, the average fuel and purchased electricity cost per kWh increased from 11.0 cents to 20.7 cents, an average increase of 7.3 percent per year. The share of fuel and purchased power cost as a percentage of the total cost of electricity sold increased from 60.0 percent in 2005 to 61.8 percent in 2014. In 2014, the share of fuel and purchased power cost was the highest in HECO at 63.7 percent, followed by MECO at 60.4 percent, HELCO at 57.2 percent, and KIUC at 53.8 percent.

Table 26. Utility Fuel Cost and Purchased Power Cost Comparison by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Average fuel cost of utility net generation										
State Total	$/kWh	0.100	0.123	0.111	0.211	0.222	0.221	0.129	-41.7%	2.5%
HECO	$/kWh	0.089	0.108	0.102	0.206	0.218	0.221	0.123	-44.4%	3.3%
HELCO	$/kWh	0.123	0.153	0.144	0.219	0.232	0.215	0.140	-34.7%	1.3%
MECO	$/kWh	0.125	0.153	0.127	0.221	0.231	0.224	0.142	-36.6%	1.3%
KIUC	$/kWh	0.124	0.165	0.122	0.217	0.228	0.221	0.142	-35.6%	1.4%
Average cost of purchased electricity										
State Total	$/kWh	0.110	0.127	0.121	0.172	0.170	0.168	0.138	-17.7%	2.3%
HECO	$/kWh	0.100	0.114	0.112	0.164	0.161	0.159	0.132	-17.3%	2.8%
HELCO	$/kWh	0.149	0.175	0.168	0.218	0.207	0.207	0.154	-25.5%	0.3%
MECO	$/kWh	0.167	0.151	0.109	0.155	0.184	0.183	0.171	-6.6%	0.2%
KIUC	$/kWh	0.144	0.175	0.113	0.209	0.196	0.184	0.152	-17.0%	0.6%
Ratio of purchased cost/fuel cost										
State Total	%	110%	104%	109%	82%	76%	76%	107%	41.1%	-0.2%
HECO	%	113%	105%	110%	79%	74%	72%	107%	48.7%	-0.5%
HELCO	%	121%	115%	117%	99%	89%	97%	110%	14.1%	-1.0%
MECO	%	134%	99%	85%	70%	80%	82%	120%	47.3%	-1.1%
KIUC	%	116%	106%	92%	96%	86%	83%	107%	28.9%	-0.8%
Ratio of fuel cost and average revenue										
State Total	%	55%	58%	52%	67%	67%	66%	49%	-25.5%	-1.1%
HECO	%	57%	60%	55%	71%	71%	70%	51%	-27.8%	-1.2%
HELCO	%	47%	49%	47%	55%	58%	54%	43%	-19.9%	-0.7%
MECO	%	52%	56%	51%	62%	62%	60%	47%	-22.0%	-1.0%
KIUC	%	43%	47%	41%	52%	53%	53%	43%	-19.1%	0.1%
Ratio of purchased power cost and average revenue										
State Total	%	60%	60%	57%	55%	51%	50%	53%	5.1%	-1.4%
HECO	%	64%	63%	60%	56%	52%	51%	54%	7.4%	-1.7%
HELCO	%	57%	57%	55%	54%	52%	52%	48%	-8.6%	-1.7%
MECO	%	69%	55%	44%	44%	49%	49%	57%	14.9%	-2.0%
KIUC	%	49%	50%	38%	50%	46%	44%	46%	4.3%	-0.7%

Source: Hawaii Electric Utility Monthly Financial Reports.

While both the average fuel cost and average purchased power cost decreased in 2015, the average cost of purchased power decreased at a slower rate. As shown in Table 26, in 2015, the average fuel cost to generate one kWh of net electricity (gross generation minus station use) by the utilities decreased 41.7 percent from 22.1 cents to 12.9 cents for the state, while the average cost of purchased electricity decreased only 17.7 percent from 16.8 cents to 13.8 cents.

In comparison, from 2005 to 2014, the average fuel cost to generate one kWh of net electricity by the utilities increased 9.2 percent per year from 10.0 cents to 22.1 cents for the state. During the same period the average cost of purchased electricity increased only 4.8 percent per year from 11.0 cents to 16.8 cents. In 2005, the average cost of purchased electricity was above the average fuel cost of the utilities. In 2014, the average cost of purchased electricity was about

23.9 percent below the average fuel cost of the utilities in Hawaii. In 2015, however, the average cost of purchased electricity was above the average fuel cost of the utilities again.

Due to the slower growth of purchased electricity costs from 2005 to 2014, the ratio of average purchased power cost to average utility fuel cost decreased from 110 percent in 2005 to 76 percent in 2014. In 2015, the ratio of average purchased power cost to average utility fuel cost increased to 107 percent. In 2015, the purchased electricity was cheapest at HECO (13.2 cents/kWh), followed by KIUC (15.2 cents/kWh), HELCO (15.4 cents/kWh), and MECO (17.1 cents/kWh).

In addition to fuel and purchased power costs, the cost of electricity is also affected by four other factors. As shown in Table 27, the operating income of the utilities accounted for about 8.2 percent, taxes accounted for about 12.8 percent, depreciation and amortization accounted for about 7.8 percent, and other utility operating expenses accounted for about 18.3 percent of the total electricity cost paid by consumers in 2015. Other utility operating expenses include other operation and maintenance expense, transmission and distribution expenses, customer accounts and service expenses, and administration and general expenses.

The total of these other costs have increased from $777 million in 2005 to $1,163 million in 2015, an average increase of 4.1 percent per year. This growth rate was higher than the 2.8 percent average inflation rate (Honolulu CPI-U) during the same period. Among the four components of other electricity costs, other utility operating expenses increased the most at 4.7 percent per year, followed by operating income at 4.2 percent per year, taxes at 3.7 percent per year, and depreciation and amortization at 3.4 percent per year.

Table 27. Other Major Costs of Electricity by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Operating income										
State Total	$M	134	121	129	173	192	209	203	-2.7%	4.2%
HECO	$M	65	54	71	90	115	129	129	-0.4%	7.0%
HELCO	$M	22	25	24	38	31	29	31	5.9%	3.7%
MECO	$M	27	21	19	27	30	32	31	-2.4%	1.6%
KIUC	$M	21	20	14	18	16	18	12	-32.9%	-5.2%
Taxes										
State Total	$M	220	241	252	355	361	374	316	-15.5%	3.7%
HECO	$M	137	146	164	232	243	255	213	-16.7%	4.5%
HELCO	$M	33	43	42	58	50	50	45	-11.0%	3.0%
MECO	$M	39	39	35	50	52	53	47	-12.4%	1.8%
KIUC	$M	11	14	11	15	16	15	12	-19.9%	1.1%
Depreciation and amortization										
State Total	$M	137	151	159	154	166	179	192	7.2%	3.4%
HECO	$M	70	78	81	88	99	108	116	7.7%	5.3%
HELCO	$M	27	30	32	32	34	35	37	3.7%	3.2%
MECO	$M	25	27	29	21	20	21	22	4.4%	-1.1%
KIUC	$M	16	16	17	13	14	15	17	15.1%	0.4%
Other utility operating expenses										
State Total	$M	286	356	389	421	446	452	451	-0.3%	4.7%
HECO	$M	173	213	241	268	286	288	286	-0.9%	5.1%
HELCO	$M	45	54	59	57	63	67	63	-5.0%	3.5%
MECO	$M	43	56	57	58	59	62	65	4.6%	4.4%
KIUC	$M	25	32	32	38	38	35	37	5.1%	3.8%
All others										
State Total	$M	777	868	929	1,103	1,166	1,215	1,163	-4.3%	4.1%
HECO	$M	445	491	558	679	744	781	744	-4.8%	5.3%
HELCO	$M	126	152	157	185	178	181	176	-3.2%	3.3%
MECO	$M	133	144	140	155	161	169	165	-2.1%	2.2%
KIUC	$M	73	82	74	84	83	83	78	-5.9%	0.6%
% of operating income										
State Total	%	7.0%	5.4%	6.0%	5.5%	6.1%	6.6%	8.2%		
HECO	%	5.4%	3.9%	5.2%	4.3%	5.4%	6.1%	7.9%		
HELCO	%	7.3%	6.9%	6.9%	8.6%	7.2%	7.0%	9.0%		
MECO	%	8.8%	6.1%	6.5%	6.4%	7.1%	7.6%	9.1%		
KIUC	%	15.8%	12.6%	10.9%	9.7%	8.5%	10.1%	8.5%		
% of taxes										
State Total	%	11.4%	10.7%	11.7%	11.3%	11.5%	11.9%	12.8%		
HECO	%	11.4%	10.5%	11.9%	11.0%	11.5%	12.0%	13.0%		
HELCO	%	11.3%	11.8%	12.3%	13.0%	11.7%	11.9%	13.0%		
MECO	%	13.0%	11.1%	11.7%	12.0%	12.4%	12.7%	13.6%		
KIUC	%	8.3%	8.5%	8.4%	8.4%	8.4%	8.4%	8.5%		
% of depreciation and amortization										
State Total	%	7.1%	6.7%	7.4%	4.9%	5.3%	5.7%	7.8%		
HECO	%	5.8%	5.6%	5.8%	4.2%	4.7%	5.1%	7.1%		
HELCO	%	9.1%	8.2%	9.4%	7.3%	7.8%	8.4%	10.7%		
MECO	%	8.1%	7.9%	9.8%	4.9%	4.7%	5.0%	6.4%		
KIUC	%	12.6%	10.0%	12.9%	7.3%	7.5%	8.3%	11.9%		
% of other utility operating expenses										
State Total	%	14.9%	15.8%	18.1%	13.4%	14.2%	14.3%	18.3%		
HECO	%	14.4%	15.5%	17.5%	12.7%	13.5%	13.5%	17.5%		
HELCO	%	15.3%	15.1%	17.1%	12.8%	14.5%	15.8%	18.4%		
MECO	%	14.1%	16.1%	19.3%	13.9%	14.0%	14.8%	18.9%		
KIUC	%	19.5%	19.4%	24.7%	20.9%	20.7%	19.7%	25.8%		

Source: Hawaii Electric Utility Monthly Financial Reports.

5. Electricity Consumption by Sector

Electricity sold by the utilities can be classified into three sectors. First is the residential sector, which includes all residential customers and utility employees' accounts. Second is the industrial sector, which includes the large power customers. Third is the commercial sector, which includes all other customers.

Due to the installation of customer-sited solar systems, total electricity sold by utilities decreased. Since most of the customer-sited solar systems were installed by residential customers, electricity sold to residential customers decreased more than that of the other sectors. As shown in Table 28, from 2005 to 2015, total electricity sold decreased an average 1.1 percent per year in Hawaii, while electricity sold to the residential sector decreased an average 2.1 percent per year from 3,164 GWH to 2,558 GWH. In comparison, electricity sold to the commercial sector and the industrial sector only decreased an average 1.0 percent and 0.6 percent per year, respectively, over the same period. As a result, the residential sector share of total electricity sold decreased from 30.0 percent in 2005 to 27.2 percent in 2015. In 2015, the residential sector's electricity sales increased 0.8 percent over the previous year.

At the county level, from 2005 to 2015, residential sales in the HECO system decreased the most at 2.7 percent per year; followed by MECO (decreased 1.5 percent per year), and HELCO (decreased 0.9 percent per year). Residential sales of KIUC increased slightly during the same period.

It appears that the decrease in electricity consumption in recent years was due to decreased consumption per customer, rather than a decrease in the number of customers. As shown in Table 29, from 2005 to 2015, total utility customers for the state increased an average 0.7 percent per year. The number of residential customers increased 0.7 percent per year from 398,332 customers to 429,085 customers, the number of commercial customers increased 0.1 percent per year from 64,072 to 64,769, and the number of industrial customers increased 1.3 percent per year from 684 to 778.

At the county utility level, the number of customers increased slower at HECO compared with the other utilities. From 2005 to 2015, the share of HECO customers as a percentage of total statewide utility customers decreased 1.8 percentage points, from 63.0 percent to 61.2 percent.

Table 28. Electricity Consumption by Sector and by Utility

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total										
State Total	GWH	10,539	10,585	10,126	9,962	9,501	9,406	9,389	-0.2%	-1.1%
HECO	GWH	7,721	7,675	7,378	7,242	6,859	6,782	6,754	-0.4%	-1.3%
HELCO	GWH	1,116	1,163	1,120	1,104	1,076	1,063	1,065	0.2%	-0.5%
MECO	GWH	1,252	1,280	1,192	1,181	1,135	1,132	1,138	0.5%	-1.0%
KIUC	GWH	449	467	437	435	431	430	432	0.5%	-0.4%
Residential										
State Total	GWH	3,164	3,201	3,055	2,929	2,609	2,539	2,558	0.8%	-2.1%
HECO	GWH	2,143	2,135	2,025	1,925	1,667	1,611	1,627	1.0%	-2.7%
HELCO	GWH	423	451	440	427	396	387	388	0.5%	-0.9%
MECO	GWH	442	450	428	418	388	382	381	-0.2%	-1.5%
KIUC	GWH	156	165	162	159	158	159	162	1.7%	0.4%
Commercial										
State Total	GWH	3,465	3,521	3,389	3,368	3,269	3,185	3,143	-1.3%	-1.0%
HECO	GWH	2,480	2,513	2,449	2,429	2,341	2,270	2,221	-2.2%	-1.1%
HELCO	GWH	453	463	441	446	435	428	432	1.1%	-0.5%
MECO	GWH	406	417	382	379	379	374	374	-0.1%	-0.8%
KIUC	GWH	125	129	118	114	113	114	116	1.9%	-0.8%
Industrial										
State Total	GWH	3,909	3,863	3,681	3,665	3,623	3,682	3,687	0.2%	-0.6%
HECO	GWH	3,098	3,028	2,904	2,888	2,850	2,900	2,906	0.2%	-0.6%
HELCO	GWH	240	248	238	231	245	248	244	-1.6%	0.2%
MECO	GWH	404	414	382	384	368	376	383	1.7%	-0.5%
KIUC	GWH	167	173	157	161	160	157	155	-1.7%	-0.8%
% of Residential										
State Total	%	30.0%	30.2%	30.2%	29.4%	27.5%	27.0%	27.2%		
HECO	%	27.7%	27.8%	27.5%	26.6%	24.3%	23.8%	24.1%		
HELCO	%	37.9%	38.8%	39.3%	38.7%	36.8%	36.4%	36.5%		
MECO	%	35.3%	35.1%	35.9%	35.4%	34.2%	33.7%	33.5%		
KIUC	%	34.8%	35.4%	37.1%	36.6%	36.6%	37.0%	37.5%		
% of Commercial										
State Total	%	32.9%	33.3%	33.5%	33.8%	34.4%	33.9%	33.5%		
HECO	%	32.1%	32.7%	33.2%	33.5%	34.1%	33.5%	32.9%		
HELCO	%	40.6%	39.8%	39.4%	40.4%	40.4%	40.2%	40.6%		
MECO	%	32.4%	32.5%	32.0%	32.1%	33.4%	33.0%	32.9%		
KIUC	%	27.9%	27.6%	26.9%	26.3%	26.3%	26.4%	26.8%		
County % of Total										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	73.3%	72.5%	72.9%	72.7%	72.2%	72.1%	71.9%		
HELCO	%	10.6%	11.0%	11.1%	11.1%	11.3%	11.3%	11.3%		
MECO	%	11.9%	12.1%	11.8%	11.9%	11.9%	12.0%	12.1%		
KIUC	%	4.3%	4.4%	4.3%	4.4%	4.5%	4.6%	4.6%		
County % of Total										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	67.7%	66.7%	66.3%	65.7%	63.9%	63.5%	63.6%		
HELCO	%	13.4%	14.1%	14.4%	14.6%	15.2%	15.2%	15.2%		
MECO	%	14.0%	14.0%	14.0%	14.3%	14.9%	15.0%	14.9%		
KIUC	%	4.9%	5.2%	5.3%	5.4%	6.1%	6.3%	6.3%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 29. Number of Retail Customers by Sector in Hawaii

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total										
State Total		463,088	475,104	478,590	482,498	488,456	492,358	494,632	0.5%	0.7%
HECO		291,580	294,591	295,282	296,800	299,528	301,953	302,958	0.3%	0.4%
HELCO		73,835	78,983	79,813	81,199	82,637	83,421	84,309	1.1%	1.3%
MECO		63,901	66,323	67,489	68,230	69,577	70,042	70,533	0.7%	1.0%
KIUC		33,772	35,207	36,006	36,269	36,714	36,942	36,832	-0.3%	0.9%
Residential										
State Total		398,332	408,923	413,643	418,174	423,281	426,862	429,085	0.5%	0.7%
HECO		257,804	260,583	261,630	263,384	265,772	268,056	269,207	0.4%	0.4%
HELCO		60,699	65,305	66,825	68,423	69,719	70,398	71,217	1.2%	1.6%
MECO		54,135	56,076	57,431	58,326	59,419	59,802	60,231	0.7%	1.1%
KIUC		25,694	26,959	27,757	28,041	28,371	28,606	28,430	-0.6%	1.0%
Commercial										
State Total		64,072	65,503	64,255	63,625	64,498	64,777	64,769	0.0%	0.1%
HECO		33,416	33,661	33,305	33,058	33,412	33,521	33,333	-0.6%	0.0%
HELCO		13,071	13,608	12,919	12,702	12,839	12,940	13,001	0.5%	-0.1%
MECO		9,632	10,110	9,916	9,769	10,025	10,103	10,152	0.5%	0.5%
KIUC		7,953	8,124	8,115	8,096	8,222	8,213	8,283	0.9%	0.4%
Industrial										
State Total		684	678	692	699	677	719	778	8.2%	1.3%
HECO		360	347	347	358	344	376	418	11.2%	1.5%
HELCO		65	70	69	74	79	83	91	9.6%	3.4%
MECO		134	137	142	135	133	137	150	9.5%	1.1%
KIUC		125	124	134	132	121	123	119	-3.3%	-0.5%
% of Residential										
State Total	%	86.0%	86.1%	86.4%	86.7%	86.7%	86.7%	86.7%		
HECO	%	88.4%	88.5%	88.6%	88.7%	88.7%	88.8%	88.9%		
HELCO	%	82.2%	82.7%	83.7%	84.3%	84.4%	84.4%	84.5%		
MECO	%	84.7%	84.5%	85.1%	85.5%	85.4%	85.4%	85.4%		
KIUC	%	76.1%	76.6%	77.1%	77.3%	77.3%	77.4%	77.2%		
% of Commercial										
State Total	%	13.8%	13.8%	13.4%	13.2%	13.2%	13.2%	13.1%		
HECO	%	11.5%	11.4%	11.3%	11.1%	11.2%	11.1%	11.0%		
HELCO	%	17.7%	17.2%	16.2%	15.6%	15.5%	15.5%	15.4%		
MECO	%	15.1%	15.2%	14.7%	14.3%	14.4%	14.4%	14.4%		
KIUC	%	23.5%	23.1%	22.5%	22.3%	22.4%	22.2%	22.5%		
County % of Total										
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	63.0%	62.0%	61.7%	61.5%	61.3%	61.3%	61.2%		
HELCO	%	15.9%	16.6%	16.7%	16.8%	16.9%	16.9%	17.0%		
MECO	%	13.8%	14.0%	14.1%	14.1%	14.2%	14.2%	14.3%		
KIUC	%	7.3%	7.4%	7.5%	7.5%	7.5%	7.5%	7.4%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 30 shows that annual electricity consumption per customer for the state decreased an average 1.8 percent per year from 22,757 kWh in 2005 to 18,981 kWh in 2015. In looking at the types of customers, annual electricity consumption per residential customer decreased an average 2.8 percent per year, from 7,943 kWh to 5,962 kWh; annual electricity consumption per commercial customer decreased an average 1.1 percent per year, from 54,081 kWh to 48,524 kWh; and annual electricity consumption by industrial customers decreased 1.9 percent per year, from 5,715,476 kWh to 4,739,613 kWh.

At the county level, MECO had the highest annual electricity consumption per residential customer in 2015 at 6,328 kWh. This was followed by HECO at 6,043 kWh, KIUC at 5,692 kWh, and HELCO at 5,453 kWh. However, the difference between utilities' average residential electricity consumption per customer has been decreasing over time with HECO's residential consumption per customer decreasing faster than others. From 2005 to 2015, residential consumption per customer decreased an average 3.1 percent per year at HECO, decreased 2.5 percent per year at MECO, decreased 2.4 percent per year at HELCO, and decreased 0.6 percent per year at KIUC.

Table 30. Annual Electricity Consumption per Customer by Sector

		2005	2007	2009	2011	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total										
State Total	kWh/C	22,757	22,279	21,158	20,646	19,451	19,104	18,981	-0.6%	-1.8%
HECO	kWh/C	26,481	26,054	24,985	24,401	22,898	22,459	22,294	-0.7%	-1.7%
HELCO	kWh/C	15,121	14,721	14,031	13,591	13,022	12,737	12,630	-0.8%	-1.8%
MECO	kWh/C	19,595	19,300	17,666	17,309	16,311	16,163	16,129	-0.2%	-1.9%
KIUC	kWh/C	13,284	13,261	12,125	11,987	11,752	11,638	11,731	0.8%	-1.2%
Residential										
State Total	kWh/C	7,943	7,827	7,386	7,004	6,163	5,948	5,962	0.2%	-2.8%
HECO	kWh/C	8,311	8,191	7,741	7,309	6,273	6,010	6,043	0.5%	-3.1%
HELCO	kWh/C	6,977	6,912	6,585	6,238	5,676	5,491	5,453	-0.7%	-2.4%
MECO	kWh/C	8,165	8,017	7,451	7,165	6,528	6,387	6,328	-0.9%	-2.5%
KIUC	kWh/C	6,072	6,127	5,834	5,673	5,564	5,564	5,692	2.3%	-0.6%
Commercial										
State Total	kWh/C	54,081	53,760	52,751	52,939	50,689	49,176	48,524	-1.3%	-1.1%
HECO	kWh/C	74,227	74,652	73,519	73,475	70,072	67,734	66,641	-1.6%	-1.1%
HELCO	kWh/C	34,685	34,027	34,165	35,089	33,892	33,040	33,234	0.6%	-0.4%
MECO	kWh/C	42,163	41,198	38,525	38,811	37,851	37,013	36,816	-0.5%	-1.3%
KIUC	kWh/C	15,749	15,881	14,487	14,139	13,804	13,820	13,967	1.1%	-1.2%
Industrial										
State Total	kWh/C	5,715,476	5,697,455	5,320,073	5,242,739	5,351,326	5,120,741	4,739,613	-7.4%	-1.9%
HECO	kWh/C	8,606,672	8,726,082	8,368,077	8,068,244	8,284,797	7,712,821	6,951,690	-9.9%	-2.1%
HELCO	kWh/C	3,686,703	3,546,493	3,455,506	3,122,719	3,104,552	2,992,745	2,685,072	-10.3%	-3.1%
MECO	kWh/C	3,014,884	3,021,683	2,692,158	2,844,143	2,763,182	2,745,471	2,551,411	-7.1%	-1.7%
KIUC	kWh/C	1,338,824	1,392,734	1,172,027	1,221,235	1,323,260	1,278,578	1,298,817	1.6%	-0.3%

Source: Hawaii Electric Utility Monthly Financial Reports.

Due to the rapid growth of electricity prices from 2005 to 2012, total revenue from retail electricity sales increased substantially over this period. This occurred in spite of a decrease in the kWh of electricity sold over the same period. From 2005 to 2012, the total revenue generated from retail electricity sales increased an average 7.9 percent per year for the state, revenue from residential sales increased an average 6.6 percent per year from $653 million to $1,023 million, and revenue from commercial and industrial sales (separate revenues from the commercial sector and the industrial sector are not available in the MFR) increased an average 8.5 percent per year from $1,274 million to $2,258 million.

In 2013, total revenue from electricity sales decreased 3.9 percent from the previous year, revenue from residential sales decreased 5.9 percent, and revenue from commercial and industrial sales decreased 3.0 percent. In 2014, revenue from residential sales decreased 1.5 percent, and revenue from commercial and industrial sales increased 0.7 percent. In 2015, due to the sharp decrease in petroleum prices, revenue from residential sales decreased 19.3 percent, and revenue from commercial and industrial sales decreased 22.9 percent

Table 31. Revenue from Retail Electricity Sales by Sector in Hawaii

		2005	2007	2009	2011	2012	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total											
State Total	$M	1,927	2,253	2,148	3,147	3,281	3,153	3,154	2,467	-21.8%	2.5%
HECO	$M	1,201	1,381	1,379	2,104	2,217	2,116	2,134	1,636	-23.3%	3.1%
HELCO	$M	294	361	343	443	439	430	421	344	-18.3%	1.6%
MECO	$M	302	349	296	417	437	422	421	344	-18.3%	1.3%
KIUC	$M	130	163	130	182	188	184	179	143	-20.0%	0.9%
Residential											
State Total	$M	653	772	739	1,016	1,023	962	948	765	-19.3%	1.6%
HECO	$M	379	438	436	617	624	577	572	456	-20.3%	1.9%
HELCO	$M	118	148	144	179	174	167	162	135	-16.9%	1.3%
MECO	$M	110	127	111	151	154	148	146	119	-18.2%	0.8%
KIUC	$M	46	59	49	69	71	70	68	56	-18.9%	1.8%
Others											
State Total	$M	1,274	1,481	1,409	2,131	2,258	2,191	2,206	1,701	-22.9%	2.9%
HECO	$M	823	943	943	1,487	1,593	1,539	1,562	1,180	-24.5%	3.7%
HELCO	$M	176	213	199	264	265	263	259	209	-19.1%	1.8%
MECO	$M	192	222	186	266	282	274	275	224	-18.4%	1.6%
KIUC	$M	84	104	81	113	118	115	110	87	-20.7%	0.4%
% of Residential											
State Total	%	33.9%	34.3%	34.4%	32.3%	31.2%	30.5%	30.1%	31.0%		
HECO	%	31.5%	31.7%	31.6%	29.3%	28.1%	27.3%	26.8%	27.9%		
HELCO	%	40.2%	41.0%	41.9%	40.4%	39.6%	38.8%	38.5%	39.1%		
MECO	%	36.5%	36.5%	37.3%	36.2%	35.3%	35.1%	34.7%	34.8%		
KIUC	%	35.5%	36.1%	37.7%	37.8%	37.6%	37.9%	38.3%	38.8%		
County % of Total											
State Total	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
HECO	%	62.3%	61.3%	64.2%	66.9%	67.6%	67.1%	67.7%	66.3%		
HELCO	%	15.2%	16.0%	16.0%	14.1%	13.4%	13.6%	13.3%	13.9%		
MECO	%	15.7%	15.5%	13.8%	13.3%	13.3%	13.4%	13.3%	13.9%		
KIUC	%	6.8%	7.2%	6.0%	5.8%	5.7%	5.9%	5.7%	5.8%		

Source: Hawaii Electric Utility Monthly Financial Reports.

The higher growth in commercial and industrial electricity revenue, compared with residential revenue from 2005 to 2012, was due to the higher growth in commercial and industrial electricity prices. From 2005 to 2012, the average electricity price increased an average of 9.3 percent per year, from 18.3 cents per kWh to 34.0 cents per kWh. The average residential electricity price increased 8.8 percent per year, from 20.6 cents per kWh to 37.3 cents per kWh, and the average commercial and industrial electricity price increased 9.6 percent per year, from 17.3 cents per kWh to 32.7 cents per kWh.

In 2013, the average residential electricity price decreased 1.2 percent and the average commercial and industrial electricity price decreased 2.9 percent. In 2014, the average residential electricity price increased 1.2 percent and the average commercial and industrial electricity price increased 1.1 percent. In 2015, the average residential electricity price decreased 19.9 percent and the average commercial and industrial electricity price decreased 22.5 percent.

Table 32. Average Electricity Price by County in Hawaii

		2005	2007	2009	2011	2012	2013	2014	2015	Growth 2015	Avg. ann. Growth 2005 - 2015
Total											
State Total	$/kWh	0.183	0.213	0.212	0.316	0.340	0.332	0.335	0.263	-21.6%	3.7%
HECO	$/kWh	0.156	0.180	0.187	0.290	0.318	0.309	0.315	0.242	-23.0%	4.5%
HELCO	$/kWh	0.263	0.310	0.306	0.402	0.405	0.400	0.396	0.323	-18.4%	2.1%
MECO	$/kWh	0.241	0.273	0.249	0.353	0.382	0.372	0.372	0.302	-18.7%	2.3%
KIUC	$/kWh	0.291	0.349	0.297	0.420	0.435	0.428	0.416	0.331	-20.4%	1.3%
Residential											
State Total	$/kWh	0.206	0.241	0.242	0.347	0.373	0.369	0.373	0.299	-19.9%	3.8%
HECO	$/kWh	0.177	0.205	0.215	0.320	0.351	0.346	0.355	0.280	-21.0%	4.7%
HELCO	$/kWh	0.279	0.328	0.327	0.419	0.425	0.422	0.419	0.346	-17.3%	2.2%
MECO	$/kWh	0.249	0.283	0.259	0.361	0.391	0.382	0.382	0.313	-18.0%	2.3%
KIUC	$/kWh	0.297	0.356	0.301	0.434	0.450	0.443	0.430	0.343	-20.2%	1.5%
Others											
State Total	$/kWh	0.173	0.201	0.199	0.303	0.327	0.318	0.321	0.249	-22.5%	3.7%
HECO	$/kWh	0.147	0.170	0.176	0.280	0.306	0.296	0.302	0.230	-23.8%	4.6%
HELCO	$/kWh	0.253	0.299	0.293	0.391	0.393	0.387	0.383	0.309	-19.2%	2.0%
MECO	$/kWh	0.236	0.267	0.243	0.349	0.377	0.367	0.366	0.296	-19.1%	2.3%
KIUC	$/kWh	0.287	0.345	0.294	0.411	0.426	0.419	0.407	0.324	-20.6%	1.2%

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 33 shows the statewide average electricity price by sector in Hawaii, sourced from EIA data. The data shows prices by sector from 1990 to 2014 are provided.

Table 33. Average Electricity Price by Sector in Hawaii

Year	Residential Cents/kWh	Commercial Cents/kWh	Industrial Cents/kWh	Other Cents/kWh	Total Cents/kWh
1990	10.26	10.18	7.57	9.40	9.02
1991	10.52	10.33	7.71	9.56	9.22
1992	10.90	10.53	7.83	9.71	9.44
1993	12.28	11.68	8.95	11.26	10.66
1994	12.45	11.67	8.82	11.21	10.68
1995	13.32	12.16	9.27	12.11	11.29
1996	14.26	12.99	10.03	12.91	12.12
1997	14.80	13.26	10.32	13.20	12.49
1998	13.82	12.31	9.41	12.28	11.56
1999	14.30	12.74	9.70	12.66	11.97
2000	16.41	14.81	11.69	14.76	14.03
2001	16.34	14.81	11.68	16.81	14.05
2002	15.63	14.11	11.02	16.85	13.39
2003	16.73	15.02	12.20	NA	14.47
2004	18.06	16.19	13.35	NA	15.70
2005	20.70	19.04	15.79	NA	18.33
2006	23.35	21.42	17.96	NA	20.72
2007	24.12	21.91	18.38	NA	21.29
2008	32.50	29.72	26.05	NA	29.20
2009	24.20	21.86	18.14	NA	21.21
2010	28.10	25.93	21.94	NA	25.12
2011	34.68	32.37	28.40	NA	31.59
2012	37.34	34.88	30.82	NA	34.04
2013	36.98	34.05	29.87	NA	33.26
2014	37.04	34.21	30.22	NA	33.43

Source: Energy Information Administration, State Energy Data System

6. Electricity Demand

The overall demand for electricity can be met through several alternative channels. Electricity users can purchase electricity from the utilities (generated by utility and non-utility producers) and/or generate electricity by themselves. Another option is to reduce electricity demand through electricity savings displacement projects such as solar water heating (SWH) and energy efficiency technologies such as the demand-side-management (DSM) programs. Total electricity generated by the electric power industry (including both utility and non-utility producers) includes electricity sold by the utilities, system losses, and station use by both utility and non-utility electricity producers. Data for electricity sold by the utilities, system losses and station use of utilities was available; however, the station use of purchased electricity from non-utility producers was not available. Therefore, we estimated this value with the assumption that the percentage of station use in gross generation for non-utility producers was the same as that for utility producers.

For the data on electricity generated and consumed by the final users, only the electricity generated from PV systems was available. The electricity saved from the SWH and DSM programs were available up to 2014. The values of electricity saved from the SWH and DSM programs in 2015 were estimated based on the historical trend. In this study, we define total electricity demand as the sum of gross generation by the electric power industry, electricity generated and consumed by the customers (mainly from the customer-sited solar systems), and electricity saved by the SWH and DSM programs.

From 2005 to 2015, total electricity demand in Hawaii increased only slightly, with an average annual increase of 0.4 percent per year from about 12,280 GWH to 12,794 GWH (Table 34). Decreased gross generation by the electric power industry was offset by electricity savings and customer-sited generations. Over this period, electricity generation by the electric power industry decreased 1.2 percent per year from 11,755 GWH to 10,450 GWH, electricity generated by user owned PV systems increased 75.3 percent per year from 2 GWH to 665 GWH; electricity replaced by SWH increased 6.7 percent per year from 84 GWH to 160 GWH; and electricity replaced by DSM programs increased 13.2 percent per year from 439 GWH to 1,518 GWH. This analysis estimated that the share of gross electricity generation produced by the electric power industry decreased from 95.7 percent in 2005 to 81.7 percent in 2015, a decrease of 14.0 percentage points.

Table 34. Total Electricity Demand in Hawaii

Electricity Generation and Conservation (Demand-Side-Management)						
		Units: GWH				
	Gross 1/	By Users				Gross
Year	Generation	PV	SWH	DSM	Sub-Total	Total
2005	11,755	2	84	439	525	12,280
2006	11,803	4	95	497	596	12,399
2007	11,822	8	109	619	736	12,558
2008	11,601	12	117	750	880	12,481
2009	11,282	33	130	809	972	12,254
2010	11,194	53	172	916	1,141	12,335
2011	11,104	90	180	1,027	1,298	12,402
2012	10,758	190	185	1,210	1,584	12,342
2013	10,598	356	174	1,320	1,850	12,447
2014	10,467	532	160	1,416	2,108	12,575
2015 2/	10,450	665	160	1,518	2,344	12,794
Growth 05-15	-1.2%	75.3%	6.7%	13.2%	16.1%	0.4%
Changes 05-15	(1,305)	662	76	1,080	1,818	513

Electricity Generation and Conservation (Demand-Side-Management)						
		Units: % in Gross Total				
	Gross 1/	By Users				Gross
Year	Generation	PV	SWH	DSM	Sub-Total	Total
2005	95.7	0.02	0.68	3.57	4.3	100.00
2006	95.2	0.03	0.77	4.01	4.8	100.00
2007	94.1	0.06	0.87	4.93	5.9	100.00
2008	93.0	0.10	0.94	6.01	7.0	100.00
2009	92.1	0.27	1.06	6.60	7.9	100.00
2010	90.7	0.43	1.39	7.43	9.3	100.00
2011	89.5	0.73	1.45	8.28	10.5	100.00
2012	87.2	1.54	1.50	9.80	12.8	100.00
2013	85.1	2.86	1.40	10.60	14.9	100.00
2014	83.2	4.23	1.28	11.26	16.8	100.00
2015 2/	81.7	5.20	1.25	11.87	18.3	100.00

1/ Including station use of non-utility producers. Estimated by DBEDT.

2/ 2015 SWH and DSM data are estimated by DBEDT

Source: HECO and KIUC Renewable Portfolio Standard Status Report and DBEDT estimate.

7. Conclusions

In recent years, electricity generated by utilities as a percentage of the total electricity generated has decreased significantly. From 1990 to 2015, the share of utility generated electricity decreased 28.7 percentage points, from 82.4 percent to 53.7 percent. A large part of this decrease can be attributed to an increase in electricity purchased by the utility, which has replaced electricity generated by the utility. Since the average cost of electricity purchased by the utility was below the average fuel cost of utility generated electricity in most of the years from 2005 to 2014, the increased share of purchased electricity had helped reduce the cost of electricity sold by the utility. In 2015, however, the average cost of electricity purchased by the utility was above the average fuel cost of utility generated electricity due to reduced petroleum price.

Not all the electricity generated by the electric power industry is sold to the utility customers. In 2015, about 5.5 percent of the gross electricity generated by the utilities in Hawaii was consumed by the utility owned power stations. In addition, about 5.0 percent of utility net generation (gross generation minus station use) and purchased power was lost during electricity transmission and distribution. Therefore, less than 90 percent of the electricity generated was sold to utility customers.

From 2005 to 2014, the average fuel cost per kWh of electricity generated by the utilities in Hawaii increased an average of 9.2 percent per year from 10.0 cents/kWh to 22.1 cents/kWh. The fuel cost increase was significantly higher than the 4.8 percent average cost increase for purchased electricity, which increased from 11.0 cents/kWh to 16.8 cents/kWh during the same period. In 2015, however, the average fuel cost per kWh of electricity generated by the utilities in Hawaii decreased 41.7 percent from 22.1 cents/kWh to 12.9 cents/kWh. In 2015, the average cost of purchased electricity was 7.4 percent above the average fuel cost of utility generated electricity.

The average cost of purchased electricity in 2015 was the lowest at HECO at about 13.2 cents/kWh. The lower average cost of purchased power at HECO was partially due to the lower purchased power cost from coal generated electricity. The average cost of purchased power from coal generated electricity was less than 10 cents/kWh, lower than the average cost of purchased power by HECO.

The relatively slower growth in purchased power prices from 2005 to 2014 was due to a high and increasing share of electricity being generated from non-petroleum sources including coal and renewable energy by non-utility producers. In 2014, about 94.9 percent of utility generated

electricity was from petroleum; in contrast, only 36.1 percent of non-utility generated electricity was from petroleum.

From 2005 to 2012, the average unit petroleum cost for the four electric utilities in Hawaii increased an average of 13.2 percent per year, from $57.57 per BBL to $136.88 per BBL. Fuel oil costs increased the most at an average 14.9 percent per year from $51.22 per BBL to $135.72 per BBL. This was followed by diesel oil (excluding biodiesel) costs increasing an average 8.9 percent per year, from $77.36 per BBL to $140.52 per BBL. It is important to note that the average crude oil price only increased an average 7.6 percent per year over the same period. In 2013 and 2014, the unit fuel oil cost decreased 5.8 percent and 1.2 percent, respectively, from the previous year. The unit diesel cost also decreased. In 2015, the unit fuel oil cost decreased 45.7 percent and the unit diesel cost decreased 34.8 percent from the previous year.

From 2005 to 2014, the average revenue from electricity sold in Hawaii increased 7.0 percent per year, from 18.3 cents/kWh to 33.5 cents/kWh. In 2015, the average revenue from electricity sold in Hawaii decreased 21.6 percent, from 33.5 cents/kWh to 26.3 cents/kWh.

In addition to the fuel and purchased power costs, the cost of electricity was also affected by four other factors. The operating income of the utilities accounted for about 8.2 percent, taxes accounted for about 12.8 percent, depreciation and amortization accounted for about 7.8 percent, and other utility operating expenses accounted for about 18.3 percent of total electricity prices paid by consumers in 2015. Other utility operating expenses include other operation and maintenance expenses, transmission and distribution expenses, customer accounts and service expenses, and administration and general expenses. The total of these other costs have increased from $777 million in 2005 to $1,163 million in 2015, an average increase of 4.1 percent per year. This growth rate was higher than the 2.8 percent average inflation rate (Honolulu CPI-U) during the same period.

Total electricity sold by utilities decreased over the period analyzed. A large part of this decrease was due to reduced consumption caused by the installation of customer-sited solar systems. From 2005 to 2015, total electricity sold decreased an average 1.1 percent per year in Hawaii. The largest decrease during this period was for residential customers, which decreased an average 2.1 percent per year from 3,164 GWH to 2,558 GWH. In contrast, electricity sold to the commercial sector and the industrial sector only decreased an average 1.0 percent and 0.6

percent per year, respectively. As a result, the residential sector share of total electricity sold decreased from 30.0 percent in 2005 to 27.2 percent in 2015.

The analysis showed that the decrease in electricity consumption was due to a decrease in consumption per customer, rather than a decrease in the number of customers. From 2005 to 2015, total utility customers for the state increased 0.7 percent per year. Industrial customers increased the most at 1.3 percent per year. This was followed by residential customers with an increase of 0.7 percent per year and commercial customers which increased 0.1 percent per year.

Electricity demand can be met by both electricity generated from the electric power industry (including both utility and non-utility producers), energy conservation (such as the DSM programs), electricity savings displacement projects (such as SWH), and user generated electricity (such as user installed PV systems). From 2005 to 2015, the total share of electricity generated by the electric power industry as a percentage of total electricity demand in Hawaii decreased 14.0 percentage points, from 95.7 percent to 81.7 percent. Without the electricity generated and conserved by users, total electricity expenditure in Hawaii would have been higher.