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: 2014 Analysis and Recent Trends

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Executive Summary

- Total electricity demand in Hawaii was an estimated 12,575 GWH in 2014. Of this amount, 2,108 GWH or 16.8 percent was supplied by customer rooftop photovoltaic (PV) 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 10,467 GWH. Electricity station use and transmission and distribution loss accounted for 10.1 percent, or 1,061 GWH, of the total electricity generated. Total electricity sold to consumers in 2014 was 9,406 GWH.
- From 2005 to 2014, total electricity demand in Hawaii increased an average of 0.3 percent per year, from 12,280 GWH to 12,575 GWH. Electricity generation by the electric power industry decreased 1.3 percent per year, from 11,755 GWH to 10,467 GWH. In contrast, electricity generated by user owned PV systems increased 82.1 percent per year from 2 GWH to 532 GWH; electricity replaced by SWH increased 7.4 percent per year from 84 GWH to 160 GWH; and electricity replaced by DSM programs increased 13.9 percent per year from 439 GWH to 1,416 GWH.
- The average price of electricity in 2014 was 33.5 cents/KWH statewide. Kauai consumers paid the highest electricity rate at 41.6 cents/KWH, followed by Big Island consumers at 39.6 cents/KWH, Maui consumers at 37.2 cents/KWH, and Oahu consumers at 31.5 cents/KWH.
- In 2014, 39.1 percent of the electricity was consumed by the industrial sector, 33.9 percent by the commercial sector, and 27.0 percent by the residential sector. From 2005 to 2014, electricity sold to the residential sector decreased an average of 2.4 percent per year. During the same period, electricity sold to the commercial sector and the industrial sector decreased an average of 0.9 percent and 0.7 percent per year, respectively.
- In 2013, approximately 70.3 percent of the electricity generated was from petroleum, representing a decrease of 19.7 percentage points from the 1990 figure of 90.0 percent. In 2014, renewable sources contributed 15.5 percent of the total electricity sold.
- The utility companies (HECO, MECO, HELCO, and KIUC) generated 56.0 percent of the total electricity in 2013, and purchased the remainder from IPPs and CHPs. This was a 26.4 percentage point decrease from 1990, when utilities generated 82.4 percent of the total electricity.

1. Introduction

Electricity plays an important role in Hawaii's economy. Hawaii's total expenditure on electricity reached a peak of about $3.3 billion in 2012, mainly due to the high price of petroleum at the time and the state's reliance on imported petroleum for electricity generation. 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% CPI growth during the same period. In 2013, total electricity expenditures decreased 3.9 percent due to decreased petroleum prices and reduced electricity sales from the utilities. Sales of electricity decreased 1.4 percent in 2013 due to increased electricity generation from customer-sited solar systems, which was not included in the electricity sales. In 2014, although electricity sales from the utilities decreased 1.0 percent, total electricity expenditures remained about the same as the previous year.

In November 2013, the Research and Economic Analysis Division of DBEDT published a report that examined Hawaii's electric power industry based on data up to 2012. As a follow up, this report is based on recently released data through 2014 and addresses 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 2014?

The data provided in this report are primarily from two sources. The first source is publicly available state level energy data from the U.S. Energy Information Administration (EIA). The second source of data is the Hawaii electric utility Monthly Financial Reports (MFR). The MFR provide 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: the 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*	10,161	54.2	10.0	28.3	3.9	3.6

* 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. As shown in Table 1, based on the most recent EIA data available, electric utilities accounted for about 56.0 percent of the 10,267 GWH of electricity generation by the electric power industry in 2013, the four types of non-utility producers accounted for about 44.0 percent of total generation. From 1990 to 2013, the electric utilities' share of total generation decreased from 82.4 percent to 56.0 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, as with the 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 from 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 2013, total utility generation (including station use) and purchased electricity in Hawaii was 10,344 GWH based on the utility MFR, slightly higher than the total electricity generation from the EIA data (10,267 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 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 5,840 GWH of electricity in 2014, a decrease of 4.3 percent or 260 GWH from the previous year. From 2005 to 2014, utility total generation decreased about 2.5 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 2014, station use for the state accounted for about 5.6 percent or 327 GWH of utility total generation. From 2005 to 2014, utility station use decreased 1.9 percent per year, less than the 2.5 percent decrease in total generation. As a result, the share of station use increased from 5.3 percent in 2005 to 5.6 percent in 2014 for the state. The share of station use was highest at HECO, followed by HELCO, MECO, and KIUC.

From 2005 to 2014, utility net generation decreased 2.5 percent per year on average, from 6,920 GWH in 2005 to 5,523 GWH in 2014. About 67.5 percent of Hawaii's utility net generation in 2014 was produced by HECO, 15.7 percent by MECO, 9.9 percent by HELCO, and 6.9 percent by KIUC.

Table 2. Hawaii Net Electricity Generation by Utility

		2005	2007	2009	2011	2012	2013	2014	Growth 2014	Avg. ann. Growth 2005 - 2014
Total utility generation										
State Total	GWh	7,309	7,328	6,889	6,818	6,377	6,100	5,840	-4.3%	-2.5%
HECO	GWh	5,021	5,153	4,779	4,699	4,399	4,170	3,970	-4.8%	-2.6%
HELCO	GWh	561	516	546	586	518	571	573	0.5%	0.2%
MECO	GWh	1,279	1,184	1,126	1,104	1,034	945	903	-4.4%	-3.8%
KIUC	GWh	448	475	438	429	426	415	394	-5.0%	-1.4%
Utility station use										
State Total	GWh	389	388	371	379	362	345	327	-5.2%	-1.9%
HECO	GWh	300	302	284	293	278	263	247	-5.9%	-2.1%
HELCO	GWh	31	27	30	31	29	30	28	-8.9%	-1.2%
MECO	GWh	45	45	45	43	43	40	40	-1.3%	-1.4%
KIUC	GWh	13	13	12	13	12	12	12	6.3%	-0.6%
Utility net generation										
State Total	GWh	6,920	6,941	6,518	6,439	6,016	5,755	5,513	-4.2%	-2.5%
HECO	GWh	4,721	4,851	4,495	4,406	4,121	3,907	3,723	-4.7%	-2.6%
HELCO	GWh	530	490	516	555	489	540	546	1.0%	0.3%
MECO	GWh	1,234	1,138	1,081	1,060	992	905	863	-4.6%	-3.9%
KIUC	GWh	435	462	426	417	414	403	381	-5.4%	-1.4%
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%	68.5%	67.9%	67.5%		
HELCO	%	7.7%	7.1%	7.9%	8.6%	8.1%	9.4%	9.9%		
MECO	%	17.8%	16.4%	16.6%	16.5%	16.5%	15.7%	15.7%		
KIUC	%	6.3%	6.7%	6.5%	6.5%	6.9%	7.0%	6.9%		
% of station use of utility generation										
State Total	%	5.3%	5.3%	5.4%	5.6%	5.7%	5.7%	5.6%		
HECO	%	6.0%	5.9%	5.9%	6.2%	6.3%	6.3%	6.2%		
HELCO	%	5.5%	5.1%	5.5%	5.2%	5.5%	5.3%	4.8%		
MECO	%	3.5%	3.8%	4.0%	3.9%	4.1%	4.3%	4.4%		
KIUC	%	2.9%	2.8%	2.6%	2.9%	2.8%	2.8%	3.1%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 3 shows that electricity purchased by the utilities increased from 4,202 GWH in 2005 to 4,371 GWH in 2014, an increase of 169 GWH. This increase is in contrast to the 1,407 GWH decrease in net utility generation during the same period. Electricity purchased decreased from 2005 to 2011, but increased from 2011 to 2014. In 2014, electricity purchased increased 3.0 percent or 127 GWH. 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 44.2 percent in 2014.

Table 3. Hawaii Electricity Sales by Utility

		2005	2007	2009	2011	2012	2013	2014	Growth 2014	Avg. ann. Growth 2005 - 2014
Electricity purchased										
State Total	GWh	4,202	4,255	4,154	4,046	4,131	4,244	4,371	3.0%	0.4%
HECO	GWh	3,383	3,238	3,267	3,187	3,190	3,281	3,379	3.0%	0.0%
HELCO	GWh	688	769	669	631	681	619	595	-3.9%	-1.6%
MECO	GWh	97	221	185	191	222	296	333	12.5%	14.7%
KIUC	GWh	35	27	34	37	38	49	65	32.1%	7.1%
Electricity net to system										
State Total	GWh	11,122	11,195	10,672	10,485	10,147	9,999	9,884	-1.1%	-1.3%
HECO	GWh	8,104	8,089	7,762	7,594	7,311	7,187	7,102	-1.2%	-1.5%
HELCO	GWh	1,217	1,259	1,184	1,187	1,170	1,159	1,140	-1.6%	-0.7%
MECO	GWh	1,331	1,359	1,266	1,252	1,214	1,201	1,196	-0.4%	-1.2%
KIUC	GWh	470	489	460	453	452	452	446	-1.3%	-0.6%
Utility loss										
State Total	GWh	584	610	546	524	508	498	478	-4.0%	-2.2%
HECO	GWh	383	414	384	352	335	329	320	-2.6%	-2.0%
HELCO	GWh	101	96	64	83	85	83	78	-6.3%	-2.9%
MECO	GWh	79	79	74	70	69	66	64	-2.3%	-2.2%
KIUC	GWh	21	22	24	19	19	20	16	-21.8%	-3.0%
Total electricity sold										
State Total	GWh	10,539	10,585	10,126	9,962	9,639	9,501	9,406	-1.0%	-1.3%
HECO	GWh	7,721	7,675	7,378	7,242	6,976	6,859	6,782	-1.1%	-1.4%
HELCO	GWh	1,116	1,163	1,120	1,104	1,085	1,076	1,063	-1.3%	-0.5%
MECO	GWh	1,252	1,280	1,192	1,181	1,145	1,135	1,132	-0.2%	-1.1%
KIUC	GWh	449	467	437	435	433	431	430	-0.4%	-0.5%
Share of purchased of net to system										
State Total	%	37.8%	38.0%	38.9%	38.6%	40.7%	42.4%	44.2%		
HECO	%	41.7%	40.0%	42.1%	42.0%	43.6%	45.6%	47.6%		
HELCO	%	56.5%	61.1%	56.5%	53.2%	58.2%	53.4%	52.1%		
MECO	%	7.3%	16.2%	14.6%	15.3%	18.3%	24.7%	27.8%		
KIUC	%	7.4%	5.5%	7.5%	8.1%	8.4%	10.8%	14.5%		
Share of loss of net to system										
State Total	%	5.2%	5.5%	5.1%	5.0%	5.0%	5.0%	4.8%		
HECO	%	4.7%	5.1%	4.9%	4.6%	4.6%	4.6%	4.5%		
HELCO	%	8.3%	7.6%	5.4%	7.0%	7.3%	7.2%	6.8%		
MECO	%	5.9%	5.8%	5.8%	5.6%	5.7%	5.5%	5.4%		
KIUC	%	4.5%	4.5%	5.2%	4.1%	4.1%	4.5%	3.6%		

Source: Hawaii Electric Utility Monthly Financial Reports.

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 4.8 percent of the electricity sent to the system was lost in 2014. The percent of loss was highest in the HELCO system (6.8%), followed by MECO (5.4%), HECO (4.5%), and KIUC (3.6%). Total electricity sold is electricity net to system minus electricity lost. From 2005 to 2014, total electricity sold decreased 1.3 percent per year on average from 10,539 GWH to 9,406 GWH. The system loss share of electricity net to system decreased from 5.2 percent to 4.8 percent for the state over this period.

Table 4 shows that utility station use and loss decreased from 972 GWH in 2005 to 805 GWH in 2014, a decrease of 2.1 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 7.9 percent in 2014.

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

		2005	2007	2009	2011	2012	2013	2014	Growth 2014	Avg. ann. Growth 2005 - 2014
Total utility generation and purchased 1/										
State Total	GWh	11,511	11,583	11,043	10,864	10,508	10,344	10,211	-1.3%	-1.3%
HECO	GWh	8,404	8,392	8,046	7,886	7,589	7,450	7,349	-1.4%	-1.5%
HELCO	GWh	1,248	1,285	1,214	1,217	1,199	1,189	1,168	-1.8%	-0.7%
MECO	GWh	1,376	1,404	1,311	1,295	1,256	1,241	1,236	-0.4%	-1.2%
KIUC	GWh	482	502	472	466	464	463	458	-1.1%	-0.6%
Station use and loss										
State Total	GWh	972	998	916	903	869	843	805	-4.5%	-2.1%
HECO	GWh	683	716	668	644	613	592	568	-4.1%	-2.0%
HELCO	GWh	132	123	94	114	114	113	105	-7.0%	-2.4%
MECO	GWh	124	124	118	114	111	106	104	-1.9%	-1.9%
KIUC	GWh	34	35	35	31	31	32	28	-11.6%	-2.0%
% of station use and loss										
State Total	%	8.4%	8.6%	8.3%	8.3%	8.3%	8.1%	7.9%	-3.2%	-0.8%
HECO	%	8.1%	8.5%	8.3%	8.2%	8.1%	7.9%	7.7%	-2.8%	-0.6%
HELCO	%	10.5%	9.5%	7.8%	9.3%	9.5%	9.5%	9.0%	-5.3%	-1.7%
MECO	%	9.0%	8.8%	9.0%	8.8%	8.9%	8.6%	8.4%	-1.6%	-0.7%
KIUC	%	7.0%	7.0%	7.5%	6.7%	6.6%	6.9%	6.2%	-10.6%	-1.5%

1/ Excluding station use of non-utility producers.

Source: Hawaii Electric Utility Monthly Financial Reports.

Since the station use of non-utility producers is not available, the percentage of station use and loss calculated above underestimates the true share of station use and loss as a percentage of the whole electric system of Hawaii. If we assume that the share of station use of the non-utility producers as a percentage of purchased electricity is similar to that of the share of utility station

use in net generation as shown in Table 5, the share of total station use and loss in gross generation would be about 10.1 percent in 2014.

Hawaii's gross electricity generation in 2014 was estimated to be about 10,467 GWH. In 2014, about 72 percent of the gross generation was produced by the HECO system (including both utility and non-utility producers), while HELCO and MECO accounted for about 11 percent and 12 percent of gross generation, respectively, and KIUC accounted for about 4 percent. From 2005 to 2014, the county utilities' share of gross generation was fairly stable.

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

		2005	2007	2009	2011	2012	2013	2014	Growth 2014	Avg. ann. Growth 2005 - 2014
Station use of non-utility										
State Total	GWh	244	239	239	240	250	254	256	0.9%	0.5%
HECO	GWh	202	190	194	198	202	207	211	1.8%	0.5%
HELCO	GWh	38	40	37	33	38	33	29	-12.9%	-3.0%
MECO	GWh	3	8	7	8	9	13	15	16.2%	17.5%
KIUC	GWh	1	1	1	1	1	1	2	48.0%	8.0%
Total gross generation 1/										
State Total	GWh	11,755	11,822	11,282	11,104	10,758	10,598	10,467	-1.2%	-1.3%
HECO	GWh	8,606	8,582	8,240	8,085	7,791	7,657	7,560	-1.3%	-1.4%
HELCO	GWh	1,286	1,325	1,251	1,250	1,237	1,222	1,197	-2.1%	-0.8%
MECO	GWh	1,379	1,413	1,318	1,302	1,265	1,254	1,251	-0.2%	-1.1%
KIUC	GWh	484	503	473	467	465	465	460	-1.0%	-0.5%
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%	0.0%	-0.2%
HELCO	%	11%	11%	11%	11%	11%	12%	11%	-0.9%	0.5%
MECO	%	12%	12%	12%	12%	12%	12%	12%	1.0%	0.2%
KIUC	%	4%	4%	4%	4%	4%	4%	4%	0.2%	0.7%
Total station use and loss										
State Total	GWh	1,217	1,237	1,156	1,143	1,119	1,097	1,061	-3.2%	-1.5%
HECO	GWh	885	906	863	842	815	799	778	-2.6%	-1.4%
HELCO	GWh	169	162	131	147	152	146	134	-8.3%	-2.6%
MECO	GWh	127	133	126	121	120	119	119	0.0%	-0.8%
KIUC	GWh	35	36	36	32	32	33	30	-9.1%	-1.6%
% of station use and loss										
State Total	%	10.3%	10.5%	10.2%	10.3%	10.4%	10.3%	10.1%	-2.0%	-0.2%
HECO	%	10.3%	10.6%	10.5%	10.4%	10.5%	10.4%	10.3%	-1.3%	0.0%
HELCO	%	13.2%	12.2%	10.5%	11.7%	12.3%	12.0%	11.2%	-6.4%	-1.8%
MECO	%	9.2%	9.4%	9.5%	9.3%	9.5%	9.5%	9.5%	0.2%	0.3%
KIUC	%	7.2%	7.1%	7.7%	6.9%	6.8%	7.2%	6.6%	-8.2%	-1.0%

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 increasing energy prices prior to 2015 were mainly due to its heavy dependence on imported petroleum as the major fuel for electricity generation. Before 1990, Hawaii's electricity was almost all generated from petroleum products. However, since 1990, electricity generated from waste, coal, and geothermal energy became more significant. Nevertheless, petroleum remains the dominant fuel in Hawaii's electricity generation and is the primary driver for the rapid growth 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	Geothermal	Hydro	Wind	Solar	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	0.6	0.2	-	-
1993	9,944	74.4	14.9	0.6	7.8	1.5	0.6	0.2	-	-
1994	10,109	75.6	13.1	0.7	7.2	1.8	1.4	0.2	-	-
1995	10,304	74.5	15.2	0.7	6.2	2.3	0.9	0.2	-	0.0
1996	10,628	74.9	15.5	0.6	5.6	2.3	1.0	0.2	-	-
1997	10,312	74.6	15.3	0.6	5.9	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	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

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
Source: Energy Information Administration, State Energy Data System

As shown in Table 6, from 1990 to 2013, the share of petroleum generated electricity in Hawaii (including both utility and non-utility producers) decreased from 90.0 percent to 70.3 percent; the share of coal generated electricity increased from 0.0 percent to 13.7 percent; the share of wind generated electricity increased from 0.3 percent to 4.9 percent; the share of geothermal

electricity increased from 0.0 to 2.7 percent; and the share of biomass decreased from 8.7 percent to 2.7 percent. In 2013, total renewable electricity (excluding customer-sited solar) accounted for about 12 percent of total electricity generation.

Since most of the non-petroleum generated electricity was produced by non-utility producers, the high petroleum price affected the average cost of purchased electricity less than the fuel cost of utility generated electricity. As shown in Table 7, almost all electricity generated from the utilities was from petroleum. From 1990 to 2013, the share of petroleum generated electricity as a percentage of total utility generated electricity decreased from 99.6 percent to 95.6 percent; the share of utility petroleum generated electricity as a percentage of total petroleum generated electricity decreased from 91.2 percent to 76.1 percent over the same period.

Table 7. Electricity Generation by Source: Electric Utilities

	Total Electricity Generation	% of Total Electricity Generation								
Year	GWH	Petroleum	Coal	Other Gases 1/	Biomass	Geothermal	Hydro	Wind	Solar	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

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
Source: Energy Information Administration, State Energy Data System

As shown in Table 8, from 1990 to 2013, the share of petroleum generated electricity in non-utility generated electricity decreased from 45.0 percent to 38.2 percent; the share of coal generated electricity increased from 0.1 percent to 31.1 percent; the share of wind generated electricity increased from 1.7 percent to 11.1 percent; the share of geothermal electricity increased from 0.0 to 6.1 percent; and the share of biomass decreased from 48.9 percent to 6.7 percent.

The increased share of non-petroleum generated electricity, especially coal-fired electricity, contributed to a lower growth rate of purchased electricity costs. 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 of about 32 cents per kWh. The average fuel cost of HECO generated electricity was about 22 cents per kWh, and the average cost of HECO purchased power was 16 cents per kWh in 2014.

Table 8. Electricity Generation by Source: IPP & CHP

	Total Electricity Generation	% of Total Electricity Generation								
Year	GWH	Petroleum	Coal	Other Gases 1/	Biomass	Geothermal	Hydro	Wind	Solar	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	0.1	1.7	0.8	-	-
1993	3,860	34.3	38.3	1.6	20.1	3.9	1.1	0.6	-	-
1994	4,054	39.6	32.7	1.6	18.0	4.6	3.0	0.5	-	-
1995	4,113	36.6	38.0	1.7	15.6	5.7	2.0	0.5	-	0.1
1996	4,208	37.1	39.0	1.4	14.1	5.8	2.0	0.5	-	-
1997	4,100	36.5	38.4	1.6	14.8	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	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

1/ Other gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
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 3,008 MW in 2013, an increase of 1.8 percent per year on average. As shown in Table 9, coal-fired capacity increased from 24 MW to 203 MW or 9.8 percent per year over the period, wind capacity increased from 23 MW to 206 MW or 10.0 percent per year on average, petroleum generation capacity increased from 1,692 MW to 2,181 MW or an average of 1.1 percent over the period, and biomass capacity increased from 211 MW to 260 MW or a 0.9 percent average per year.

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	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	-	-	2,556
2001	2,093	227	9	151	35	26	11	-	-	2,552
2002	2,093	227	9	110	35	25	11	-	-	2,509
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	-	-	2,648
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	-	2,805
2010	2,214	203	9	227	35	25	62	2	-	2,776
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

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 1,945 MW in 2013, an increase of 1.0 percent per year on average. The generating capacity added by the utilities from 1990 to 2013 was mainly petroleum and biomass-fired (utilizing biodiesel) capacity. In 2014, the average cost of biodiesel for HECO was about 65 cents per kWh, much higher than the HECO average cost of diesel at about 56 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	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	-	-	1,711
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	-	-	1,840
2007	1,838	-	-	-	-	4	2	-	-	1,845
2008	1,838	-	-	-	-	4	2	-	-	1,845
2009	1,856	-	-	113	-	4	2	-	-	1,976
2010	1,827	-	-	113	-	4	-	-	-	1,945
2011	1,827	-	-	113	-	4	-	-	-	1,945
2012	1,788	-	-	113	-	4	-	-	39	1,945
2013	1,788	-	-	113	-	4	-	-	39	1,945

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 1,064 MW in 2013, an increase of 4.0 percent per year on average. The growth rate of wind capacity was the highest during this period at 10.0 percent on average per year. Wind was followed by coal-fired capacity at 9.8 percent per year and petroleum capacity at 4.2 percent per year. Geothermal capacity increased from zero to 51 MW, but the biomass capacity decreased from 211 MW to 147 MW over the period.

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	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	-	-	845
2001	390	227	9	151	35	23	9	-	-	844
2002	391	227	9	110	35	23	9	-	-	803
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	-	-	808
2007	386	203	9	114	35	21	62	-	-	829
2008	386	203	9	114	35	21	62	1	-	830
2009	386	203	9	114	35	21	62	1	-	829
2010	387	203	9	114	35	21	62	2	-	831
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

Source: Energy Information Administration, State Energy Data System

The detailed power generating capacity by county in 2013 is provided in Table 12. Currently, the state of Hawaii has about 2,433 MW firm capacity; 1,731 MW in Honolulu, 286 MW in Hawaii County, 290 MW in Maui County, and 125 MW in Kauai County. About 82.4 percent of the firm capacity is generated from petroleum, 7.4 percent from coal, and 8.6 percent from biofuel or waste.

The state also installed about 269 MW non-firm capacity, mostly belonging to non-utility producers; there is 138 MW in Honolulu, 49 MW in Hawaii County, 74 MW in Maui County, and 8 MW in Kauai County. Wind accounted for about 75.6 percent of the non-firm capacity; followed by hydro at 9.2 percent, petroleum at 6.9 percent, and solar at 4.8 percent. In addition, about 303 MW customer-sited solar was installed in the state, with210 MW in Honolulu, 38 MW in Hawaii County, 41 MW in Maui County, and 14 MW in Kauai County. Most of the electricity generated from the customer-sited systems is directly consumed by the consumers and not included in the utility electricity sales.

Table 12. Power Generating Capacity by Type in 2013

	Petroleum	Coal	Other Gases	Biofuel Waste	Geothermal	Hydro	Wind	Solar	Total
State Total MW	2,023	180	10	209	38	26	203	13	2,701
State Total Firm MW	2,004	180	-	209	38	1	-	-	2,433
State Total Non-Firm MW	19	-	10	-	-	25	203	13	269
State Total Customer-Sited Solar	-	-	-	-	-	-	-	303	303
State Total MW	2,023	180	10	209	38	26	203	13	2,701
Honolulu	1,377	180	10	193	-	-	99	11	1,869
Hawaii	248	-	-	-	38	16	32	1	335
Maui	274	-	-	16	-	1	72	1	364
Kauai	124	-	-	-	-	9	-	-	133
State Total Firm MW	2,004	180	-	209	38	1	-	-	2,433
Honolulu	1,358	180	-	193	-	-	-	-	1,731
Hawaii	248	-	-	-	38	-	-	-	286
Maui	274	-	-	16	-	-	-	-	290
Kauai	124	-	-	-	-	1	-	-	125
State Total Non-Firm MW	19	-	10	-	-	25	203	13	269
Honolulu	19	-	10	-	-	-	99	11	138
Hawaii	-	-	-	-	-	16	32	1	49
Maui	-	-	-	-	-	1	72	1	74
Kauai	-	-	-	-	-	8	-	-	8
State Total Customer-Sited Solar	-	-	-	-	-	-	-	303	303
Honolulu	-	-	-	-	-	-	-	210	210
Hawaii	-	-	-	-	-	-	-	38	38
Maui	-	-	-	-	-	-	-	41	41
Kauai	-	-	-	-	-	-	-	14	14

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 base load needs have higher 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	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	3,509	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	3,554	6,177	5,052	902	-	4,047
1995	3,887	6,853	7,701	3,314	6,701	3,384	932	-	4,136
1996	4,014	7,213	6,707	3,071	6,914	3,600	1,023	-	4,252
1997	3,899	6,913	7,265	3,406	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	-	4,145
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	-	4,648
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	-	4,365
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	3,925
2010	3,653	7,613	2,435	1,249	5,731	2,817	4,212	885	3,903
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

Source: Energy Information Administration, State Energy Data System

As shown in Table 13, for the whole electric power industry in 2013, coal-fired generating units have the highest average operating hours at 6,915 hours per year, followed by other gases-fueled capacity at 6,888 hours per year, and geothermal units at 5,389 hours per year. The coal and geothermal units serve base load needs. Hydro and petroleum units have average operating hours of around 3,000-3,300 hours per year, similar to the average operating hours of all units at

3,413 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 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 2,956 hours per year in 2013, a decrease of 2.4 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 4,247 hours per year in 2013, an increase of 0.3 percent per year on average.

Table 14. Average Operating Hours: Electric Utilities

	Average Operating Hours Units: Hours/Year								
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar	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	-	3,819
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	-	3,826
2007	3,761	-	-	-	-	3,682	219	-	3,755
2008	3,636	-	-	-	-	4,468	86	-	3,632
2009	3,374	-	-	29	-	7,152	43	-	3,294
2010	3,382	-	-	14	-	4,180	-	-	3,299
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

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 3,073 hours per year in 2013, an average decrease of 2.2 percent per year. The average operating hours of non-utility units decreased from 5,000 hours per year in 1990 to 4,400 hours per year in 2013, an average decrease of 0.6 percent per year.

Table 15. Average Operating Hours: IPP and CHP

	Average Operating Hours Units: Hours/Year								
Year	Petroleum	Coal	Other Gases	Biomass	Geothermal	Hydro	Wind	Solar	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	3,509	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	3,554	6,177	4,974	902	-	4,830
1995	4,697	6,853	7,701	3,314	6,701	3,204	932	-	4,941
1996	4,874	7,213	6,707	3,071	6,914	3,372	1,023	-	5,054
1997	4,669	6,913	7,265	3,406	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	-	4,803
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	-	5,168
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	-	5,592
2007	5,184	7,778	5,025	2,502	6,568	3,696	3,835	-	5,555
2008	5,149	8,116	4,286	2,653	6,695	3,165	3,869	18	5,633
2009	5,251	7,390	2,483	2,466	4,788	4,002	4,054	1,390	5,429
2010	4,932	7,613	2,435	2,473	5,731	2,557	4,212	885	5,319
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

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, total petroleum used for electricity generation decreased from about 16.0 million barrels (BBLs) in 1990 to 10.8 million BBLs in 2013, an average decrease of 1.7 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 2013, total electricity generated by petroleum decreased an average of 0.8 percent per year and petroleum consumption per MWH of electricity decreased 0.9 percent per year, from 1.84 BBL per MWH in 1990 to 1.49 BBL per MWH in 2013.

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

Source: Energy Information Administration, State Energy Data System

Coal used for electricity generation in Hawaii was very limited before 1993. From 1993 to 2013, total coal used for electricity generation increased from 603,669 short tons (STs) to 701,013 STs, an average increase of 0.8 percent per year. During this period, total coal generated electricity decreased 0.3 percent per year, but coal consumption per MWH generated increased 1.0 percent per year on average from 0.41 ST per MWH to 0.50 ST per MWH.

The utilities account 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 2013, petroleum consumption per MWH decreased only slightly from 1.73 BBL per MWH to 1.69 BBL per MWH.

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	-	-

Source: Energy Information Administration, State Energy Data System

For non-utility producers, petroleum consumption per MWH produced decreased significantly over time. From 1990 to 2013, petroleum consumption per MWH decreased an average of 5.2 percent per year from 2.95 BBL to 0.87 BBL. In 2013, the per unit petroleum consumption for non-utility producers was only about 52 percent of the unit consumption by utility producers.

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

Source: Energy Information Administration, State Energy Data System

Fuel consumption data provided by EIA is only available at the state level, and the most recent data available is the 2013 data. 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 2014. The fuel cost of non-utility producers, however, is not available in the utility MFR.

As shown in Table 19, from 2005 to 2014, total petroleum consumption by the four electric utilities in Hawaii decreased an average of 2.9 percent per year from about 12.0 million BBLs to about 9.3 million BBLs; fuel oil consumption decreased an average of 3.1 percent per year from 9.1 million BBLs to 6.9 million BBLs; diesel oil (excluding biodiesel) consumption decreased an average of 2.2 percent per year from 2.9 million BBLs to 2.4 million BBLs. In 2014, petroleum consumption by the utilities decreased 3.8 percent from the previous year, fuel oil decreased 4.7 percent, and diesel decreased 1.1 percent.

Table 19. Hawaii Utility Fuel Consumption

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Petroleum										
State Total	BBL	12,046,758	12,045,419	11,244,809	10,873,734	10,027,770	9,633,073	9,265,797	-3.8%	-2.9%
HECO	BBL	7,993,010	8,195,607	7,555,082	7,312,962	6,719,585	6,408,203	6,167,276	-3.8%	-2.8%
HELCO	BBL	1,136,268	1,067,210	1,089,738	1,031,711	904,034	997,659	965,542	-3.2%	-1.8%
MECO	BBL	2,170,554	1,959,432	1,869,575	1,806,667	1,697,767	1,539,175	1,480,580	-3.8%	-4.2%
KIUC	BBL	746,926	823,170	730,414	722,394	706,384	688,036	652,399	-5.2%	-1.5%
Fuel Oil										
State Total	BBL	9,120,687	9,358,136	8,617,627	8,263,907	7,612,236	7,207,891	6,867,426	-4.7%	-3.1%
HECO	BBL	7,874,530	8,098,475	7,411,899	7,285,178	6,703,981	6,391,243	6,112,576	-4.4%	-2.8%
HELCO	BBL	726,866	787,051	734,535	577,107	533,394	533,483	458,212	-14.1%	-5.0%
MECO	BBL	519,291	472,610	471,193	401,622	374,861	283,165	296,638	4.8%	-6.0%
KIUC	BBL	-	-	-	-	-	-	-	-	
Diesel										
State Total	BBL	2,926,071	2,687,283	2,627,182	2,609,827	2,415,534	2,425,182	2,398,371	-1.1%	-2.2%
HECO	BBL	118,480	97,132	143,183	27,784	15,604	16,960	54,700	222.5%	-8.2%
HELCO	BBL	409,402	280,159	355,203	454,604	370,640	464,176	507,330	9.3%	2.4%
MECO	BBL	1,651,263	1,486,822	1,398,382	1,405,045	1,322,906	1,256,010	1,183,942	-5.7%	-3.6%
KIUC	BBL	746,926	823,170	730,414	722,394	706,384	688,036	652,399	-5.2%	-1.5%
% of Fuel Oil										
State Total	%	75.7%	77.7%	76.6%	76.0%	75.9%	74.8%	74.1%		
HECO	%	98.5%	98.8%	98.1%	99.6%	99.8%	99.7%	99.1%		
HELCO	%	64.0%	73.7%	67.4%	55.9%	59.0%	53.5%	47.5%		
MECO	%	23.9%	24.1%	25.2%	22.2%	22.1%	18.4%	20.0%		
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%	88.1%	88.7%	89.0%		
HELCO	%	8.0%	8.4%	8.5%	7.0%	7.0%	7.4%	6.7%		
MECO	%	5.7%	5.1%	5.5%	4.9%	4.9%	3.9%	4.3%		
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%	0.6%	0.7%	2.3%		
HELCO	%	14.0%	10.4%	13.5%	17.4%	15.3%	19.1%	21.2%		
MECO	%	56.4%	55.3%	53.2%	53.8%	54.8%	51.8%	49.4%		
KIUC	%	25.5%	30.6%	27.8%	27.7%	29.2%	28.4%	27.2%		

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 74.1 percent in 2014. For HECO, almost all the petroleum consumed was fuel oil. Fuel oil also accounted for about half of total petroleum consumption at HELCO in 2014. Fuel oil only accounted for about 20 percent of total petroleum consumption at MECO, and all petroleum consumed at KIUC was diesel.

From 2005 to 2012, the cost of fuel oil and diesel oil increased significantly for Hawaii's utilities, 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	Growth in 2014	Avg. ann. Growth 2005 - 2014
Petroleum										
State Total	$M	694	850	724	1,339	1,373	1,259	1,193	-5.3%	6.2%
HECO	$M	421	526	460	892	926	833	798	-4.3%	7.4%
HELCO	$M	65	75	74	122	117	126	117	-6.6%	6.7%
MECO	$M	154	174	137	234	235	209	193	-7.4%	2.6%
KIUC	$M	54	76	52	91	94	92	84	-8.0%	5.1%
Fuel Oil										
State Total	$M	467	592	519	993	1,033	922	868	-5.8%	7.1%
HECO	$M	412	516	447	889	924	831	790	-4.9%	7.5%
HELCO	$M	33	48	44	62	65	60	48	-19.8%	4.1%
MECO	$M	22	28	28	42	44	31	30	-3.6%	3.2%
KIUC	$M	-	-	-	-	-	-	-		
Diesel										
State Total	$M	226	258	205	346	339	338	325	-3.9%	4.1%
HECO	$M	9	9	13	3	2	2	7	229.2%	-2.2%
HELCO	$M	32	27	30	60	52	66	69	5.3%	9.0%
MECO	$M	132	145	110	192	191	178	164	-8.1%	2.4%
KIUC	$M	54	76	52	91	94	92	84	-8.0%	5.1%
% of Fuel Oil										
State Total	%	67.4%	69.6%	71.7%	74.2%	75.3%	73.2%	72.8%		
HECO	%	97.9%	98.2%	97.2%	99.7%	99.8%	99.7%	99.1%		
HELCO	%	51.2%	63.5%	59.1%	50.6%	55.4%	47.5%	40.8%		
MECO	%	14.5%	16.2%	20.3%	18.0%	18.7%	14.7%	15.3%		
KIUC	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Source: Hawaii Electric Utility Monthly Financial Reports.

As shown in Table 20 above, from 2005 to 2012, total petroleum costs by the utilities in Hawaii increased an average of 10.2 percent per year from $694 million to $1.37 billion; fuel oil costs increased an average of 12.0 percent per year from $467 million to $1.03 billion; diesel oil costs increased an average of 6.0 percent per year from $226 million to $339 million. Due to the faster growth in 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. In 2013 and 2014, however, the costs of fuel oil and diesel both decreased from the previous year.

The decrease in diesel expenditures by HECO is due to the increased use of biodiesel. In 2014, HECO spent $23.5 million on biodiesel. The average cost of biodiesel consumed by HECO was $202.83/BBL, significantly higher than the average cost of diesel ($134.92/BBL).

The average unit cost of petroleum used in utility electricity generation increased rapidly from 2005 to 2012 with the growth rate being significantly higher than the growth rate of crude oil prices. As shown in Table 21, 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 an average of 14.9 percent per year from $51.22 per BBL to $135.72 per BBL, and diesel oil (excluding biodiesel) costs increased an average of 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 of 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; and the unit diesel cost also decreased. In 2014, the unit fuel oil costs were highest at HECO, followed by HELCO and MECO. Unit diesel costs were highest at MECO, followed by HELCO, HECO, and KIUC.

Table 21. Hawaii Utility Average Fuel Cost

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Petroleum										
State Total	$/BBL	57.57	70.60	64.38	123.11	136.88	130.73	128.71	-1.5%	9.4%
HECO	$/BBL	52.61	64.13	60.90	121.99	137.86	130.05	129.35	-0.5%	10.5%
HELCO	$/BBL	57.44	70.24	68.28	118.09	129.27	125.81	121.40	-3.5%	8.7%
MECO	$/BBL	70.88	88.60	73.54	129.58	138.60	135.57	130.51	-3.7%	7.0%
KIUC	$/BBL	72.19	92.64	71.13	125.40	133.12	133.37	129.37	-3.0%	6.7%
Fuel Oil										
State Total	$/BBL	51.22	63.27	60.24	120.15	135.72	127.85	126.38	-1.2%	10.6%
HECO	$/BBL	52.26	63.75	60.34	122.03	137.88	130.04	129.30	-0.6%	10.6%
HELCO	$/BBL	45.96	60.50	59.89	106.84	121.43	111.80	104.45	-6.6%	9.6%
MECO	$/BBL	42.93	59.63	59.24	105.17	117.39	108.67	99.99	-8.0%	9.8%
KIUC	$/BBL									
Diesel										
State Total	$/BBL	77.36	96.13	77.96	132.48	140.52	139.28	135.38	-2.8%	6.4%
HECO	$/BBL	76.07	95.67	89.82	112.16	128.37	132.18	134.92	2.1%	6.6%
HELCO	$/BBL	77.84	97.63	85.63	132.38	140.56	141.92	136.71	-3.7%	6.5%
MECO	$/BBL	79.67	97.80	78.36	136.56	144.61	141.64	138.15	-2.5%	6.3%
KIUC	$/BBL	72.19	92.64	71.13	125.40	133.12	133.37	129.37	-3.0%	6.7%

Source: Hawaii Electric Utility Monthly Financial Reports.

In recent years, electricity generated from renewable sources has increased significantly. Based on data provided by the utilities' Renewable Portfolio Standard Status Reports from 2005 to 2014, total renewable electricity generated by the electric power industry (excluding customer generated electricity) increased 8.3 percent per year on average from 714 GWH to 1,457 GWH (Table 22). The renewable electricity share of total electricity sales increased from 6.8 percent to 15.5 percent during this period.

In 2014, 39.7 percent of Hawaii's renewable electricity was generated from wind, 29.7 percent from biomass, 17.5 percent from geothermal, 5.9 percent from hydro, 2.5 percent from biofuels, and 4.7 percent from PV and solar thermal.

Table 22. Renewable Electricity Generation in Hawaii

	Renewable Electricity Generation (GWH)						
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	PV&Solar
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
Growth 05-14	8.3%	0.8%	93.0%	1.6%	0.4%	63.3%	
	% in Renewable Electricity Generation						
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	PV & Solar
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

Source: HECO and KIUC Renewable Portfolio Standard Status Report.

Table 23 shows renewable electricity generation by county. From 2005 to 2014, Honolulu renewable electricity generation increased the most at 314 GWH or 7.7 percent per year. This was followed by Maui at 240 GWH or 17.3 percent per year, Hawaii County at 168 GWH or 5.5 percent per year, and Kauai at 21 GWH or 5.0 percent per year. In 2014, renewable electricity accounted for about 41.0 percent of electricity sales in Hawaii County. Hawaii County was followed by Maui at about 27.9 percent, Kauai at 13.6 percent, and Honolulu at 9.5 percent.

Table 23. Hawaii Renewable Electricity Generation by County

		2005	2007	2009	2011	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Renewable Generation State	GWH	714	938	930	1,096	1,352	1,457	7.7%	8.3%
Honolulu	GWH	333	326	364	431	552	647	17.3%	7.7%
Hawaii	GWH	268	389	368	436	470	436	-7.3%	5.5%
Maui	GWH	75	196	161	189	283	315	11.6%	17.3%
Kauai	GWH	37	26	37	40	48	58	22.5%	5.0%
Biomass State	GWH	403	392	399	365	416	433	4.2%	0.8%
Honolulu	GWH	333	326	360	322	375	390	4.1%	1.8%
Hawaii	GWH	-	-	-	-	-	-		
Maui	GWH	70	66	38	44	41	43	4.9%	-5.2%
Kauai	GWH	-	-	-	-	-	-		
Biofuels State	GWH	0	1	5	59	30	37	24.5%	93.0%
Honolulu	GWH	-	-	3	45	29	36	26.9%	
Hawaii	GWH	-	-	-	-	-	-		
Maui	GWH	0	1	2	15	1	1	-28.3%	27.9%
Kauai	GWH	-	-	-	-	-	-		
Geothermal State	GWH	221	230	168	233	281	255	-9.4%	1.6%
Honolulu	GWH	-	-	-	-	-	-		
Hawaii	GWH	221	230	168	233	281	255	-9.4%	1.6%
Maui	GWH	-	-	-	-	-	-		
Kauai	GWH	-	-	-	-	-	-		
Hydroelectricity State	GWH	82	72	107	90	74	85	16.2%	0.4%
Honolulu	GWH	-	-	-	-	-	-		
Hawaii	GWH	40	42	60	45	35	43	21.4%	0.8%
Maui	GWH	5	3	10	6	5	8	71.8%	5.6%
Kauai	GWH	37	26	37	39	33	34	2.8%	-1.0%
Wind State	GWH	7	242	250	344	504	578	14.8%	63.3%
Honolulu	GWH	-	-	-	64	122	184	51.1%	
Hawaii	GWH	7	116	141	157	152	136	-10.2%	39.1%
Maui	GWH	-	126	110	123	230	258	12.0%	
Kauai	GWH	-	-	-	-	-	-		
Photovoltaic and Solar State	GWH	-	-	1	4	48	68	41.7%	
Honolulu	GWH	-	-	-	0	27	37	36.8%	
Hawaii	GWH	-	-	-	0	2	2	2.8%	
Maui	GWH	-	-	1	2	5	5	4.5%	
Kauai	GWH	-	-	-	1	14	24	68.3%	
Electricity Sold State	GWH	10,539	10,585	10,126	9,962	9,501	9,406	-1.0%	-1.3%
Honolulu	GWH	7,721	7,675	7,378	7,242	6,859	6,782	-1.1%	-1.4%
Hawaii	GWH	1,116	1,163	1,120	1,104	1,076	1,063	-1.3%	-0.5%
Maui	GWH	1,252	1,280	1,192	1,181	1,135	1,132	-0.2%	-1.1%
Kauai	GWH	449	467	437	435	431	430	-0.4%	-0.5%
% of Renewable State	%	6.8	8.9	9.2	11.0	14.2	15.5		
Honolulu	%	4.3	4.2	4.9	5.9	8.0	9.5		
Hawaii	%	24.0	33.4	32.9	39.5	43.7	41.0		
Maui	%	6.0	15.3	13.5	16.0	24.9	27.9		
Kauai	%	8.4	5.7	8.5	9.3	11.0	13.6		

Source: HECO and KIUC Renewable Portfolio Standard Status Report.

4. Factors Affecting Electricity Prices in Hawaii

In 2014, the 9,406 GWH of electricity sold in Hawaii generated a total revenue of about $3.2 billion. Total revenue or total cost to customers of electricity in Hawaii increased 5.6 percent per year on average from $1.9 billion in 2005 to $3.2 billion in 2014. Revenue from electricity sales increased 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. Following a slight increase from 2005 to 2007, total GWH sold has been decreasing each year since 2007.

The increased electricity cost to customers was due to the increased average price of electricity. As shown in Table 24, the average revenue per kWh sold in Hawaii increased from 18.3 cents in 2005 to 33.5 cents in 2014, an increase of 7.0 percent per year. In 2014, the average revenue from electricity sales increased 1.0 percent from the previous year. The average electricity revenue in 2014 was the highest at KIUC at about 41.6 cents per kWh. This was followed by HELCO at 39.6 cents per kWh, MECO at 37.2 cents per kWh, and HECO at 31.5 cents per kWh. From 2005 to 2014, the average cost of electricity increased the most at HECO at 8.1 percent per year. HECO was followed by MECO at 4.9 percent per year, HELCO at 4.6 percent per year, and KIUC at 4.1 percent per year.

Table 24. Hawaii Average Revenue of Electricity by Utility

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Revenue from electricity sales										
State Total	$M	1,927	2,253	2,148	3,147	3,281	3,153	3,154	0.0%	5.6%
HECO	$M	1,201	1,381	1,379	2,104	2,217	2,116	2,134	0.8%	6.6%
HELCO	$M	294	361	343	443	439	430	421	-2.2%	4.1%
MECO	$M	302	349	296	417	437	422	421	-0.3%	3.8%
KIUC	$M	130	163	130	182	188	184	179	-3.1%	3.6%
Total electricity sold										
State Total	GWh	10,539	10,585	10,126	9,962	9,639	9,501	9,406	-1.0%	-1.3%
HECO	GWh	7,721	7,675	7,378	7,242	6,976	6,859	6,782	-1.1%	-1.4%
HELCO	GWh	1,116	1,163	1,120	1,104	1,085	1,076	1,063	-1.3%	-0.5%
MECO	GWh	1,252	1,280	1,192	1,181	1,145	1,135	1,132	-0.2%	-1.1%
KIUC	GWh	449	467	437	435	433	431	430	-0.4%	-0.5%
Average revenue/kWh sold										
State Total	$/kWh	0.183	0.213	0.212	0.316	0.340	0.332	0.335	1.0%	7.0%
HECO	$/kWh	0.156	0.180	0.187	0.290	0.318	0.309	0.315	2.0%	8.1%
HELCO	$/kWh	0.263	0.310	0.306	0.402	0.405	0.400	0.396	-1.0%	4.6%
MECO	$/kWh	0.241	0.273	0.249	0.353	0.382	0.372	0.372	-0.1%	4.9%
KIUC	$/kWh	0.291	0.349	0.297	0.420	0.435	0.428	0.416	-2.8%	4.1%

Source: Hawaii Electric Utility Monthly Financial Reports.

In 2014, the fuel and purchased power cost accounted for about 61.8 percent of the total electricity costs. The growth of electricity costs in Hawaii was mainly due to increased fuel costs

and an increase in the average cost of purchased power. Although petroleum prices are significantly lower in 2015, the increase in the average cost of purchased power during the 2005 to 2014 period was impacted by increasing petroleum prices during this period. As shown in the table 25, 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 $1.22 billion and the purchased power cost increased from $463 million to $734 million. The fuel and purchased power cost increased the most at HECO at 6.7 percent per year. HECO was followed by KIUC at 5.6 percent per year, MECO at 4.6 percent per year, and HELCO at 4.1 percent per year.

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

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Fuel and purchased power cost										
State Total	$M	1,157	1,392	1,228	2,053	2,124	1,998	1,950	-2.4%	6.0%
HECO	$M	760	894	827	1,432	1,486	1,379	1,359	-1.5%	6.7%
HELCO	$M	168	210	187	259	262	254	240	-5.3%	4.1%
MECO	$M	170	207	158	264	273	263	254	-3.4%	4.6%
KIUC	$M	59	81	56	98	102	101	96	-5.0%	5.6%
Utility fuel cost										
State Total	$M	694	850	724	1,356	1,391	1,277	1,216	-4.8%	6.4%
HECO	$M	421	526	460	909	945	851	821	-3.5%	7.7%
HELCO	$M	65	75	74	122	117	126	117	-6.6%	6.7%
MECO	$M	154	174	137	234	235	209	193	-7.4%	2.6%
KIUC	$M	54	76	52	91	94	92	84	-8.0%	5.1%
Purchased power cost										
State Total	$M	463	542	504	697	732	720	734	1.9%	5.2%
HECO	$M	339	369	367	523	541	528	538	1.9%	5.3%
HELCO	$M	103	135	113	137	145	128	123	-4.0%	2.0%
MECO	$M	16	33	20	30	38	54	61	11.9%	15.8%
KIUC	$M	5	5	4	8	8	10	12	23.4%	10.0%
Average fuel and purchased power cost										
State Total	$/kWh	0.110	0.132	0.121	0.206	0.220	0.210	0.207	-1.4%	7.3%
HECO	$/kWh	0.098	0.117	0.112	0.198	0.213	0.201	0.200	-0.3%	8.2%
HELCO	$/kWh	0.150	0.181	0.167	0.235	0.242	0.236	0.226	-4.1%	4.6%
MECO	$/kWh	0.136	0.162	0.132	0.223	0.239	0.232	0.225	-3.2%	5.7%
KIUC	$/kWh	0.131	0.173	0.128	0.226	0.236	0.235	0.224	-4.7%	6.1%
Share of fuel and purchased power cost										
State Total	%	60.0%	61.8%	57.1%	65.2%	64.7%	63.4%	61.8%	-2.4%	0.3%
HECO	%	63.2%	64.8%	60.0%	68.0%	67.0%	65.2%	63.7%	-2.3%	0.1%
HELCO	%	57.2%	58.2%	54.5%	58.5%	59.7%	59.0%	57.2%	-3.1%	0.0%
MECO	%	56.4%	59.3%	53.1%	63.2%	62.6%	62.3%	60.4%	-3.1%	0.8%
KIUC	%	45.2%	49.7%	43.1%	53.9%	54.3%	54.9%	53.8%	-2.0%	2.0%

Source: Hawaii Electric Utility Monthly Financial Reports.

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	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Average fuel cost of utility net generation										
State Total	$/kWh	0.100	0.123	0.111	0.211	0.231	0.222	0.221	-0.6%	9.2%
HECO	$/kWh	0.089	0.108	0.102	0.206	0.229	0.218	0.221	1.2%	10.6%
HELCO	$/kWh	0.123	0.153	0.144	0.219	0.239	0.232	0.215	-7.5%	6.4%
MECO	$/kWh	0.125	0.153	0.127	0.221	0.237	0.231	0.224	-3.0%	6.7%
KIUC	$/kWh	0.124	0.165	0.122	0.217	0.227	0.228	0.221	-2.8%	6.6%
Average cost of purchased electricity										
State Total	$/kWh	0.110	0.127	0.121	0.172	0.177	0.170	0.168	-1.1%	4.8%
HECO	$/kWh	0.100	0.114	0.112	0.164	0.170	0.161	0.1592	-1.1%	5.3%
HELCO	$/kWh	0.149	0.175	0.168	0.218	0.213	0.207	0.2073	-0.1%	3.7%
MECO	$/kWh	0.167	0.151	0.109	0.157	0.173	0.185	0.1841	-0.7%	1.1%
KIUC	$/kWh	0.144	0.175	0.113	0.209	0.214	0.196	0.1835	-6.6%	2.8%
Ratio of purchased cost/fuel cost										
State Total	%	110%	104%	109%	82%	77%	76%	76%	-0.5%	-4.0%
HECO	%	113%	105%	110%	79%	74%	74%	72%	-2.3%	-4.8%
HELCO	%	121%	115%	117%	99%	89%	89%	97%	8.0%	-2.5%
MECO	%	134%	99%	86%	71%	73%	80%	82%	2.4%	-5.3%
KIUC	%	116%	106%	92%	96%	94%	86%	83%	-3.9%	-3.7%
Ratio of fuel cost and average revenue										
State Total	%	55%	58%	52%	67%	68%	67%	66%	-1.6%	2.0%
HECO	%	57%	60%	55%	71%	72%	71%	70%	-0.7%	2.3%
HELCO	%	47%	49%	47%	55%	59%	58%	54%	-6.6%	1.7%
MECO	%	52%	56%	51%	62%	62%	62%	60%	-2.9%	1.7%
KIUC	%	43%	47%	41%	52%	52%	53%	53%	0.0%	2.5%
Ratio of purchased power cost and average revenue										
State Total	%	60.3%	60%	57%	55%	52%	51%	50.1%	-2.1%	-2.0%
HECO	%	64%	63%	60%	56%	53%	52%	51%	-3.0%	-2.7%
HELCO	%	57%	57%	55%	54%	53%	52%	52%	0.9%	-0.9%
MECO	%	69%	55%	44%	44%	45%	50%	50%	-0.6%	-3.7%
KIUC	%	49%	50%	38%	50%	49%	46%	44%	-4.0%	-1.3%

Source: Hawaii Electric Utility Monthly Financial Reports.

While both the average fuel cost and average purchased power cost increased during the analysis period, the average cost of purchased power increased at a slower rate. As shown in Table 26, from 2005 to 2014, the average fuel cost to generate one kWh of net electricity (gross generation minus station use) 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, however, the average cost of purchased electricity was about 23.9 percent below the average fuel cost of the utilities in Hawaii. Since the purchased electricity cost also includes other costs in addition to the fuel cost, the average fuel cost of purchased electricity should even be lower.

Due to the slower growth of purchased electricity costs, the ratio of average purchased power cost to average utility fuel cost decreased from 110 percent in 2005 to 76 percent in 2014. In 2014, purchased electricity was cheapest at HECO (15.92 cents/kWh), followed by KIUC (18.35 cents/kWh), MECO (18.41 cents/kWh), and HELCO (20.73 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 6.5 percent, taxes accounted for about 11.9 percent, depreciation and amortization accounted for about 5.7 percent, and other utility operating expenses accounted for about 14.4 percent of the total electricity cost paid by consumers in 2014. 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 $1.22 billion in 2014, an average increase of 5.1 percent per year.

This growth rate was lower than the 6.0 percent growth rate of fuel and purchased power cost, but higher than the 3.0 percent average inflation rate (Honolulu CPI-U) during the same period. Among the four components of other electricity costs, taxes increased the most at 6.1 percent per year, followed by other utility operating expenses at 5.2 percent per year, operating income at 5.1 percent per year, and depreciation and amortization at 3.0 percent per year.

Table 27. Other Major Costs of Electricity by Utility

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Operating income										
State Total	$M	131	121	129	173	191	192	206	6.9%	5.16%
HECO	$M	65	54	71	90	117	115	129	12.4%	7.90%
HELCO	$M	22	25	24	38	31	31	29	-5.4%	3.45%
MECO	$M	27	21	19	27	24	30	32	6.8%	2.07%
KIUC	$M	17	21	14	18	19	16	15	-7.8%	-1.60%
Taxes										
State Total	$M	220	241	252	355	379	361	374	3.5%	6.10%
HECO	$M	137	146	164	232	260	243	255	5.0%	7.21%
HELCO	$M	33	43	42	58	53	50	50	-0.4%	4.71%
MECO	$M	39	39	35	50	51	52	53	2.2%	3.51%
KIUC	$M	11	14	11	15	16	16	15	-2.9%	3.74%
Depreciation and amortization										
State Total	$M	137	151	159	154	156	166	179	7.8%	3.00%
HECO	$M	70	78	81	88	90	99	108	9.5%	5.02%
HELCO	$M	27	30	32	32	33	34	35	5.0%	3.18%
MECO	$M	25	27	29	21	20	20	21	5.8%	-1.74%
KIUC	$M	16	16	17	13	13	14	15	5.5%	-1.27%
Other utility operating expenses										
State Total	$M	290	356	389	420	440	446	456	2.2%	5.17%
HECO	$M	173	213	241	268	269	286	288	0.7%	5.83%
HELCO	$M	45	54	59	57	61	63	67	6.4%	4.46%
MECO	$M	43	56	57	58	72	59	62	5.0%	4.33%
KIUC	$M	29	32	32	38	38	38	38	1.9%	3.3%
All others										
State Total	$M	777	868	929	1,103	1,167	1,166	1,215	4.2%	5.1%
HECO	$M	445	491	558	679	736	744	781	5.1%	6.5%
HELCO	$M	126	152	157	185	178	178	181	2.2%	4.1%
MECO	$M	133	144	140	155	166	161	169	4.5%	2.7%
KIUC	$M	73	82	74	84	87	83	83	-0.3%	1.4%
% of operating income										
State Total	%	6.8%	5.4%	6.0%	5.5%	5.8%	6.1%	6.5%		
HECO	%	5.4%	3.9%	5.2%	4.3%	5.3%	5.4%	6.1%		
HELCO	%	7.3%	6.9%	6.9%	8.6%	7.0%	7.2%	7.0%		
MECO	%	8.8%	6.1%	6.5%	6.4%	5.5%	7.1%	7.6%		
KIUC	%	13.2%	12.6%	10.9%	9.8%	10.2%	8.8%	8.4%		
% of taxes										
State Total	%	11.4%	10.7%	11.7%	11.3%	11.6%	11.5%	11.9%		
HECO	%	11.4%	10.5%	11.9%	11.0%	11.7%	11.5%	12.0%		
HELCO	%	11.3%	11.8%	12.3%	13.0%	12.1%	11.7%	11.9%		
MECO	%	13.0%	11.1%	11.7%	12.0%	11.6%	12.4%	12.7%		
KIUC	%	8.3%	8.5%	8.4%	8.4%	8.4%	8.4%	8.4%		
% of depreciation and amortization										
State Total	%	7.1%	6.7%	7.4%	4.9%	4.8%	5.3%	5.7%		
HECO	%	5.8%	5.6%	5.8%	4.2%	4.1%	4.7%	5.1%		
HELCO	%	9.1%	8.2%	9.4%	7.3%	7.5%	7.8%	8.4%		
MECO	%	8.1%	7.9%	9.8%	4.9%	4.6%	4.7%	5.0%		
KIUC	%	12.6%	10.0%	12.9%	7.3%	7.1%	7.5%	8.2%		
% of other utility operating expenses										
State Total	%	15.0%	15.8%	18.1%	13.4%	13.4%	14.1%	14.4%		
HECO	%	14.4%	15.5%	17.5%	12.7%	12.2%	13.5%	13.5%		
HELCO	%	15.3%	15.1%	17.1%	12.8%	13.9%	14.5%	15.8%		
MECO	%	14.1%	16.1%	19.3%	13.9%	16.4%	14.0%	14.8%		
KIUC	%	22.1%	19.4%	24.7%	20.8%	20.3%	20.5%	21.5%		

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 rapid growth in electricity prices and the installation of customer-sited solar systems, total electricity sold by utilities decreased during the analysis period. Due to the high price sensitivity of residential customers and the increase of customer-sited solar systems, electricity sold to residential customers decreased more than that of the other sectors. As shown in Table 28, from 2005 to 2014, total electricity sold decreased an average of 1.3 percent per year in Hawaii, while electricity sold to the residential sector decreased an average of 2.4 percent per year from 3,164 GWH to 2,539 GWH. In comparison, electricity sold to the commercial sector and the industrial sector only decreased an average of 0.9 percent and 0.7 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 27.0 percent in 2014. In 2014, the decrease of residential sector electricity sales over the previous year was 2.7 percent.

At the county level, residential sales in the HECO system decreased the most. From 2005 to 2014, residential electricity sales of HECO decreased 3.1 percent per year; followed by MECO (a decrease of 1.6 percent per year), and HELCO (a decrease of 1.0 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 2014, total utility customers for the state increased an average of 0.7 percent per year. The number of residential customers increased 0.8 percent per year from 398,332 customers to 426,862 customers; the number of commercial customers increased 0.1 percent per year from 64,072 to 64,777; and the number of industrial customers increased 0.6 percent per year from 684 to 719.

The number of customers at HECO increased at a slower rate than those of the utilities serving other counties and, therefore, HECO's share of total state customers has declined slightly. From 2005 to 2014, the share of HECO customers, as a percentage of total statewide utility customers, decreased 1.7 percentage points, from 63.0 percent to 61.3 percent. During the same

period, HECO's share of residential customers decreased slightly more than the overall total, with a 1.9 percentage point decrease from 64.7 percent to 62.8 percent.

Table 28. Electricity Consumption by Sector and by Utility

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Total										
State Total	GWH	10,539	10,585	10,126	9,962	9,639	9,501	9,406	-1.0%	-1.3%
HECO	GWH	7,721	7,675	7,378	7,242	6,976	6,859	6,782	-1.1%	-1.4%
HELCO	GWH	1,116	1,163	1,120	1,104	1,085	1,076	1,063	-1.3%	-0.5%
MECO	GWH	1,252	1,280	1,192	1,181	1,145	1,135	1,132	-0.2%	-1.1%
KIUC	GWH	449	467	437	435	433	431	430	-0.4%	-0.5%
Residential										
State Total	GWH	3,164	3,201	3,055	2,929	2,739	2,609	2,539	-2.7%	-2.4%
HECO	GWH	2,143	2,135	2,025	1,925	1,777	1,667	1,611	-3.4%	-3.1%
HELCO	GWH	423	451	440	427	410	396	387	-2.3%	-1.0%
MECO	GWH	442	450	428	418	395	388	382	-1.5%	-1.6%
KIUC	GWH	156	165	162	159	157	158	159	0.8%	0.2%
Commercial										
State Total	GWH	3,465	3,521	3,389	3,368	3,238	3,269	3,185	-2.6%	-0.9%
HECO	GWH	2,480	2,513	2,449	2,429	2,320	2,341	2,270	-3.0%	-1.0%
HELCO	GWH	453	463	441	446	430	435	428	-1.7%	-0.6%
MECO	GWH	406	417	382	379	374	379	374	-1.5%	-0.9%
KIUC	GWH	125	129	118	114	114	113	114	0.0%	-1.1%
Industrial										
State Total	GWH	3,909	3,863	3,681	3,665	3,662	3,623	3,682	1.6%	-0.7%
HECO	GWH	3,098	3,028	2,904	2,888	2,879	2,850	2,900	1.8%	-0.7%
HELCO	GWH	240	248	238	231	245	245	248	1.3%	0.4%
MECO	GWH	404	414	382	384	375	368	376	2.3%	-0.8%
KIUC	GWH	167	173	157	161	162	160	157	-1.8%	-0.7%
% of Residential										
State Total	%	30.0%	30.2%	30.2%	29.4%	28.4%	27.5%	27.0%		
HECO	%	27.7%	27.8%	27.5%	26.6%	25.5%	24.3%	23.8%		
HELCO	%	37.9%	38.8%	39.3%	38.7%	37.8%	36.8%	36.4%		
MECO	%	35.3%	35.1%	35.9%	35.4%	34.5%	34.2%	33.7%		
KIUC	%	34.8%	35.4%	37.1%	36.6%	36.3%	36.6%	37.0%		
% of Commercial										
State Total	%	32.9%	33.3%	33.5%	33.8%	33.6%	34.4%	33.9%		
HECO	%	32.1%	32.7%	33.2%	33.5%	33.3%	34.1%	33.5%		
HELCO	%	40.6%	39.8%	39.4%	40.4%	39.6%	40.4%	40.2%		
MECO	%	32.4%	32.5%	32.0%	32.1%	32.7%	33.4%	33.0%		
KIUC	%	27.9%	27.6%	26.9%	26.3%	26.4%	26.3%	26.4%		
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%	72.4%	72.2%	72.1%		
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%	11.9%	12.0%		
KIUC	%	4.3%	4.4%	4.3%	4.4%	4.5%	4.5%	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%	64.9%	63.9%	63.5%		
HELCO	%	13.4%	14.1%	14.4%	14.6%	15.0%	15.2%	15.2%		
MECO	%	14.0%	14.0%	14.0%	14.3%	14.4%	14.9%	15.0%		
KIUC	%	4.9%	5.2%	5.3%	5.4%	5.7%	6.1%	6.3%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 29. Number of Retail Customers by Sector in Hawaii

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Total										
State Total		463,088	475,104	478,590	482,498	484,716	488,456	492,358	0.8%	0.7%
HECO		291,580	294,591	295,282	296,800	297,529	299,528	301,953	0.8%	0.4%
HELCO		73,835	78,983	79,813	81,199	81,792	82,637	83,421	0.9%	1.4%
MECO		63,901	66,323	67,489	68,230	68,922	69,577	70,042	0.7%	1.0%
KIUC		33,772	35,207	36,006	36,269	36,473	36,714	36,942	0.6%	1.0%
Residential										
State Total		398,332	408,923	413,643	418,174	420,240	423,281	426,862	0.8%	0.8%
HECO		257,804	260,583	261,630	263,384	264,047	265,772	268,056	0.9%	0.4%
HELCO		60,699	65,305	66,825	68,423	69,099	69,719	70,398	1.0%	1.7%
MECO		54,135	56,076	57,431	58,326	58,879	59,419	59,802	0.6%	1.1%
KIUC		25,694	26,959	27,757	28,041	28,215	28,371	28,606	0.8%	1.2%
Commercial										
State Total		64,072	65,503	64,255	63,625	63,772	64,498	64,777	0.4%	0.1%
HECO		33,416	33,661	33,305	33,058	33,116	33,412	33,521	0.3%	0.0%
HELCO		13,071	13,608	12,919	12,702	12,617	12,839	12,940	0.8%	-0.1%
MECO		9,632	10,110	9,916	9,769	9,908	10,025	10,103	0.8%	0.5%
KIUC		7,953	8,124	8,115	8,096	8,131	8,222	8,213	-0.1%	0.4%
Industrial										
State Total		684	678	692	699	704	677	719	6.2%	0.6%
HECO		360	347	347	358	366	344	376	9.3%	0.5%
HELCO		65	70	69	74	76	79	83	5.1%	2.8%
MECO		134	137	142	135	135	133	137	3.0%	0.2%
KIUC		125	124	134	132	127	121	123	1.7%	-0.2%
% 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%	88.7%	88.8%		
HELCO	%	82.2%	82.7%	83.7%	84.3%	84.5%	84.4%	84.4%		
MECO	%	84.7%	84.5%	85.1%	85.5%	85.4%	85.4%	85.4%		
KIUC	%	76.1%	76.6%	77.1%	77.3%	77.4%	77.3%	77.4%		
% of Commercial										
State Total	%	13.8%	13.8%	13.4%	13.2%	13.2%	13.2%	13.2%		
HECO	%	11.5%	11.4%	11.3%	11.1%	11.1%	11.2%	11.1%		
HELCO	%	17.7%	17.2%	16.2%	15.6%	15.4%	15.5%	15.5%		
MECO	%	15.1%	15.2%	14.7%	14.3%	14.4%	14.4%	14.4%		
KIUC	%	23.5%	23.1%	22.5%	22.3%	22.3%	22.4%	22.2%		
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%	61.4%	61.3%	61.3%		
HELCO	%	15.9%	16.6%	16.7%	16.8%	16.9%	16.9%	16.9%		
MECO	%	13.8%	14.0%	14.1%	14.1%	14.2%	14.2%	14.2%		
KIUC	%	7.3%	7.4%	7.5%	7.5%	7.5%	7.5%	7.5%		

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 30 shows that Hawaii's annual electricity consumption per customer decreased an average of 1.9 percent per year, from 22,757 kWh in 2005 to 19,104 kWh in 2014. In looking at the types of customers, annual electricity consumption per residential customer decreased an average of 3.2 percent per year from 7,943 kWh to 5,948 kWh, annual electricity consumption per commercial customer decreased an average of 1.1 percent per year from 54,081 kWh to 49,176 kWh, and annual electricity consumption by industrial customers decreased 1.2 percent per year from 5,715,476 kWh to 5,120,741 kWh.

At the county level for 2013, MECO had the highest annual electricity consumption per residential customer at 6,387 kWh. This was followed by HECO at 6,010 kWh, KIUC at 5,564 kWh, and HELCO at 5,491 kWh. From 2005 to 2014, residential consumption per customer decreased an average of 3.5 percent per year at HECO, 2.7 percent per year at MECO, 2.6 percent per year at HELCO, and 1.0 percent at KIUC. Largely due to a higher rate of decrease for residential customers at HECO, the difference between utilities' average residential electricity consumption per customer decreased during the period analyzed.

Table 30. Annual Electricity Consumption per Customer by Sector

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Total										
State Total	kWh/C	22,757	22,279	21,158	20,646	19,886	19,451	19,104	-1.8%	-1.9%
HECO	kWh/C	26,481	26,054	24,985	24,401	23,446	22,898	22,459	-1.9%	-1.8%
HELCO	kWh/C	15,121	14,721	14,031	13,591	13,267	13,022	12,737	-2.2%	-1.9%
MECO	kWh/C	19,595	19,300	17,666	17,309	16,611	16,311	16,163	-0.9%	-2.1%
KIUC	kWh/C	13,284	13,261	12,125	11,987	11,876	11,752	11,638	-1.0%	-1.5%
Residential										
State Total	kWh/C	7,943	7,827	7,386	7,004	6,518	6,163	5,948	-3.5%	-3.2%
HECO	kWh/C	8,311	8,191	7,741	7,309	6,729	6,273	6,010	-4.2%	-3.5%
HELCO	kWh/C	6,977	6,912	6,585	6,238	5,931	5,676	5,491	-3.2%	-2.6%
MECO	kWh/C	8,165	8,017	7,451	7,165	6,715	6,528	6,387	-2.2%	-2.7%
KIUC	kWh/C	6,072	6,127	5,834	5,673	5,574	5,564	5,564	0.0%	-1.0%
Commercial										
State Total	kWh/C	54,081	53,760	52,751	52,939	50,780	50,689	49,176	-3.0%	-1.1%
HECO	kWh/C	74,227	74,652	73,519	73,475	70,053	70,072	67,734	-3.3%	-1.0%
HELCO	kWh/C	34,685	34,027	34,165	35,089	34,095	33,892	33,040	-2.5%	-0.5%
MECO	kWh/C	42,163	41,198	38,525	38,811	37,758	37,851	37,013	-2.2%	-1.4%
KIUC	kWh/C	15,749	15,881	14,487	14,139	14,046	13,804	13,820	0.1%	-1.4%
Industrial										
State Total	kWh/C	5,715,476	5,697,455	5,320,073	5,242,739	5,201,000	5,351,326	5,120,741	-4.3%	-1.2%
HECO	kWh/C	8,606,672	8,726,082	8,368,077	8,068,244	7,866,900	8,284,797	7,712,821	-6.9%	-1.2%
HELCO	kWh/C	3,686,703	3,546,493	3,455,506	3,122,719	3,225,790	3,104,552	2,992,745	-3.6%	-2.3%
MECO	kWh/C	3,014,884	3,021,683	2,692,158	2,844,143	2,780,620	2,763,182	2,745,471	-0.6%	-1.0%
KIUC	kWh/C	1,338,824	1,392,734	1,172,027	1,221,235	1,273,029	1,323,260	1,278,578	-3.4%	-0.5%

Source: Hawaii Electric Utility Monthly Financial Reports.

Total revenue from retail electricity sales increased substantially from 2005 to 2012 due to the rapid increase of electricity prices. 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 of 7.9 percent per year for the state; revenue from residential sales increased an average of 6.6 percent per year from $653 million to $1.02 billion; 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 of 8.5 percent per year from $1.27 billion to $2.26 billion.

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.

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

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Total										
State Total	$M	1,927	2,253	2,148	3,147	3,281	3,153	3,154	0.0%	5.6%
HECO	$M	1,201	1,381	1,379	2,104	2,217	2,116	2,134	0.8%	6.6%
HELCO	$M	294	361	343	443	439	430	421	-2.2%	4.1%
MECO	$M	302	349	296	417	437	422	421	-0.3%	3.8%
KIUC	$M	130	163	130	182	188	184	179	-3.1%	3.6%
Residential										
State Total	$M	653	772	739	1,016	1,023	962	948	-1.5%	4.2%
HECO	$M	379	438	436	617	624	577	572	-1.0%	4.7%
HELCO	$M	118	148	144	179	174	167	162	-3.0%	3.6%
MECO	$M	110	127	111	151	154	148	146	-1.5%	3.2%
KIUC	$M	46	59	49	69	71	70	68	-2.0%	4.4%
Others										
State Total	$M	1,274	1,481	1,409	2,131	2,258	2,191	2,206	0.7%	6.3%
HECO	$M	823	943	943	1,487	1,593	1,539	1,562	1.5%	7.4%
HELCO	$M	176	213	199	264	265	263	259	-1.8%	4.4%
MECO	$M	192	222	186	266	282	274	275	0.3%	4.1%
KIUC	$M	84	104	81	113	118	115	110	-3.8%	3.1%
% of Residential										
State Total	%	33.9%	34.3%	34.4%	32.3%	31.2%	30.5%	30.1%		
HECO	%	31.5%	31.7%	31.6%	29.3%	28.1%	27.3%	26.8%		
HELCO	%	40.2%	41.0%	41.9%	40.4%	39.6%	38.8%	38.5%		
MECO	%	36.5%	36.5%	37.3%	36.2%	35.3%	35.1%	34.7%		
KIUC	%	35.5%	36.1%	37.7%	37.8%	37.6%	37.9%	38.3%		
County % of Total										
State Total	%	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%		
HELCO	%	15.2%	16.0%	16.0%	14.1%	13.4%	13.6%	13.3%		
MECO	%	15.7%	15.5%	13.8%	13.3%	13.3%	13.4%	13.3%		
KIUC	%	6.8%	7.2%	6.0%	5.8%	5.7%	5.9%	5.7%		

Source: Hawaii Electric Utility Monthly Financial Reports.

The higher growth in commercial and industrial electricity revenue over residential revenue 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. Table 32 shows that the average residential electricity price increased 1.2 percent and the average commercial and industrial electricity price increased 1.1 percent in 2014.

The price elasticity for electricity was a negative 0.19 for total customers and a negative 0.31 for residential customers. The price elasticity calculated from the percentage change in electricity consumption per customer and the percentage change in the average price of electricity from 2005 to 2014. In other words, residential customers were more price sensitive to increases or decreases in the price of electricity. If electricity prices increased, residential customers decreased their electricity consumption more than the overall total.

Table 32. Average Electricity Price by County in Hawaii

		2005	2007	2009	2011	2012	2013	2014	Growth in 2014	Avg. ann. Growth 2005 - 2014
Total										
State Total	$/kWh	0.183	0.213	0.212	0.316	0.340	0.332	0.335	1.0%	7.0%
HECO	$/kWh	0.156	0.180	0.187	0.290	0.318	0.309	0.315	2.0%	8.1%
HELCO	$/kWh	0.263	0.310	0.306	0.402	0.405	0.400	0.396	-1.0%	4.6%
MECO	$/kWh	0.241	0.273	0.249	0.353	0.382	0.372	0.372	-0.1%	4.9%
KIUC	$/kWh	0.291	0.349	0.297	0.420	0.435	0.428	0.416	-2.8%	4.1%
Residential										
State Total	$/kWh	0.206	0.241	0.242	0.347	0.373	0.369	0.373	1.2%	6.8%
HECO	$/kWh	0.177	0.205	0.215	0.320	0.351	0.346	0.355	2.5%	8.1%
HELCO	$/kWh	0.279	0.328	0.327	0.419	0.425	0.422	0.419	-0.7%	4.6%
MECO	$/kWh	0.249	0.283	0.259	0.361	0.391	0.382	0.382	0.0%	4.9%
KIUC	$/kWh	0.297	0.356	0.301	0.434	0.450	0.443	0.430	-2.8%	4.2%
Others										
State Total	$/kWh	0.173	0.201	0.199	0.303	0.327	0.318	0.321	1.1%	7.1%
HECO	$/kWh	0.147	0.170	0.176	0.280	0.306	0.296	0.302	1.9%	8.3%
HELCO	$/kWh	0.253	0.299	0.293	0.391	0.393	0.387	0.383	-1.1%	4.7%
MECO	$/kWh	0.236	0.267	0.243	0.349	0.377	0.367	0.366	-0.1%	5.0%
KIUC	$/kWh	0.287	0.345	0.294	0.411	0.426	0.419	0.407	-2.8%	4.0%

Source: Hawaii Electric Utility Monthly Financial Reports.

Table 33 shows the statewide average electricity price by sector in Hawaii based on EIA data. Separate prices for the commercial and industrial sector from 1990 to 2013 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	-	14.47
2004	18.06	16.19	13.35	-	15.70
2005	20.70	19.04	15.79	-	18.33
2006	23.35	21.42	17.96	-	20.72
2007	24.12	21.91	18.38	-	21.29
2008	32.50	29.72	26.05	-	29.20
2009	24.20	21.86	18.14	-	21.21
2010	28.10	25.93	21.94	-	25.12
2011	34.68	32.37	28.40	-	31.59
2012	37.34	34.88	30.82	-	34.04
2013	36.98	34.05	29.87	-	33.26

Source: Energy Information Administration, State Energy Data System

6. Electricity Demand

In this study, we defined 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.

The above definition reflects the fact that overall demand for electricity can be supplied by various channels. Electricity users can purchase electricity from the utilities (generated by utility and non-utility producers) and/or generate electricity via customer-sited systems.

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 (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 is available for electricity sold by the utilities, system losses, and station use of utilities are available. However, data was not available for the station use of purchased electricity from non-utility producers. Therefore, we estimated this value with the assumption that the percentage of station use in gross generation was the same for non-utility both as it was for utility producers.

The only data available for electricity generated and consumed by the end user was the electricity generated from PV systems. Regarding electricity savings, data was available for both the SWH and DSM programs.

As shown in Table 34, from 2005 to 2014, total electricity demand in Hawaii increased only an average of 0.3 percent per year, from about 12,280 GWH to 12,575 GWH. The decrease in gross generation by the electric power industry was offset by electricity savings and customer-sited generation. During this period, electricity generation by the electric power industry decreased 1.3 percent per year from 11,755 GWH to 10,467 GWH, electricity generated by user owned PV systems increased 82.1 percent per year from 2 GWH to 532 GWH; electricity replaced by SWH increased 7.4 percent per year from 84 GWH to 160 GWH; and electricity replaced by DSM programs increased 13.9 percent per year from 439 GWH to 1,416 GWH. The analysis estimates that the share of gross electricity generation produced by the electric power industry decreased from 95.7 percent in 2005 to 83.2 percent in 2014, a decrease of 12.5 percentage points.

Table 34. Total Electricity Demand in Hawaii

Electricity Generation and Conservation (Demand-Side-Management)

Units: GWH

Year	Gross 1/ Generation	By Users PV	SWH 2/	DSM	Sub-Total	Gross 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
Growth 05-14	-1.3%	82.1%	7.4%	13.9%	16.7%	0.3%
Changes 05-14	(1,288)	529	76	977	1,583	295

Electricity Generation and Conservation (Demand-Side-Management)

Units: % in Gross Total

Year	Gross 1/ Generation	By Users PV	SWH	DSM	Sub-Total	Gross 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

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

2/ SWH in KIUC is included in DSM

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

7. Conclusions

In order to draw conclusions from this report, it is first important to note the period of analysis. The latest EIA data used for this report was through 2013 and the other data sources were through 2014. As shown in Appendix A, petroleum prices dropped in mid-2014 and continue to remain low as of this writing September 2015. The impact of decreased petroleum prices are generally not reflected in this report due to the period of analysis. When 2015 data becomes available, this report will be updated and the impact of reduced petroleum prices will be analyzed.

From 1990 to 2013, the utility generated share of total electricity generated decreased significantly, from 82.4 percent to 56.0 percent. A large part of this decrease can be attributed to an increase in electricity purchased by the utility, which has supplanted a portion of the electricity generated by the utility. Since the average cost of electricity purchased by the utility is below the average fuel cost of utility generated electricity, the increased share of purchased electricity has helped reduce the cost of electricity sold by the utility.

Not all the electricity generated by the electric power industry is sold to utility customers. In 2014, about 5.6 percent of the gross electricity generated by the utilities in Hawaii was consumed by the utility owned power stations. In addition, about 4.8 percent of utility net generation (gross generation minus station use) and purchased power was lost during electricity transmission and distribution. As a result, 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 Hawaii's utilities 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 2014, the average cost of purchased electricity was 23.9 percent below the average fuel cost of utility generated electricity.

The average cost of purchased electricity in 2014 was the lowest at HECO at about 15.9 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, significantly lower than the average cost of purchased power by HECO.

The relatively slower growth in purchased power prices in recent years 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. According to the most recent data available, in 2013 about 95.6 percent of utility generated electricity was from petroleum, while only 38.2 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 of 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 of 8.9 percent per year from $77.36 per BBL to $140.52 per BBL.

In contrast to the 13.2 percent average annual increase for utility petroleum costs, the average annual increase for crude oil prices was 7.6 percent over the 2005 to 2012 period. While outside the scope of this paper, an interesting area for future research would be to examine the causes of the gap between utility petroleum cost changes and crude oil price changes. In 2013 and 2014, the unit fuel oil cost decreased 5.8 percent and 1.2 percent, respectively, from the previous year, and the unit diesel cost also decreased.

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. The utility fuel cost share of average electricity revenue increased 11.0 percentage points, from 54.8 percent to 65.8 percent. This increase was largely due to the increase in the average petroleum cost during this period. On the other hand, the average purchased power cost as a percentage of the average revenue of electricity sold decreased 10.2 percentage points, from 60.3 percent to 50.1 percent.

In addition to the fuel and purchased power cost, the cost of electricity is also affected by four other factors. The operating income of the utilities accounted for 6.5 percent, taxes accounted for 11.9 percent, depreciation and amortization accounted for 5.7 percent, and other utility operating expenses accounted for 14.4 percent of total electricity prices paid by consumers in 2014. 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 $1.22 billion in 2014, an average increase of 5.1 percent per year. This growth rate was lower than the 6.0 percent growth rate of fuel and purchased power cost, but higher than the 3.0 percent average

inflation rate (Honolulu CPI-U) during the same period. Among the four components of other electricity costs, taxes increased the most at 6.1 percent per year, followed by other utility operating expenses at 5.2 percent per year, operating income at 5.1 percent per year, and depreciation and amortization at 3.0 percent per year.

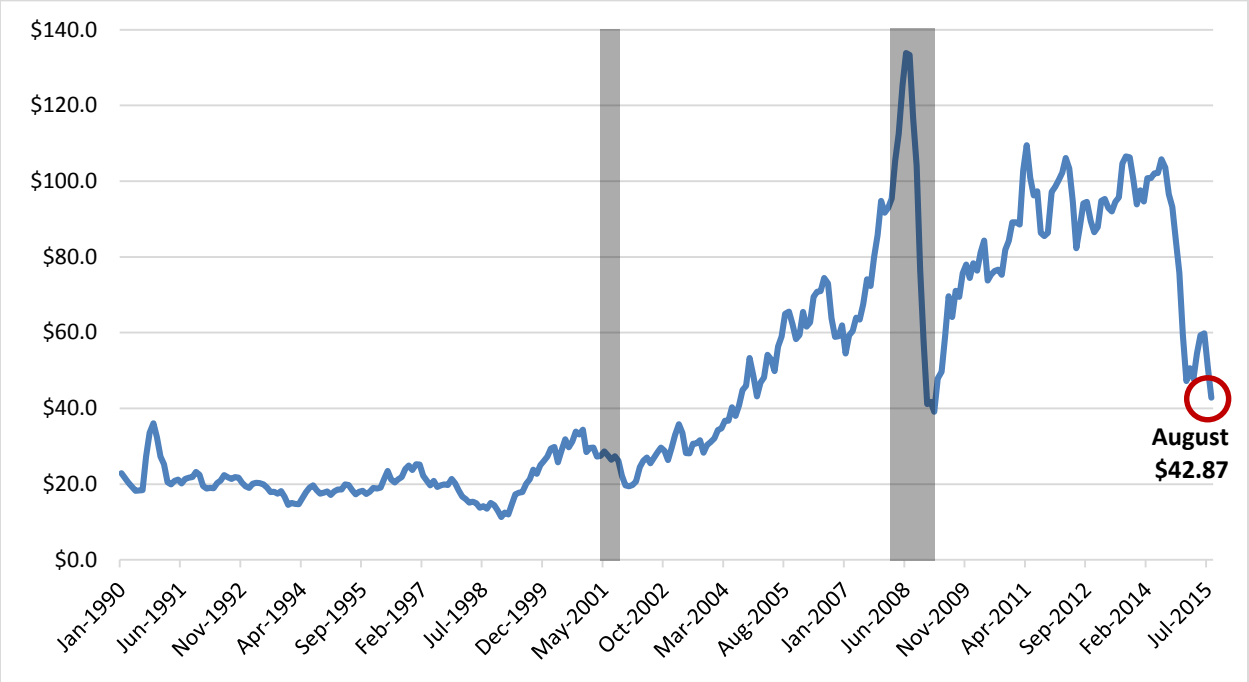
Total electricity sold by utilities decreased over the period analyzed. A large part of this decrease was due to reduced consumption caused by electricity price increases and the installation of customer-sited solar systems. From 2005 to 2014, total electricity sold decreased an average of 1.3 percent per year in Hawaii. The largest decrease during this period was for residential customers, which decreased an average of 2.4 percent per year from 3,164 GWH to 2,539 GWH. In contrast, electricity sold to the commercial sector and the industrial sector only decreased an average of 0.9 percent and 0.7 percent per year, respectively. As a result, the residential sector share of total electricity sold decreased from 30.0 percent in 2005 to 27.0 percent in 2014. In 2014, the decrease in residential sector electricity sales over the previous year was 2.7 percent.

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 2014, total utility customers for the state increased 0.7 percent per year. Residential customers increased the most at 0.8 percent per year. This was followed by commercial customers with an increase of 0.1 percent per year and industrial customers with an increase of 0.6 percent per year.

This analysis also looked at the price elasticity for electricity prices and found that residential customers are more price sensitive than customers overall. The price elasticity for total customers was a negative 0.19 and the price elasticity for residential customers was a negative 0.31. In other words, if electricity prices increase, residential customers will reduce their consumption more than the total of all customers.

Electricity demand can be met by both electricity generated by 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 2014, the total share of electricity generated by the electric power industry, as a percentage of total electricity demand in Hawaii, decreased 12.5 percentage points from 95.7 percent to 83.2 percent. Without the electricity generated and conserved by users, total electricity expenditure in Hawaii would be even higher.

Appendix A. Petroleum Prices 1990-2015



Source: EIA 2015 Cushing Spot Price

Shaded areas are recessions March 2001 to November 2001 and December 2007 to June 2009