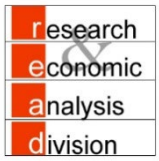
Status of Renewable Primary Energy and Renewable Electricity in Hawaii



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Executive Summary

Energy can be classified into primary energy and secondary energy based on its sources. A primary source of energy is one that occurs naturally. Fossil fuels (coal, petroleum, and gas), biofuels, wind, waves, solar radiation and nuclear fuels are all primary sources of energy. A secondary energy source is one that is made using a primary resource. For example, electricity is secondary resource and can be generated by primary sources.

This report focuses on the renewable portion of the energy sources. On the primary energy side, this report provides statistics and analysis on detailed renewable sources and the major sectors using these renewable sources from the consumption perspective. On the secondary energy side, this report provides information on the detailed primary sources used to generate electricity.

Renewable Primary Energy

Hawaii's renewable energy development started late compared with other states in the nation. In 1960, primary energy from renewable sources accounted for only 0.3% of the total, while the U.S. average was 6.5% that year. With the rapid development of biomass in the early 1980s, the percentage of Hawaii's renewable primary energy climbed to 9.3% in 1989, higher than the U.S. average at 7.4% for that year. By 2020, the latest year data are available, Hawaii's renewable primary energy accounted for 13.5% of the total primary energy consumption, higher than that of the U.S. figure of 12.3% for the same year.

Renewable primary energy sources mainly include: biomass which includes wood & waste (W&W) and ethanol, geothermal, hydro, wind, and solar. Among the renewable energy sources consumed, Hawaii had relatively larger shares in solar (53.7% for Hawaii; 10.6% for U.S. in 2020) while U.S. had heavier use of biomass, hydro, and wind (39.7%, 21.9% and 26.0%, respectively for U.S.; 26.8%, 2.8%, and 16.5%, respectively for Hawaii in 2020).

The following is a brief history of renewable primary energy consumptions in Hawaii:

Biomass: W&W was introduced in Mid 1960s and increased rapidly during the 1980s and reached peak level in 1989. From 1989 to 2002, W&W consumption decreased from 26,984 billion BTUs (BBTUs) to 7,491 BBTUs, causing the share of renewable primary energy to decrease substantially. From 2002 to 2020, W&W consumption decreased from 7,491 BBTUs to 4,427 BBTUs (Table 3.1).

Before 2005, all biomass consumed in Hawaii was W&W. Fuel ethanol consumption started in 2005. From 2005 to 2020, fuel ethanol consumption increased from 1,192 BBTUs in 2005 to 3,173 BBTUs in 2020, an 166% increase. Hawaii started to consume biodiesel in 2001, from 2001 to 2020, biodiesel consumption increased from 7 BBTUs to 821 BBTUs (Table 3.1).

Geothermal: Hawaii started using geothermal in 1985, but not until 1993 when the geothermal usage became stable. From 1993 to 2017, geothermal consumption increased from 1,570 BBTUs to 2,980 BBTUs. In 2018, geothermal consumption decreased to 1,010 BBTUs. In 2019 geothermal consumption decreased to 8 BBTUs. In 2020 geothermal consumption increased to 92 BBTUs. Geothermal was almost entirely used for electricity generation (Table 2.1 and Table 3.4).

Hydro: Hawaii's hydro energy was the first renewable energy source developed in the 1960s. Consumption of hydro energy was fluctuating around 1,000 BBTUs over the half century. In 2020, Hawaii consumed 867 BBTUs of hydro energy. Hydro energy was used in the electricity sector and the industrial sector (Table 2.1 and Table 3.5).

Solar: Hawaii's solar energy (including customer-sited grid-connected solar) consumption began in 1989. Before 2005, solar energy was mainly consumed in the residential sector. From 2005 to 2020, solar energy consumed by the residential sector increased from 1,285 BBTUs to 8,548 BBTUs. Commercial sector accelerated solar energy development since 2005. Between 2005 and 2020, solar energy used by commercial sector increased from 16 BBTUs to 4,073 BBTUS. Since 2009, solar energy started to play a role in utility scale electricity generation. From 2009 to 2020, solar energy consumed by utility scale electricity generation increased from 14 BBTUs to 4,246 BBTUs. From 2005 to 2020, total solar energy consumption in Hawaii increased from 1,304 BBTUs to 16,902 BBTUs (Table 3.6).

Wind: Hawaii started to use wind energy in 1989. From 1989 to 2020, wind energy consumption increased from 344 BBTUs to 5,196 BBTUs. Wind energy was entirely used in electricity generation (Table 2.1).

Major Energy Users

The U.S. Energy Information Administration (EIA) defined the users of primary energy into five sectors: (1) **Transportation sector:** Consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. (2) **Industrial sector:** Consists of all facilities and equipment used for producing, processing, or assembling goods. (3) **Commercial sector:** Consists of service-providing facilities and equipment of businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. (4) **Residential sector:** Consists of living quarters for private households, and (5) **Electricity sector**: Consists of electricity generation facilities. The first four are end use sectors and the electricity sector generates and provide secondary energy sources.

In terms of primary energy, the largest user of energy in Hawaii was the transportation sector which consisted of vehicles transporting people and goods, consumed over half (46.9%) of the total state primary energy in 2020, followed by the electricity sector at 36.8%, industrial sector at 6.7%, commercial sector at 5.7%, and residential sector at 3.9% (Table 4.3).

After allocating electricity into the other end use sectors, transportation was still the highest energy user at 46.9%, industrial use became the second largest at 20.4%, followed by commercial sector at 16.9%, and residential sector at 15.8% in 2020 (Table 4.1).

In terms of renewable energy sources, electricity sector used 34.4% of the total renewable sources developed, followed by residential sector at 27.2%, commercial sector at 23.7%, transportation sector used 12.0%, and industrial sector at 2.6% of the total renewable energy sources in 2020 (Table 4.4).

Renewable Electricity

According to the data from EIA, the share of electricity generated using renewable sources (renewable electricity) by the electric power industry, excluding the electricity generated from customer-sited solar systems, decreased from 9.8% in 1990 to 5.2% in 2002. From 2002 to 2020, the share of renewable electricity increased from 5.2% to 19.4%. The decrease from 1990 to 2002 was mainly due to decreased W&W generated electricity; and the increase from 2002 to 2020 was mainly due to increased wind, solid waste, and solar generated electricity (Table 5.1).

The renewable electricity data from EIA included only the electricity generated by the electric power industry. Electricity generated by customer-sited solar systems was not included. However, the Renewable Portfolio Standard Status Report (RPS) submitted to the State Public Utilities Commission (PUC) by the utility companies included data on the customer-sited grid-connected solar electricity generation. According to the RPS, in 2021, the customer-sited grid-connected solar systems generated about 1,481 GWH of electricity and the report revealed that renewable electricity (including customer-sited grid-connected solar system) accounted for 40.0% of total electricity sold in 2021 (Table 5.3).

Based on the RPS data, from 2005 to 2021, the share of biomass generated electricity decreased from 56.3% to 11.9%; the share of biofuels increased from 0.0% to 2.1%; the share of geothermal decreased from 30.9% to 5.3%; the share of hydro decreased from 11.5% to 3.0%; the share of wind increased from 1.0% to 20.2%, the share of solar (excluding customer-sited solar) increased from 0.0% to 15.0%; and the share of customer-sited grid-connected solar increased from 0.3% to 42.6% (Table 5.4).

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1. INTRODUCTION

Hawaii is the most fossil fuel dependent state in the nation. This presents an inherent risk for the state due to the fluctuation of oil prices and the finite nature of fossil fuels. Before 1980, Hawaii's primary energy consumption was almost entirely dependent on imported petroleum. Renewable energy accounted for less than 1% of total primary energy consumption.

From 1980 to 1989, the share of renewable energy consumption increased mainly due to increased consumption of wood and waste (W&W). Reduced W&W consumption from 1989 to 2002 caused the share of renewable energy to decrease from 9.3% in 1989 to only 3.7% in 2002. The share of renewable energy increased to 13.5% in 2020, due to increased solar, wind, fuel ethanol, and biodiesel consumption.

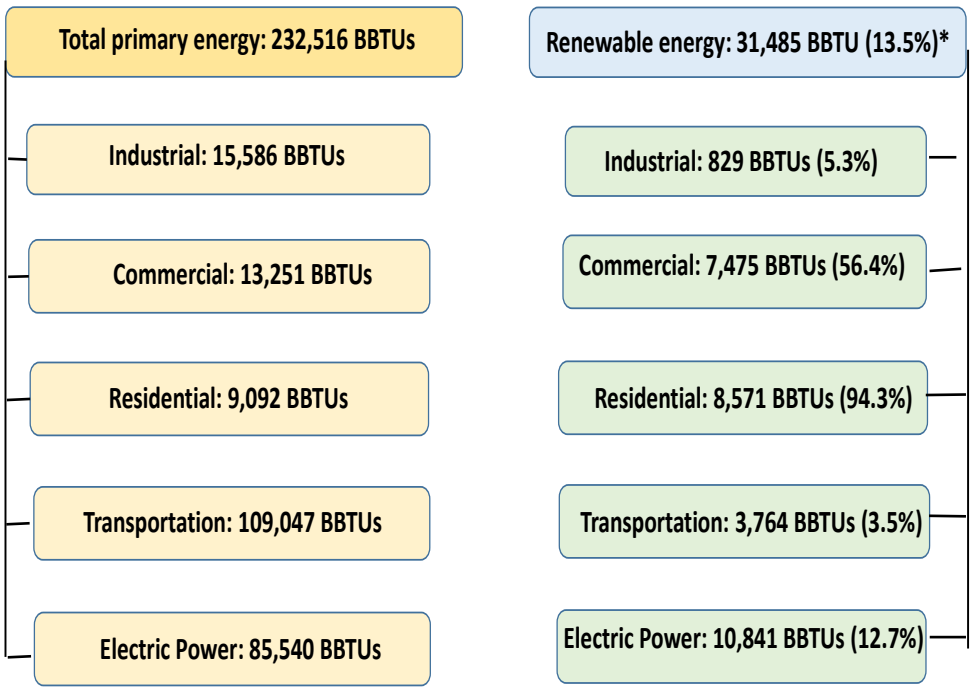
Hawaii's Clean Energy Initiative (HCEI) has set a target of 100% clean energy by 2045. This was modified by Act 097 of 2015, which increased the 2020 RPS target to 30% and maintained the 2030 RPS target at 40%. Furthermore, it added a 2040 RPS target of 70% in addition to the final 2045 RPS target of 100%. Hawaii's clean energy goals are the most aggressive in the nation. Although the RPS target is for electricity only, it is also a useful metric to measure the renewable energy share of total energy consumption. This study will examine the historical performance of Hawaii's renewable energy and renewable electricity development by sources of energy and by sectors.

There are three major data sources for this report. The first is the U.S. Energy Information Administration (EIA). The EIA data include two parts, data from the State Energy Data System (SEDS) and data from Detailed State Data in the Electricity (DSDE) section. The most recent SEDS data include energy consumption from 1960 to 2020 by sources of energy. The most recent DSDE data include electricity generation by source and total retail sales of electricity from 1990 to 2020. The other two data sources are the utility Renewable Portfolio Standard Status Report (RPS) and the utility Monthly Financial Report (MFR). The RPS data include total electricity sold and net generation of renewable electricity by source, including electricity generated by customer-sited solar systems from 2005 to 2021.

Using these data sources, the shares of renewable are analyzed in two contexts. The first one is the renewable energy's share of total primary energy consumption as measured in BTUs, and the second is the renewable electricity's share of total electricity consumption as measured in GWH. As shown in the figures below, in 2020, the renewable energy's share of total primary energy consumption was 13.5 percent for all sectors combined.

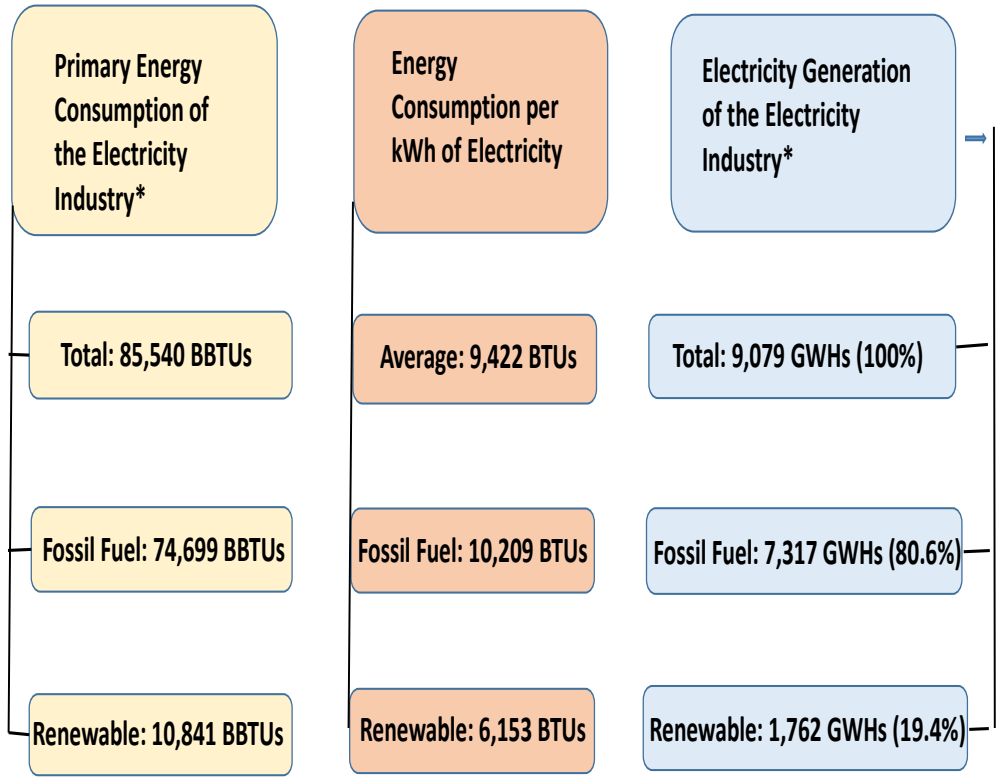
For the electricity sector (does not include customer-sited PV systems), the share of renewable energy consumption of total primary energy consumption was 12.7 percent (Figure 1.1), and the share of renewable electricity of total electricity generation was 19.4 percent in 2020 (Figure 1.2). The difference in these two values arises from the loss when converting primary energy into electricity and the conversion efficiency varies by renewable energy source. For example, generally, renewable energy has a higher conversion efficiency rate than fossil fuel.

Figure 1.1. Hawaii Primary Energy and Renewable Energy Consumption by Sector (2020)



* % of renewable energy in total primary energy consumption.

Figure 1.2. Hawaii Renewable Electricity Generation (2020)



* Does not include customer-sited PV.

2. RENEWABLE ENERGY CONSUMPTION IN HAWAII AND THE U.S.

Before 1970, renewable energy consumed in Hawaii only included a small amount of hydro and biomass. In 1970 renewable energy accounted for only 0.8% of Hawaii's total primary energy consumption.

Table 2.1. Hawaii's Renewable Energy Consumption by Source

	Energy Consumption In Billion BTUs						
	Primary	Total	Renewable Energy				
Year	Energy	Renewable	Biomass	Geothermal	Hydro	Solar*	Wind
1960	94,839	292	-	-	292	-	-
1970	196,947	1,559	429	-	1,131	-	-
1980	262,347	12,808	11,910	-	898	-	-
1989	309,767	28,875	26,984	147	581	819	344
1990	321,420	27,937	25,924	1	827	885	300
1995	296,775	24,608	19,803	2,419	1,009	1,168	210
1996	283,060	24,088	19,066	2,502	1,076	1,211	233
1997	273,483	22,503	17,433	2,506	1,178	1,222	164
1998	273,388	21,657	16,548	2,418	1,237	1,258	197
1999	269,352	21,767	16,981	2,162	1,175	1,281	169
2000	273,307	20,387	15,194	2,681	1,055	1,283	173
2001	270,122	12,397	7,954	2,143	1,041	1,237	22
2002	284,663	10,464	7,491	748	967	1,241	16
2003	300,914	13,320	9,314	1,813	916	1,260	16
2004	314,720	13,788	9,354	2,144	941	1,274	75
2005	324,737	14,189	9,632	2,224	962	1,304	66
2006	327,288	15,534	10,054	2,114	1,191	1,385	790
2007	337,829	17,009	9,936	2,280	913	1,526	2,354
2008	276,654	19,356	12,030	2,316	831	1,813	2,365
2009	275,928	19,734	12,482	1,643	1,099	2,055	2,454
2010	297,556	18,242	10,700	1,964	687	2,343	2,547
2011	302,550	20,510	11,187	2,183	905	2,923	3,311
2012	297,399	21,648	10,026	2,491	1,090	4,441	3,599
2013	301,914	25,972	11,720	2,630	747	6,073	4,802
2014	295,244	27,997	11,624	2,422	895	7,553	5,503
2015	298,992	29,428	12,075	2,154	1,129	8,360	5,710
2016	300,390	32,376	13,414	2,409	839	9,813	5,900
2017	308,376	32,014	10,944	2,980	609	12,579	4,902
2018	306,342	31,140	10,700	1,010	879	13,070	5,480
2019	307,764	29,855	9,971	8	842	14,320	4,714
2020	232,516	31,485	8,428	92	867	16,902	5,196

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Significant W&W was introduced in 1980 and the consumption of W&W increased from 1980 to 1989. From 1989 to 2001, W&W consumption decreased substantially, causing the share of renewable energy to decrease substantially. From 2001 to 2020, W&W consumption decreased further; however increased consumption of solar, wind, fuel ethanol, and biodiesel caused the share of renewable energy increased.

Table 2.2. Renewable Energy's Share of Total Primary Energy in Hawaii

	Share of Total Primary Energy Consumption (%)					
	Total	Renewable Energy				
Year	Renewable	Biomass	Geothermal	Hydro	Solar*	Wind
1960	0.3	0.0	0.0	0.3	0.0	0.0
1970	0.8	0.2	0.0	0.6	0.0	0.0
1980	4.9	4.5	0.0	0.3	0.0	0.0
1989	9.3	8.7	0.0	0.2	0.3	0.1
1990	8.7	8.1	0.0	0.3	0.3	0.1
1995	8.3	6.7	0.8	0.3	0.4	0.1
1996	8.5	6.7	0.9	0.4	0.4	0.1
1997	8.2	6.4	0.9	0.4	0.4	0.1
1998	7.9	6.1	0.9	0.5	0.5	0.1
1999	8.1	6.3	0.8	0.4	0.5	0.1
2000	7.5	5.6	1.0	0.4	0.5	0.1
2001	4.6	2.9	0.8	0.4	0.5	0.0
2002	3.7	2.6	0.3	0.3	0.4	0.0
2003	4.4	3.1	0.6	0.3	0.4	0.0
2004	4.4	3.0	0.7	0.3	0.4	0.0
2005	4.4	3.0	0.7	0.3	0.4	0.0
2006	4.7	3.1	0.6	0.4	0.4	0.2
2007	5.0	2.9	0.7	0.3	0.5	0.7
2008	7.0	4.3	0.8	0.3	0.7	0.9
2009	7.2	4.5	0.6	0.4	0.7	0.9
2010	6.1	3.6	0.7	0.2	0.8	0.9
2011	6.8	3.7	0.7	0.3	1.0	1.1
2012	7.3	3.4	0.8	0.4	1.5	1.2
2013	8.6	3.9	0.9	0.2	2.0	1.6
2014	9.5	3.9	0.8	0.3	2.6	1.9
2015	9.8	4.0	0.7	0.4	2.8	1.9
2016	10.8	4.5	0.8	0.3	3.3	2.0
2017	10.4	3.5	1.0	0.2	4.1	1.6
2018	10.2	3.5	0.3	0.3	4.3	1.8
2019	9.7	3.2	0.0	0.3	4.7	1.5
2020	13.5	3.6	0.0	0.4	7.3	2.2

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

As shown in Table 2.2, the renewable energy share of total primary energy consumption increased from 4.9% in 1980 to 9.3% in 1989, decreased to 3.7% in 2002, and then increased to 13.5% in 2020. From 1989 to 2020, the biomass' share of total renewable energy consumption decreased from 93.5% to 26.8%; the share of solar increased from 2.8% to 53.7%; the share of wind increased from 1.2% to 16.5%; and the share of hydro increased from 2.0% to 2.8% (Table 2.3).

Table 2.3 Hawaii's Share of Renewable Energy by Source

	Share of Renewable Energy Consumption (%)					
	Total	Renewable Energy				
Year	Renewable	Biomass	Geothermal	Hydro	Solar*	Wind
1960	100.0	0.0	0.0	100.0	0.0	0.0
1970	100.0	27.5	0.0	72.5	0.0	0.0
1980	100.0	93.0	0.0	7.0	0.0	0.0
1989	100.0	93.5	0.5	2.0	2.8	1.2
1990	100.0	92.8	0.0	3.0	3.2	1.1
1995	100.0	80.5	9.8	4.1	4.7	0.9
1996	100.0	79.2	10.4	4.5	5.0	1.0
1997	100.0	77.5	11.1	5.2	5.4	0.7
1998	100.0	76.4	11.2	5.7	5.8	0.9
1999	100.0	78.0	9.9	5.4	5.9	0.8
2000	100.0	74.5	13.2	5.2	6.3	0.8
2001	100.0	64.2	17.3	8.4	10.0	0.2
2002	100.0	71.6	7.1	9.2	11.9	0.2
2003	100.0	69.9	13.6	6.9	9.5	0.1
2004	100.0	67.8	15.5	6.8	9.2	0.5
2005	100.0	67.9	15.7	6.8	9.2	0.5
2006	100.0	64.7	13.6	7.7	8.9	5.1
2007	100.0	58.4	13.4	5.4	9.0	13.8
2008	100.0	62.2	12.0	4.3	9.4	12.2
2009	100.0	63.3	8.3	5.6	10.4	12.4
2010	100.0	58.7	10.8	3.8	12.8	14.0
2011	100.0	54.5	10.6	4.4	14.3	16.1
2012	100.0	46.3	11.5	5.0	20.5	16.6
2013	100.0	45.1	10.1	2.9	23.4	18.5
2014	100.0	41.5	8.7	3.2	27.0	19.7
2015	100.0	41.0	7.3	3.8	28.4	19.4
2016	100.0	41.4	7.4	2.6	30.3	18.2
2017	100.0	34.2	9.3	1.9	39.3	15.3
2018	100.0	34.4	3.2	2.8	42.0	17.6
2019	100.0	33.4	0.0	2.8	48.0	15.8
2020	100.0	26.8	0.3	2.8	53.7	16.5

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

In comparison, the share of renewable energy in the U.S. was relatively stable from 1960 to 2007. Renewable energy consumed before 2007 was mainly hydro and biomass. From 2007 to 2020, the share of renewable energy in the U.S. increased from 6.5% to 12.3%. About 54% of the increase was due to the increased wind energy consumption, 21% due to increased biomass, and 23% due to increased solar.

Table 2.4. Renewable Energy's Share of Total Primary Energy in the U.S.

	Share of Total Primary Energy Consumption (%)					
	Total	Renewable Energy				
Year	Renewable	Biomass	Geothermal	Hydro	Solar*	Wind
1960	6.5	2.9	0.0	3.6	0.0	0.0
1970	6.0	2.1	0.0	3.9	0.0	0.0
1980	7.0	3.2	0.1	3.7	0.0	0.0
1985	8.0	3.9	0.1	3.9	0.0	0.0
1989	7.4	3.7	0.2	3.3	0.1	0.0
1990	7.2	3.2	0.2	3.6	0.1	0.0
2000	6.2	3.0	0.2	2.8	0.1	0.1
2001	5.4	2.7	0.2	2.3	0.1	0.1
2002	5.9	2.8	0.2	2.8	0.1	0.1
2003	6.1	2.9	0.2	2.9	0.1	0.1
2004	6.1	3.0	0.2	2.7	0.1	0.1
2005	6.2	3.1	0.2	2.7	0.1	0.2
2006	6.7	3.3	0.2	2.9	0.1	0.3
2007	6.5	3.5	0.2	2.4	0.1	0.3
2008	7.3	3.9	0.2	2.5	0.1	0.6
2009	8.1	4.2	0.2	2.8	0.1	0.8
2010	8.5	4.6	0.2	2.6	0.1	0.9
2011	9.5	4.8	0.2	3.2	0.1	1.2
2012	9.4	4.8	0.2	2.8	0.2	1.4
2013	9.7	5.0	0.2	2.6	0.2	1.6
2014	9.9	5.1	0.2	2.5	0.3	1.8
2015	10.0	5.1	0.2	2.4	0.4	1.8
2016	10.6	5.1	0.2	2.5	0.6	2.2
2017	11.3	5.1	0.2	2.8	0.8	2.4
2018	11.2	5.0	0.2	2.6	0.9	2.5
2019	11.3	4.9	0.2	2.6	1.0	2.6
2020	12.3	4.9	0.2	2.7	1.3	3.2

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Table 2.5. U.S. Share of Renewable Energy by Source

	Share of Renewable Energy Consumption (%)					
	Total	Renewable Energy				
Year	Renewable	Biomass	Geothermal	Hydro	Solar*	Wind
1960	100.0	45.1	0.0	54.9	0.0	0.0
1970	100.0	35.2	0.1	64.7	0.0	0.0
1980	100.0	45.6	1.0	53.5	0.0	0.0
1985	100.0	49.6	1.6	48.8	0.0	0.0
1989	100.0	50.7	2.6	45.5	0.9	0.4
1990	100.0	45.3	2.8	50.4	1.0	0.5
2000	100.0	49.3	2.7	46.1	1.0	0.9
2001	100.0	50.9	3.2	43.4	1.2	1.3
2002	100.0	47.2	3.0	47.0	1.0	1.8
2003	100.0	47.2	2.9	47.0	1.0	1.9
2004	100.0	49.5	2.9	44.3	1.0	2.3
2005	100.0	49.9	2.9	43.4	0.9	2.9
2006	100.0	49.1	2.7	43.2	0.9	4.0
2007	100.0	53.4	2.8	37.5	1.0	5.2
2008	100.0	53.7	2.7	35.0	1.0	7.6
2009	100.0	51.8	2.6	35.1	1.0	9.5
2010	100.0	54.5	2.5	30.7	1.1	11.2
2011	100.0	50.1	2.3	33.7	1.2	12.7
2012	100.0	50.9	2.4	29.7	1.8	15.1
2013	100.0	51.2	2.3	27.2	2.4	17.0
2014	100.0	51.2	2.2	25.4	3.5	17.8
2015	100.0	51.2	2.2	23.9	4.4	18.3
2016	100.0	48.3	2.0	23.9	5.5	20.2
2017	100.0	45.0	1.9	25.0	7.0	21.2
2018	100.0	44.6	1.8	23.5	8.1	21.9
2019	100.0	43.6	1.8	22.5	8.9	23.2
2020	100.0	39.7	1.8	21.9	10.6	26.0

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

3. HAWAII'S RENEWABLE ENERGY BY SOURCE

Renewable energy consumed in Hawaii mainly includes five types of energy: biomass, geothermal, hydro, wind, and solar. Biomass consumed in Hawaii includes W&W, fuel ethanol, and biodiesel. Before 2005, all biomass consumed in Hawaii was W&W. Significant W&W was consumed since 1980 and increased until 1989. From 1989 to 2002, W&W consumption decreased 19,504 BBTUs or 72%. From 2002 to 2020, W&W consumption decreased further from 7,480 BBTUs to 4,427 BBTUs. Fuel ethanol consumption began in 2005. From 2005 to 2020, fuel ethanol consumption increased by 1,981 BBTUs or 166%. As a result, the share of fuel ethanol of total biomass consumption increased from 12% in 2005 to 38% in 2020. Hawaii started to consume biodiesel in 2001, from 2001 to 2020, biodiesel consumption increased from 7 BBTUs to 821 BBTUs.

Table 3.1. Hawaii's Biomass Consumption by Source

	Biomass Consumption						
	Biomass	W&W	Ethanol	Biodiesel	% of Total Biomas		
Year	BBTUs	BBTUs	BBTUs	BBTUs	W&W	Ethanol	Biodiesel
1960	-	-	-	-	NA	NA	NA
1970	429	429	-	-	100	-	-
1980	11,910	11,910	-	-	100	-	-
1989	26,984	26,984	-	-	100	-	-
1990	25,924	25,924	-	-	100	-	-
1995	19,803	19,803	-	-	100	-	-
1996	19,066	19,066	-	-	100	-	-
1997	17,433	17,433	-	-	100	-	-
1998	16,548	16,548	-	-	100	-	-
1999	16,981	16,981	-	-	100	-	-
2000	15,194	15,194	-	-	100	-	-
2001	7,954	7,947	-	7	100	-	0
2002	7,491	7,480	-	11	100	-	0
2003	9,314	9,305	-	9	100	-	0
2004	9,354	9,336	-	17	100	-	0
2005	9,632	8,382	1,192	59	87	12	1
2006	10,054	8,524	1,361	169	85	14	2
2007	9,936	7,969	1,738	229	80	17	2
2008	12,030	8,609	3,224	196	72	27	2
2009	12,482	8,586	3,688	208	69	30	2
2010	10,700	7,744	2,789	168	72	26	2
2011	11,187	7,378	3,236	573	66	29	5
2012	10,026	6,691	2,937	397	67	29	4
2013	11,720	8,156	3,033	527	70	26	4
2014	11,624	7,708	3,291	620	66	28	5
2015	12,075	7,220	3,983	867	60	33	7
2016	13,414	8,181	4,000	1,227	61	30	9
2017	10,944	5,415	4,039	1,483	49	37	14
2018	10,700	5,351	3,941	1,402	50	37	13
2019	9,971	4,905	4,033	1,027	49	40	10
2020	8,428	4,427	3,173	821	53	38	10

Source: Energy Information Administration, State Energy Data System

Before 1990, Hawaii's W&W was mainly consumed in the industrial sector. From 1990 to 2020, the share of W&W consumed by the electricity sector decreased from 30% to 24%; the share of W&W consumed by the industrial sector decreased from 70% to 2%; and the share of W&W consumed by the commercial sector increased from 0% to 74%.

Table 3.2. Hawaii's Wood and Waste Consumption by Sector

	Wood and Waste Consumption By Sector in BBTUs				Share of Wood and Waste Consumption By Sector in % of W&W Consumption			
Year	Electric	Industrial	Commercial	Residential	Electric	Industrial	Commercial	Residential
1960	-	-	-	-	-	-	-	-
1970	257	172	-	-	60	40	-	-
1980	-	11,910	-	-	-	100	-	-
1989	360	26,624	-	-	1	99	-	-
1990	7,765	18,159	-	-	30	70	-	-
1995	6,547	13,256	-	-	33	67	-	-
1996	4,921	14,145	-	-	26	74	-	-
1997	5,608	11,825	-	-	32	68	-	-
1998	5,423	11,125	-	-	33	67	-	-
1999	5,410	11,571	-	-	32	68	-	-
2000	5,325	9,869	-	-	35	65	-	-
2001	2,830	5,117	-	-	36	64	-	-
2002	2,398	5,083	-	-	32	68	-	-
2003	2,561	6,745	-	-	28	72	-	-
2004	-	6,795	2,541	-	-	73	27	-
2005	-	5,943	2,264	175	-	71	27	2
2006	-	5,753	2,616	156	-	67	31	2
2007	-	5,447	2,350	172	-	68	29	2
2008	-	5,351	3,066	192	-	62	36	2
2009	44	5,155	3,045	342	1	60	35	4
2010	40	4,392	2,945	367	1	57	38	5
2011	579	3,659	2,785	356	8	50	38	5
2012	403	3,778	2,213	297	6	56	33	4
2013	519	4,036	3,214	388	6	49	39	5
2014	609	3,412	3,295	392	8	44	43	5
2015	853	3,169	3,185	14	12	44	44	0
2016	1,076	3,360	3,734	10	13	41	46	0
2017	1,762	68	3,553	32	33	1	66	1
2018	1,456	68	3,805	23	27	1	71	0
2019	1,297	68	3,517	23	26	1	72	0
2020	1,062	68	3,275	23	24	2	74	1

Source: Energy Information Administration, State Energy Data System

Hawaii's fuel ethanol was almost all consumed in the transportation sector. Only a small amount of ethanol was consumed in the industrial sector and the commercial sector.

Table 3.3. Hawaii's Fuel Ethanol Consumption by Sector

	Ethanol Consumption By Sector in BBTUs			Share of Ethanol Consumption By Sector in % of Ethanol Consumption		
Year	Industrial	Commercial	Transportation	Industrial	Commercial	Transportation
1960	-	-	-	-	-	-
1970	-	-	-	-	-	-
1980	-	-	-	-	-	-
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1995	-	-	-	-	-	-
1996	-	-	-	-	-	-
1997	-	-	-	-	-	-
1998	-	-	-	-	-	-
1999	-	-	-	-	-	-
2000	-	-	-	-	-	-
2001	-	-	-	-	-	-
2002	-	-	-	-	-	-
2003	-	-	-	-	-	-
2004	-	-	-	-	-	-
2005	14	1	1,176	1	0	99
2006	17	1	1,343	1	0	99
2007	37	2	1,699	2	0	98
2008	75	4	3,146	2	0	98
2009	79	4	3,604	2	0	98
2010	40	3	2,745	1	0	98
2011	43	4	3,190	1	0	99
2012	39	3	2,895	1	0	99
2013	39	4	2,990	1	0	99
2014	52	4	3,235	2	0	98
2015	102	111	3,769	3	3	95
2016	100	112	3,788	3	3	95
2017	103	115	3,822	3	3	95
2018	105	117	3,719	3	3	94
2019	107	119	3,806	3	3	94
2020	109	121	2,943	3	4	93

Source: Energy Information Administration, State Energy Data System

Significant geothermal consumption in Hawaii began in 1993. From 1993 to 2017, geothermal consumption increased from 1,570 to 2,980 BBTUs. In 2018, geothermal consumption decreased to 1,010 BBTUs. In 2019, geothermal consumption decreased to only 8 BBTUs. In 2020, geothermal consumption increased to 93 BBTUs. Geothermal was almost entirely consumed in the electricity sector.

Table 3.4. Hawaii's Geothermal Consumption by Sector

	Geothermal Consumption By Sector in BBTUs				
Year	Total	Electric	Industrial	Commercial	Residential
1960	-	-	-	-	-
1970	-	-	-	-	-
1980	-	-	-	-	-
1989	148	147	1	-	-
1990	1	-	1	-	-
1993	1,571	1,570	1	-	-
1995	2,418	2,418	-	-	-
1996	2,502	2,502	-	-	-
1997	2,506	2,506	-	-	-
1998	2,418	2,418	-	-	-
1999	2,162	2,156	2	4	-
2000	2,681	2,673	2	6	-
2001	2,143	2,135	2	6	-
2002	748	740	2	6	-
2003	1,812	1,805	1	6	-
2004	2,144	2,136	2	6	-
2005	2,225	2,216	2	7	-
2006	2,114	2,106	2	6	-
2007	2,280	2,272	2	6	-
2008	2,316	2,309	2	5	-
2009	1,643	1,636	2	5	-
2010	1,964	1,957	2	5	-
2011	2,183	2,175	2	6	-
2012	2,492	2,484	2	6	-
2013	2,630	2,622	2	6	-
2014	2,422	2,414	2	6	-
2015	2,155	2,147	2	6	-
2016	2,409	2,401	2	6	-
2017	2,980	2,972	2	6	-
2018	1,010	1,002	2	6	-
2019	8	-	2	6	-
2020	93	85	2	6	-

Source: Energy Information Administration, State Energy Data System

Hawaii's hydro energy consumption fluctuated around 1,000 BBTUs over the analysis period. Hydro energy was consumed in the electricity sector and the industrial sector.

Table 3.5. Hawaii's Hydro Energy Consumption by Sector

	Hydro Energy Consumption By Sector				
	in BBTUs			In % of Hydro	
Year	Total	Electric	Industrial	Electric	Industrial
1960	292	292	-	100.0	-
1970	1,131	227	904	20.1	79.9
1980	898	205	693	22.8	77.2
1989	581	234	347	40.3	59.7
1990	828	237	591	28.7	71.5
1995	1,009	351	658	34.8	65.2
1996	1,075	404	671	37.5	62.4
1997	1,178	496	682	42.1	57.9
1998	1,236	468	768	37.8	62.1
1999	1,175	458	717	39.0	61.0
2000	1,056	441	615	41.8	58.3
2001	1,041	520	521	50.0	50.0
2002	967	354	613	36.6	63.4
2003	917	410	507	44.8	55.3
2004	941	574	367	61.0	39.0
2005	962	623	339	64.8	35.2
2006	1,191	811	380	68.1	31.9
2007	913	540	373	59.1	40.9
2008	831	444	387	53.4	46.6
2009	1,099	754	345	68.6	31.4
2010	687	279	408	40.6	59.4
2011	905	433	472	47.8	52.2
2012	1,091	532	559	48.8	51.3
2013	747	325	422	43.5	56.5
2014	895	397	498	44.4	55.6
2015	1,130	584	546	51.7	48.4
2016	838	490	348	58.4	41.5
2017	608	269	339	44.2	55.7
2018	879	565	314	64.3	35.7
2019	841	315	526	37.4	62.5
2020	867	252	615	29.1	70.9

Source: Energy Information Administration, State Energy Data System

Hawaii's solar energy (including customer-sited solar) consumption began in 1989. From 1989 to 2020, solar energy consumption increased by 16,083 BBTUs or 1,964%. Before 2005, solar energy was mainly consumed in the residential sector. Since 2005, the commercial sector started to consume significant solar energy; and since 2009, the electricity sector started to consume solar energy. In 2020, the residential sector accounted for 50.6% of total solar energy consumption; followed by the electricity sector at 25.1%, and the commercial sector at 24.1%.

Table 3.6. Hawaii's Solar Energy Consumption by Sector

	Solar Energy Consumption By Sector* in BBTUs					Share of Solar Energy Consumption By Sector in % of Solar Consumption			
Year	Total	Electric	Industrial	Commercial	Residential	Electric	Industrial	Commercial	Residential
1960	-	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-	-
1989	819	-	-	1	818	-	-	0.1	99.9
1990	885	-	-	2	883	-	-	0.2	99.8
1995	1,168	-	1	3	1,165	-	0.1	0.3	99.7
1996	1,211	-	1	3	1,207	-	0.1	0.2	99.7
1997	1,222	-	1	3	1,218	-	0.1	0.2	99.7
1998	1,258	-	1	4	1,253	-	0.1	0.3	99.6
1999	1,281	-	1	5	1,276	-	0.1	0.4	99.6
2000	1,283	-	1	5	1,277	-	0.1	0.4	99.5
2001	1,237	-	1	6	1,230	-	0.1	0.5	99.4
2002	1,241	-	2	7	1,232	-	0.2	0.6	99.3
2003	1,260	-	2	9	1,250	-	0.2	0.7	99.2
2004	1,274	-	2	10	1,261	-	0.2	0.8	99.0
2005	1,304	-	3	16	1,285	-	0.2	1.2	98.5
2006	1,385	-	-	42	1,343	-	-	3.0	97.0
2007	1,526	-	-	85	1,441	-	-	5.6	94.4
2008	1,813	-	-	179	1,634	-	-	9.9	90.1
2009	2,055	14	-	292	1,750	0.7	-	14.2	85.2
2010	2,343	17	-	411	1,915	0.7	-	17.5	81.7
2011	2,923	35	-	681	2,207	1.2	-	23.3	75.5
2012	4,441	44	-	1,384	3,013	1.0	-	31.2	67.8
2013	6,073	186	-	1,649	4,238	3.1	-	27.2	69.8
2014	7,553	373	-	2,168	5,012	4.9	-	28.7	66.4
2015	8,360	507	4	2,267	5,581	6.1	0.0	27.1	66.8
2016	9,813	817	19	2,577	6,400	8.3	0.2	26.3	65.2
2017	12,579	1,612	23	3,314	7,629	12.8	0.2	26.3	60.6
2018	13,070	1,680	23	3,697	7,670	12.9	0.2	28.3	58.7
2019	14,320	2,388	33	3,873	8,027	16.7	0.2	27.0	56.1
2020	16,902	4,246	35	4,073	8,548	25.1	0.2	24.1	50.6

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Hawaii's wind energy consumption began in 1989 and then increased from 344 BBTUs to 5,196 BBTUs from 1989 and 2020. Wind energy was entirely consumed in the electricity sector.

4. HAWAII'S RENEWABLE ENERGY BY SECTOR

The EIA data includes five sectors: industrial, commercial, residential, transportation, and electricity. The first four sectors are final users of energy, the electricity generation and the electrical system losses of the electricity sector are allocated to the four final user sectors.

Hawaii's total primary energy consumption increased from 94,839 BBTUs in 1960 to 321,420 BBTUs in 1990, decreased from 1990 to 2001, increased from 2001 to 2007, decreased from 2007 to 2009, increased from 2009 to 2019, and decreased in 2020 to 232,516 BBTUs (Table 4.1). From 1960 to 2020, including electricity allocated to the final user sectors, the share of transportation decreased from 65.1% to 46.9%; the share of the industrial sector decreased from 21.7% to 20.4%; the share of the commercial sector increased from 5.6% to 16.9%; and the share of the residential sector increased from 7.5% to 15.8%.

Table 4.1. Hawaii's Primary Energy Consumption by Final-User Sector

	Primary Energy Consumption By Sector* in BBTUs					Share of Primary Energy Consumption By Sector % of Primary Energy Consumption			
Year	Total	Industrial	Commercial	Residential	Transportation	Industrial	Commercial	Residential	Transportation
1960	94,839	20,617	5,300	7,144	61,778	21.7	5.6	7.5	65.1
1965	130,560	34,680	7,025	9,876	78,979	26.6	5.4	7.6	60.5
1970	196,947	43,623	12,521	15,461	125,344	22.1	6.4	7.9	63.6
1975	214,378	50,344	14,534	18,957	130,543	23.5	6.8	8.8	60.9
1980	262,347	74,539	20,074	21,021	146,713	28.4	7.7	8.0	55.9
1985	248,554	67,345	18,393	19,928	142,888	27.1	7.4	8.0	57.5
1990	321,420	98,939	37,212	30,724	154,545	30.8	11.6	9.6	48.1
1995	296,775	92,871	34,607	31,256	138,041	31.3	11.7	10.5	46.5
2000	273,307	77,944	37,283	32,984	125,096	28.5	13.6	12.1	45.8
2001	270,122	69,465	36,574	32,163	131,920	25.7	13.5	11.9	48.8
2005	324,737	72,369	39,905	33,336	179,128	22.3	12.3	10.3	55.2
2006	327,288	71,564	40,683	33,679	181,362	21.9	12.4	10.3	55.4
2007	337,829	69,038	40,249	34,100	194,442	20.4	11.9	10.1	57.6
2008	276,654	65,843	40,880	33,424	136,507	23.8	14.8	12.1	49.3
2009	275,928	69,087	40,705	33,307	132,829	25.0	14.8	12.1	48.1
2010	297,556	68,075	40,143	32,681	156,657	22.9	13.5	11.0	52.6
2011	302,550	67,551	41,210	32,506	161,283	22.3	13.6	10.7	53.3
2012	297,399	65,112	39,295	31,530	161,462	21.9	13.2	10.6	54.3
2013	301,914	65,422	40,607	30,848	165,038	21.7	13.4	10.2	54.7
2014	295,244	64,557	41,137	31,407	158,144	21.9	13.9	10.6	53.6
2015	298,992	64,228	41,330	31,571	161,862	21.5	13.8	10.6	54.1
2016	300,390	63,093	41,486	32,506	163,304	21.0	13.8	10.8	54.4
2017	308,376	60,486	42,989	34,020	170,882	19.6	13.9	11.0	55.4
2018	306,342	56,322	42,654	34,237	173,129	18.4	13.9	11.2	56.5
2019	307,764	56,137	42,895	34,543	174,189	18.2	13.9	11.2	56.6
2020	232,516	47,319	39,353	36,797	109,047	20.4	16.9	15.8	46.9

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Primary energy consumed by the electricity sector, excluding customer-sited solar, increased from 17,603 BBTUs in 1960 to 85,541 BBTUs in 2020. The share of electricity sector energy consumption allocated to the residential sector decreased 7.6 percentage points from 40.0% to 32.4%; the share of commercial sector increased 6.7 percentage points from 23.8% to 30.5%; and the share of the industrial sector increased 0.9 of a percentage point from 36.2% to 37.1%.

Table 4.2. Hawaii's Electricity Sold and Electrical System Energy Losses by Sector

	Electricity Sold and System Energy Losses By Sector in BBTUs					Share of Electricity Sold and System Losses By Sector in %			
Year	Total	Industrial	Commercial	Residential	Transportation	Industrial	Commercial	Residential	Transportation
1960	17,603	6,374	4,185	7,044	-	36.2	23.8	40.0	-
1965	27,569	12,325	5,564	9,679	-	44.7	20.2	35.1	-
1970	43,176	19,667	8,818	14,691	-	45.6	20.4	34.0	-
1975	58,778	28,093	12,276	18,408	-	47.8	20.9	31.3	-
1980	69,748	33,360	16,107	20,282	-	47.8	23.1	29.1	-
1985	69,758	33,050	16,954	19,755	-	47.4	24.3	28.3	-
1990	105,928	47,592	28,715	29,621	-	44.9	27.1	28.0	-
1995	105,520	43,674	31,913	29,934	-	41.4	30.2	28.4	-
1996	107,442	44,497	32,291	30,654	-	41.4	30.1	28.5	-
1997	107,306	44,197	32,531	30,577	-	41.2	30.3	28.5	-
1998	105,629	43,198	32,312	30,118	-	40.9	30.6	28.5	-
1999	106,576	42,576	33,449	30,550	-	39.9	31.4	28.7	-
2000	108,477	42,916	34,613	30,947	-	39.6	31.9	28.5	-
2001	105,273	40,776	34,345	30,152	-	38.7	32.6	28.6	-
2002	110,917	42,279	36,138	32,500	-	38.1	32.6	29.3	-
2003	102,737	38,027	34,774	29,935	-	37.0	33.8	29.1	-
2004	104,437	38,314	35,350	30,773	-	36.7	33.8	29.5	-
2005	104,105	38,641	34,209	31,255	-	37.1	32.9	30.0	-
2006	104,704	38,597	34,575	31,530	-	36.9	33.0	30.1	-
2007	105,688	38,583	35,148	31,958	-	36.5	33.3	30.2	-
2008	102,832	37,650	34,647	30,534	-	36.6	33.7	29.7	-
2009	100,248	36,460	33,541	30,247	-	36.4	33.5	30.2	-
2010	98,670	36,177	33,045	29,449	-	36.7	33.5	29.8	-
2011	98,841	36,362	33,419	29,060	-	36.8	33.8	29.4	-
2012	94,772	36,002	31,838	26,932	-	38.0	33.6	28.4	-
2013	92,323	35,198	31,779	25,344	-	38.1	34.4	27.5	-
2014	92,129	35,876	31,132	25,122	-	38.9	33.8	27.3	-
2015	91,580	35,582	30,565	25,432	-	38.9	33.4	27.8	-
2016	91,768	36,165	30,228	25,374	-	39.4	32.9	27.7	-
2017	91,296	35,375	30,174	25,748	-	38.7	33.1	28.2	-
2018	89,747	34,540	29,153	26,055	-	38.5	32.5	29.0	-
2019	88,915	34,193	28,762	25,958	-	38.5	32.3	29.2	-
2020	85,541	31,733	26,102	27,705	-	37.1	30.5	32.4	-

Source: Energy Information Administration, State Energy Data System

Table 4.3 shows Hawaii's primary energy consumption by five sectors, with the energy consumption of the four final user sectors excluding the electricity allocated to the sector. Energy consumption of the electricity sector, excluding customer-sited solar, was separated into an independent sector. From 1960 to 2020, the share of the electricity sector increased 18.2 percentage points from 18.6% to 36.8%; the share of commercial sector increased 4.5 percentage points from 1.2% to 5.7%; the share of the residential sector increased 3.8 percentage points from 0.1% to 3.9%; the share of the transportation sector decreased 18.2 percentage points from 65.1% to 46.9%; and the share of the industrial sector decreased 8.3 percentage points from 15.0% to 6.7%.

Table 4.3. Hawaii's Primary Energy Consumption by Sector

	Primary Energy Consumption By Sector in BBTUs						Share of Primary Energy Consumption By Sector % of Primary Energy Consumption				
Year	Total	Industrial	Commercial*	Residential*	Transportation	Electric	Industrial	Commercial*	Residential*	Transportation	Electric
1960	94,839	14,243	1,115	100	61,778	17,603	15.0	1.2	0.1	65.1	18.6
1965	130,560	22,355	1,461	197	78,979	27,568	17.1	1.1	0.2	60.5	21.1
1970	196,947	23,956	3,703	770	125,344	43,176	12.2	1.9	0.4	63.6	21.9
1975	214,378	22,251	2,258	549	130,543	58,778	10.4	1.1	0.3	60.9	27.4
1980	262,347	41,179	3,967	739	146,713	69,749	15.7	1.5	0.3	55.9	26.6
1985	248,554	34,295	1,439	173	142,888	69,758	13.8	0.6	0.1	57.5	28.1
1990	321,420	51,347	8,497	1,103	154,545	105,928	16.0	2.6	0.3	48.1	33.0
1995	296,775	49,197	2,694	1,322	138,041	105,520	16.6	0.9	0.4	46.5	35.6
2000	273,307	35,028	2,670	2,037	125,096	108,477	12.8	1.0	0.7	45.8	39.7
2005	324,737	33,728	5,696	2,081	179,128	104,105	10.4	1.8	0.6	55.2	32.1
2006	327,288	32,967	6,108	2,149	181,362	104,703	10.1	1.9	0.7	55.4	32.0
2007	337,829	30,455	5,101	2,142	194,442	105,688	9.0	1.5	0.6	57.6	31.3
2008	276,654	28,193	6,233	2,890	136,507	102,831	10.2	2.3	1.0	49.3	37.2
2009	275,928	32,627	7,164	3,060	132,829	100,247	11.8	2.6	1.1	48.1	36.3
2010	297,556	31,898	7,098	3,232	156,657	98,671	10.7	2.4	1.1	52.6	33.2
2011	302,550	31,189	7,791	3,446	161,283	98,841	10.3	2.6	1.1	53.3	32.7
2012	297,399	29,110	7,457	4,598	161,462	94,772	9.8	2.5	1.5	54.3	31.9
2013	301,914	30,224	8,828	5,504	165,038	92,322	10.0	2.9	1.8	54.7	30.6
2014	295,244	28,681	10,005	6,285	158,144	92,130	9.7	3.4	2.1	53.6	31.2
2015	298,992	28,646	10,765	6,139	161,862	91,579	9.6	3.6	2.1	54.1	30.6
2016	300,390	26,928	11,258	7,132	163,304	91,768	9.0	3.7	2.4	54.4	30.5
2017	308,376	25,111	12,815	8,272	170,882	91,296	8.1	4.2	2.7	55.4	29.6
2018	306,342	21,782	13,501	8,182	173,129	89,747	7.1	4.4	2.7	56.5	29.3
2019	307,764	21,944	14,133	8,585	174,189	88,915	7.1	4.6	2.8	56.6	28.9
2020	232,516	15,586	13,251	9,092	109,047	85,540	6.7	5.7	3.9	46.9	36.8

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Table 4.4 shows Hawaii's renewable energy consumption by five sectors, with significant renewable energy consumption beginning in 1980. From 1980 to 2020, the electricity sector's share of total renewable energy consumption increased 32.8 percentage points from 1.6% to 34.4%; the residential sector's share increased 27.2 percentage points from 0.0% to 27.2%; the commercial sector's share increased 23.7 percentage points from 0.0% to 23.7%; the transportation sector's share increased 12.0 percentage points from 0.0% to 12.0%; and the industrial sector's share decreased 95.8 percentage points from 98.4% to 2.6%.

Table 4.4. Hawaii's Renewable Energy Consumption by Sector

	Renewable Energy Consumption By Sector in BBTUs						Share of Renewable Energy Consumption By Sector % of Renewable Energy Consumption				
Year	Total	Industrial	Commercial*	Residential*	Transportation	Electric	Industrial	Commercial*	Residential*	Transportation	Electric
1960	292	-	-	-	-	292	-	-	-	-	100.0
1965	1,265	1,036	-	-	-	229	81.9	-	-	-	18.1
1970	1,559	1,076	-	-	-	484	69.0	-	-	-	31.0
1975	1,498	1,049	-	-	-	449	70.0	-	-	-	30.0
1980	12,808	12,603	-	-	-	205	98.4	-	-	-	1.6
1985	15,307	14,652	-	-	-	656	95.7	-	-	-	4.3
1990	27,937	18,751	2	883	-	8,302	67.1	0.0	3.2	-	29.7
1995	24,608	13,915	3	1,165	-	9,526	56.5	0.0	4.7	-	38.7
2000	20,387	10,487	11	1,277	-	8,612	51.4	0.1	6.3	-	42.2
2001	12,397	5,641	12	1,230	7	5,507	45.5	0.1	9.9	0.1	44.4
2002	10,464	5,700	13	1,232	11	3,508	54.5	0.1	11.8	0.1	33.5
2003	13,320	7,255	15	1,250	9	4,792	54.5	0.1	9.4	0.1	36.0
2004	13,788	7,166	2,557	1,261	17	2,785	52.0	18.5	9.1	0.1	20.2
2005	14,189	6,301	2,288	1,460	1,235	2,905	44.4	16.1	10.3	8.7	20.5
2006	15,534	6,152	2,665	1,499	1,512	3,707	39.6	17.2	9.6	9.7	23.9
2007	17,009	5,859	2,443	1,613	1,928	5,166	34.4	14.4	9.5	11.3	30.4
2008	19,356	5,815	3,254	1,826	3,342	5,118	30.0	16.8	9.4	17.3	26.4
2009	19,734	5,581	3,346	2,092	3,812	4,902	28.3	17.0	10.6	19.3	24.8
2010	18,242	4,842	3,364	2,282	2,913	4,840	26.5	18.4	12.5	16.0	26.5
2011	20,510	4,176	3,476	2,563	3,763	6,533	20.4	16.9	12.5	18.3	31.9
2012	21,648	4,378	3,606	3,310	3,292	7,062	20.2	16.7	15.3	15.2	32.6
2013	25,972	4,499	4,873	4,626	3,517	8,454	17.3	18.8	17.8	13.5	32.6
2014	27,997	3,964	5,473	5,404	3,855	9,296	14.2	19.5	19.3	13.8	33.2
2015	29,428	3,823	5,569	5,595	4,636	9,801	13.0	18.9	19.0	15.8	33.3
2016	32,376	3,829	6,429	6,410	5,015	10,684	11.8	19.9	19.8	15.5	33.0
2017	32,014	535	6,988	7,661	5,305	11,517	1.7	21.8	23.9	16.6	36.0
2018	31,140	512	7,625	7,693	5,121	10,183	1.6	24.5	24.7	16.4	32.7
2019	29,855	736	7,515	8,050	4,833	8,714	2.5	25.2	27.0	16.2	29.2
2020	31,485	829	7,475	8,571	3,764	10,841	2.6	23.7	27.2	12.0	34.4

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Table 4.5 shows the share of renewable energy consumption by five sectors. Before 1989, only the industrial sector consumed a significant share of renewable energy; however, the share of renewable energy in the industrial sector decreased substantially since 1989. Since 1989, renewable energy (including customer-sited solar) became the dominant energy source in the residential sector. Since 2004, renewable energy also became a major source of energy in the commercial sector. The share of renewable energy in the electricity sector increased from 1960 to 1993, decreased from 1993 to 2004, and increased from 2.7% in 2004 to 12.7% in 2020.

Table 4.5. Hawaii's Share of Renewable Energy Consumption by Sector

		Share of Renewable Energy Consumption By Sector in % of Total Primary Energy Consumption				
Year	Total Renewable	Industrial	Commercial*	Residential*	Transportation	Electric
1960	0.3	-	-	-	-	1.7
1970	0.8	4.5	-	-	-	1.1
1980	4.9	30.6	-	-	-	0.3
1989	9.3	49.0	0.0	77.3	-	1.3
1990	8.7	36.5	0.0	80.1	-	7.8
1993	9.8	35.1	0.1	86.8	-	9.6
1994	8.5	29.7	0.0	87.3	-	9.1
1995	8.3	28.3	0.1	88.1	-	9.0
2000	7.5	29.9	0.4	62.7	-	7.9
2001	4.6	19.7	0.5	61.2	0.0	5.2
2002	3.7	20.0	0.4	61.0	0.0	3.2
2003	4.4	23.6	0.5	67.9	0.0	4.7
2004	4.4	23.4	43.3	67.6	0.0	2.7
2005	4.4	18.7	40.2	70.2	0.7	2.8
2006	4.7	18.7	43.6	69.8	0.8	3.5
2007	5.0	19.2	47.9	75.3	1.0	4.9
2008	7.0	20.6	52.2	63.2	2.4	5.0
2009	7.2	17.1	46.7	68.4	2.9	4.9
2010	6.1	15.2	47.4	70.6	1.9	4.9
2011	6.8	13.4	44.6	74.4	2.3	6.6
2012	7.3	15.0	48.4	72.0	2.0	7.5
2013	8.6	14.9	55.2	84.0	2.1	9.2
2014	9.5	13.8	54.7	86.0	2.4	10.1
2015	9.8	13.3	51.7	91.1	2.9	10.7
2016	10.8	14.2	57.1	89.9	3.1	11.6
2017	10.4	2.1	54.5	92.6	3.1	12.6
2018	10.2	2.4	56.5	94.0	3.0	11.3
2019	9.7	3.4	53.2	93.8	2.8	9.8
2020	13.5	5.3	56.4	94.3	3.5	12.7

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Table 4.6 shows the renewable energy consumption by source in the industrial sector. From 1960 to 1989, the share of renewable in the industrial sector increased from 0.0% to 28.8%. However, from 1989 to 2020, the share of renewable energy decreased from 28.8% to 1.8%. From 1989 to 2020, among the five types of renewable energy sources consumed in the industrial sector, the share of W&W decreased from 98.7% to 8.2%, the share of hydro increased from 1.3% to 74.2%; and the share of ethanol increased from 0.0% to 13.1%.

Table 4.6. Industrial Sector Renewable Energy Consumption by Source

	Industrial Sector Energy Consumption By Source Units: Billion Btu							Renewable % of	Share of Industrial Sector Renewable Energy By Source % of Industrial Renewable Energy Consumption				
Year	Primary Energy	Total Renewable	Wood and Waste	Ethanol	Geothermal	Hydro	Solar	Primary Energy	Wood and Waste	Ethanol	Geothermal	Hydro	Solar
1960	20,617	-	-	-	-	-	-	-	-	-	-	-	-
1965	34,680	1,036	172	-	-	864	-	3.0	16.6	-	-	83.4	-
1970	43,623	1,076	172	-	-	904	-	2.5	16.0	-	-	84.0	-
1975	50,344	1,049	310	-	-	739	-	2.1	29.6	-	-	70.4	-
1980	74,539	12,603	11,910	-	-	693	-	16.9	94.5	-	-	5.5	-
1985	67,345	14,652	13,955	-	-	697	-	21.8	95.2	-	-	4.8	-
1989	93,794	26,972	26,624	-	1	347	-	28.8	98.7	-	0.0	1.3	-
1990	98,939	18,751	18,159	-	1	591	-	19.0	96.8	-	0.0	3.2	-
1995	92,871	13,915	13,256	-	-	658	1	15.0	95.3	-	-	4.7	0.0
2000	77,944	10,487	9,869	-	2	615	1	13.5	94.1	-	0.0	5.9	0.0
2001	69,465	5,641	5,117	-	2	521	1	8.1	90.7	-	0.0	9.2	0.0
2002	70,728	5,700	5,083	-	2	613	2	8.1	89.2	-	0.0	10.8	0.0
2003	68,832	7,255	6,745	-	1	507	2	10.5	93.0	-	0.0	7.0	0.0
2004	68,904	7,166	6,795	-	2	367	2	10.4	94.8	-	0.0	5.1	0.0
2005	72,369	6,301	5,943	14	2	339	3	8.7	94.3	0.2	0.0	5.4	0.0
2006	71,564	6,152	5,753	17	2	380	-	8.6	93.5	0.3	0.0	6.2	-
2007	69,038	5,859	5,447	37	2	373	-	8.5	93.0	0.6	0.0	6.4	-
2008	65,843	5,815	5,351	75	2	387	-	8.8	92.0	1.3	0.0	6.7	-
2009	69,087	5,581	5,155	79	2	345	-	8.1	92.4	1.4	0.0	6.2	-
2010	68,075	4,842	4,392	40	2	408	-	7.1	90.7	0.8	0.0	8.4	-
2011	67,551	4,176	3,659	43	2	472	-	6.2	87.6	1.0	0.0	11.3	-
2012	65,112	4,378	3,778	39	2	559	-	6.7	86.3	0.9	0.0	12.8	-
2013	65,422	4,499	4,036	39	2	422	-	6.9	89.7	0.9	0.0	9.4	-
2014	64,557	3,964	3,412	52	2	498	-	6.1	86.1	1.3	0.1	12.6	-
2015	64,228	3,823	3,169	102	2	546	4	6.0	82.9	2.7	0.1	14.3	0.1
2016	63,093	3,829	3,360	100	2	348	19	6.1	87.8	2.6	0.1	9.1	0.5
2017	60,486	535	68	103	2	339	23	0.9	12.7	19.3	0.4	63.4	4.3
2018	56,322	512	68	105	2	314	23	0.9	13.3	20.5	0.4	61.3	4.5
2019	56,137	736	68	107	2	526	33	1.3	9.2	14.5	0.3	71.5	4.5
2020	47,319	829	68	109	2	615	35	1.8	8.2	13.1	0.2	74.2	4.2

Source: Energy Information Administration, State Energy Data System

Table 4.7 shows the renewable energy consumption by source for the commercial sector. Before 2004, renewable energy consumption in the commercial sector was very limited. Since 2004, the commercial sector started to consume W&W and solar. From 2003 to 2020, the share of renewable in the commercial sector increased from 0.0% to 19.0%. From 2004 to 2020, among the four types of renewable energy sources consumed in the commercial sector, the share of W&W decreased from 99.4% to 43.8%, and the share of solar increased from 0.4% to 54.5%.

Table 4.7. Commercial Sector Renewable Energy Consumption by Source

	Commercial Sector Energy Consumption By Source Units: Billion Btu						Renewable % of	Share of Commercial Sector Renewable Energy By Source % of Commercial Renewable Energy Consumption			
Year	Primary Energy	Total Renewable	Wood and Waste	Ethanol	Geothermal	Solar*	Primary Energy	Wood and Waste	Ethanol	Geothermal	Solar*
1989	36,095	1	-	-	-	1	0.0	-	-	-	100.0
1990	37,212	2	-	-	-	2	0.0	-	-	-	100.0
1995	34,607	3	-	-	-	3	0.0	-	-	-	100.0
2000	37,283	11	-	-	6	5	0.0	-	-	54.5	45.5
2001	36,574	12	-	-	6	6	0.0	-	-	50.0	50.0
2002	39,357	13	-	-	6	7	0.0	-	-	46.2	53.8
2003	37,509	15	-	-	6	9	0.0	-	-	40.0	60.0
2004	41,262	2,557	2,541	-	6	10	6.2	99.4	-	0.2	0.4
2005	39,905	2,288	2,264	1	7	16	5.7	99.0	0.0	0.3	0.7
2006	40,683	2,665	2,616	1	6	42	6.6	98.2	0.0	0.2	1.6
2007	40,249	2,443	2,350	2	6	85	6.1	96.2	0.1	0.2	3.5
2008	40,880	3,254	3,066	4	5	179	8.0	94.2	0.1	0.2	5.5
2009	40,705	3,346	3,045	4	5	292	8.2	91.0	0.1	0.1	8.7
2010	40,143	3,364	2,945	3	5	411	8.4	87.5	0.1	0.1	12.2
2011	41,210	3,476	2,785	4	6	681	8.4	80.1	0.1	0.2	19.6
2012	39,295	3,606	2,213	3	6	1,384	9.2	61.4	0.1	0.2	38.4
2013	40,607	4,873	3,214	4	6	1,649	12.0	66.0	0.1	0.1	33.8
2014	41,137	5,473	3,295	4	6	2,168	13.3	60.2	0.1	0.1	39.6
2015	41,330	5,569	3,185	111	6	2,267	13.5	57.2	2.0	0.1	40.7
2016	41,486	6,429	3,734	112	6	2,577	15.5	58.1	1.7	0.1	40.1
2017	42,989	6,988	3,553	115	6	3,314	16.3	50.8	1.6	0.1	47.4
2018	42,654	7,625	3,805	117	6	3,697	17.9	49.9	1.5	0.1	48.5
2019	42,895	7,515	3,517	119	6	3,873	17.5	46.8	1.6	0.1	51.5
2020	39,353	7,475	3,275	121	6	4,073	19.0	43.8	1.6	0.1	54.5

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Table 4.8 shows the renewable energy consumption by source in the residential sector. Before 1989, there was no renewable energy consumption in the residential sector. Since 1989, the residential sector started to consume solar and, since 2005, a small amount of wood. From 1989 to 2020, the share of renewable in the residential sector increased from 3.2% to 23.3%; total renewable energy consumption in the residential sector increased by 7,475 BBTUs, about 99.7% from solar, with the remainder from wood.

Table 4.8. Residential Sector Renewable Energy Consumption by Source

	Residential Sector Energy Consumption By Source Units: Billion Btu					Renewable % of	Share of Residential Sector Renewable Energy By Source % of Residential Renewable Energy Consumption		
Year	Primary Energy	Total Renewable	W&W	Geothermal	Solar*	Primary Energy	W&W	Geothermal	Solar*
1989	25,381	818	-	-	818	3.2	-	-	100.0
1990	30,724	883	-	-	883	2.9	-	-	100.0
1995	31,256	1,165	-	-	1,165	3.7	-	-	100.0
1996	32,045	1,207	-	-	1,207	3.8	-	-	100.0
1997	32,135	1,218	-	-	1,218	3.8	-	-	100.0
1998	32,332	1,253	-	-	1,253	3.9	-	-	100.0
1999	32,372	1,276	-	-	1,276	3.9	-	-	100.0
2000	32,984	1,277	-	-	1,277	3.9	-	-	100.0
2001	32,163	1,230	-	-	1,230	3.8	-	-	100.0
2002	34,519	1,232	-	-	1,232	3.6	-	-	100.0
2003	31,775	1,250	-	-	1,250	3.9	-	-	100.0
2004	32,638	1,261	-	-	1,261	3.9	-	-	100.0
2005	33,336	1,460	175	-	1,285	4.4	12.0	-	88.0
2006	33,679	1,499	156	-	1,343	4.5	10.4	-	89.6
2007	34,100	1,613	172	-	1,441	4.7	10.7	-	89.3
2008	33,424	1,826	192	-	1,634	5.5	10.5	-	89.5
2009	33,307	2,092	342	-	1,750	6.3	16.3	-	83.7
2010	32,681	2,282	367	-	1,915	7.0	16.1	-	83.9
2011	32,506	2,563	356	-	2,207	7.9	13.9	-	86.1
2012	31,530	3,310	297	-	3,013	10.5	9.0	-	91.0
2013	30,848	4,626	388	-	4,238	15.0	8.4	-	91.6
2014	31,407	5,404	392	-	5,012	17.2	7.3	-	92.7
2015	31,571	5,595	14	-	5,581	17.7	0.3	-	99.7
2016	32,506	6,410	10	-	6,400	19.7	0.2	-	99.8
2017	34,020	7,661	32	-	7,629	22.5	0.4	-	99.6
2018	34,237	7,693	23	-	7,670	22.5	0.3	-	99.7
2019	34,543	8,050	23	-	8,027	23.3	0.3	-	99.7
2020	36,797	8,571	23	-	8,548	23.3	0.3	-	99.7

* Customer-sited PV included.

Source: Energy Information Administration, State Energy Data System

Renewable energy consumed in the transportation sector includes biodiesel and ethanol. Hawaii started to consume biodiesel in 2001. From 2001 to 2020, biodiesel consumption in the transportation sector increased from 7 BBTUs to 821 BBTUs. Hawaii started to consume ethanol in 2005. From 2005 to 2020, ethanol consumption in the transportation sector increased from 1,176 BBTUs to 2,943 BBTUs. As a result, the share of renewable energy in the transportation sector increased from 0.7% to 3.5%.

Table 4.9. Transportation Sector Renewable Energy Consumption by Source

	Transportation Sector Energy Consumption Units: Billion Btu				Renewable % of
Year	Primary Energy	Total Renewable	Biodiesel	Ethanol	Primary Energy
2001	131,920	7	7	-	0.0
2002	140,060	11	11	-	0.0
2003	162,799	9	9	-	0.0
2004	171,915	17	17	-	0.0
2005	179,128	1,235	59	1,176	0.7
2006	181,362	1,512	169	1,343	0.8
2007	194,442	1,928	229	1,699	1.0
2008	136,507	3,342	196	3,146	2.4
2009	132,829	3,812	208	3,604	2.9
2010	156,657	2,913	168	2,745	1.9
2011	161,283	3,763	573	3,190	2.3
2012	161,462	3,292	397	2,895	2.0
2013	165,038	3,517	527	2,990	2.1
2014	158,144	3,855	620	3,235	2.4
2015	161,862	4,636	867	3,769	2.9
2016	163,304	5,015	1,227	3,788	3.1
2017	170,882	5,305	1,483	3,822	3.1
2018	173,129	5,121	1,402	3,719	3.0
2019	174,189	4,833	1,027	3,806	2.8
2020	109,047	3,764	821	2,943	3.5

Source: Energy Information Administration, State Energy Data System

Table 4.10 shows the renewable energy consumption of the electricity sector (excluding customer-sited solar). Before 1989, renewable energy consumption in the electricity sector was very limited. From 1990 to 2003, a significant amount of W&W was used to generate electricity. Since 1993, a significant amount of geothermal was used to generate electricity, and wind started to play an important role since 2007. As a result, the share of renewable energy in the electricity sector increased from 0.4% in 1988 to 12.7% in 2020.

Table 4.10. Electric Power Sector Renewable Energy Consumption by Source

	Electric Power Sector Energy Consumption By Source Units: Billion Btu							Renewable % of
Year	Primary Energy	Total Renewable	Wood and Waste	Geothermal	Hydro	Wind	Solar*	Primary Energy
1988	81,734	313	-	168	145	-	-	0.4
1989	86,465	1,085	360	147	234	344	-	1.3
1990	105,928	8,302	7,765	-	237	300	-	7.8
1995	105,520	9,526	6,547	2,418	351	210	-	9.0
2000	108,477	8,612	5,325	2,673	441	173	-	7.9
2001	105,273	5,507	2,830	2,135	520	22	-	5.2
2002	110,917	3,508	2,398	740	354	16	-	3.2
2003	102,736	4,792	2,561	1,805	410	16	-	4.7
2004	104,437	2,785	-	2,136	574	75	-	2.7
2005	104,105	2,905	-	2,216	623	66	-	2.8
2006	104,703	3,707	-	2,106	811	790	-	3.5
2007	105,688	5,166	-	2,272	540	2,354	-	4.9
2008	102,831	5,118	-	2,309	444	2,365	-	5.0
2009	100,247	4,902	44	1,636	754	2,454	14	4.9
2010	98,671	4,840	40	1,957	279	2,547	17	4.9
2011	98,841	6,533	579	2,175	433	3,311	35	6.6
2012	94,772	7,062	403	2,484	532	3,599	44	7.5
2013	92,322	8,454	519	2,622	325	4,802	186	9.2
2014	92,130	9,296	609	2,414	397	5,503	373	10.1
2015	91,579	9,801	853	2,147	584	5,710	507	10.7
2016	91,768	10,684	1,076	2,401	490	5,900	817	11.6
2017	91,296	11,517	1,762	2,972	269	4,902	1,612	12.6
2018	89,747	10,183	1,456	1,002	565	5,480	1,680	11.3
2019	88,915	8,714	1,297	-	315	4,714	2,388	9.8
2020	85,540	10,841	1,062	85	252	5,196	4,246	12.7

* Does not include customer-sited PV.

Source: Energy Information Administration, State Energy Data System

Table 4.11 shows the shares of renewable energy consumption by source in the electricity sector. In 2020, wind accounted for 47.9% of total renewable consumption in the electricity sector; followed by solar at 39.2%, W&W at 9.8%, and hydro at 2.3%.

Table 4.11. Share of Electric Power Sector Renewable Energy Consumption by Source

	Electric Power Sector Renewable Energy Consumption By Source % of Renewable Energy Consumption				
Year	Wood and Waste	Geothermal	Hydro	Wind	Solar*
1988	-	53.7	46.3	-	-
1989	33.2	13.5	21.6	31.7	-
1990	93.5	-	2.9	3.6	-
1995	68.7	25.4	3.7	2.2	-
2000	61.8	31.0	5.1	2.0	-
2001	51.4	38.8	9.4	0.4	-
2002	68.4	21.1	10.1	0.5	-
2003	53.4	37.7	8.6	0.3	-
2004	-	76.7	20.6	2.7	-
2005	-	76.3	21.4	2.3	-
2006	-	56.8	21.9	21.3	-
2007	-	44.0	10.5	45.6	-
2008	-	45.1	8.7	46.2	-
2009	0.9	33.4	15.4	50.1	0.3
2010	0.8	40.4	5.8	52.6	0.4
2011	8.9	33.3	6.6	50.7	0.5
2012	5.7	35.2	7.5	51.0	0.6
2013	6.1	31.0	3.8	56.8	2.2
2014	6.6	26.0	4.3	59.2	4.0
2015	8.7	21.9	6.0	58.3	5.2
2016	10.1	22.5	4.6	55.2	7.6
2017	15.3	25.8	2.3	42.6	14.0
2018	14.3	9.8	5.5	53.8	16.5
2019	14.9	-	3.6	54.1	27.4
2020	9.8	0.8	2.3	47.9	39.2

* Does not include customer-sited PV.

Source: Energy Information Administration, State Energy Data System

5. HAWAII'S RENEWABLE ELECTRICITY

Renewable energy consumed in Hawaii is mainly used to generate electricity and provide heat. Table 5.1 shows the electricity generated by renewable energy sources in GWh by the electric power industry, excluding the electricity generated from customer-sited solar systems. According to the EIA electricity data, from 1990 to 2002, the percentage of renewable energy generated electricity in total electricity generation decreased from 9.8% to 5.2%. From 2002 to 2020, the share of renewable increased from 5.2% to 19.4%. The decrease from 1990 to 2002 was mainly due to decreased W&W generated electricity; and the increase from 2002 to 2020 was mainly due to increased wind and solar generated electricity.

Table 5.1. Electric Power Sector Renewable Electricity by Source

	Net Generation of Electricity by Selected Renewable Energy Units: GWH								Total Net Electricity Generation	% of Selected Renewable in Total Net
Year	Biomass	Wood	Geothermal	Hydro	Wind	Solar*	Others**	Sum	GWH	Generation
1990	840	-	-	80	29	-	-	948	9,703	9.8
1995	639	1	235	98	20	-	2	994	10,304	9.7
2000	538	-	262	103	17	-	-	921	10,593	8.7
2001	288	-	207	101	2	-	169	767	10,633	7.2
2002	297	-	73	95	2	-	143	609	11,663	5.2
2003	347	-	178	91	2	-	172	789	10,976	7.2
2004	329	-	213	94	7	-	171	814	11,410	7.1
2005	310	-	222	96	7	-	149	783	11,523	6.8
2006	326	-	212	120	80	-	176	913	11,559	7.9
2007	285	-	230	92	238	-	149	995	11,533	8.6
2008	302	-	234	84	240	0	159	1,020	11,376	9.0
2009	284	-	168	113	251	1	381	1,199	11,011	10.9
2010	283	0	201	70	261	2	364	1,181	10,836	10.9
2011	313	-	224	93	341	4	366	1,340	10,723	12.5
2012	281	-	261	115	378	5	363	1,402	10,469	13.4
2013	329	-	275	78	503	19	394	1,599	10,267	15.6
2014	334	-	254	94	579	39	405	1,705	10,204	16.7
2015	321	-	230	121	613	54	369	1,709	10,120	16.9
2016	359	-	260	91	639	89	322	1,760	9,949	17.7
2017	293	-	323	66	532	175	363	1,752	9,813	17.9
2018	306	-	110	97	602	185	382	1,681	9,797	17.2
2019	292	-	-	95	529	268	395	1,578	9,750	16.2
2020	256	-	10	99	592	484	321	1,762	9,079	19.4

* Does not include customer-sited solar.

** Including non-biogenic municipal solid waste

Source: Energy Information Administration, Electricity, Detailed State Data

From 1990 to 2002, the share of biomass generated electricity in total renewable electricity decreased from 88.6% to 48.7%; the share of geothermal increased from 0.0% to 11.9%; the share of hydro increased from 8.4% to 15.6%; the share of wind decreased from 3.0% to 0.3%; and the share of others (mainly non-biogenic municipal solid waste) increased from 0.0% to 23.5% (Table 5.2). From 2002 to 2020, the share of biomass decreased further to 14.5%; the share of geothermal decreased to 0.5%; the share of hydro decreased to 5.6%; the share of wind increased to 33.6%; the share of solar increased to 27.5%; and the share of others decreased to 18.2%.

Table 5.2. Share of Electric Power Sector Renewable Electricity by Source

	% of Electricity Net Generation by Selected Renewable Energy Units: % of Total Renewable Electricity							
Year	Biomass	Wood	Geothermal	Hydro	Wind	Solar*	Others**	Total
1990	88.6%	0.0%	0.0%	8.4%	3.0%	0.0%	0.0%	100.0%
1995	64.2%	0.1%	23.6%	9.8%	2.0%	0.0%	0.2%	100.0%
2000	58.5%	0.0%	28.5%	11.2%	1.8%	0.0%	0.0%	100.0%
2001	37.5%	0.0%	26.9%	13.1%	0.3%	0.0%	22.1%	100.0%
2002	48.7%	0.0%	11.9%	15.6%	0.3%	0.0%	23.5%	100.0%
2003	44.0%	0.0%	22.6%	11.5%	0.2%	0.0%	21.8%	100.0%
2004	40.4%	0.0%	26.2%	11.5%	0.9%	0.0%	20.9%	100.0%
2005	39.5%	0.0%	28.3%	12.3%	0.8%	0.0%	19.0%	100.0%
2006	35.7%	0.0%	23.2%	13.1%	8.7%	0.0%	19.2%	100.0%
2007	28.7%	0.0%	23.1%	9.3%	23.9%	0.0%	15.0%	100.0%
2008	29.6%	0.0%	23.0%	8.3%	23.5%	0.0%	15.6%	100.0%
2009	23.7%	0.0%	14.0%	9.4%	21.0%	0.1%	31.8%	100.0%
2010	24.0%	0.0%	17.0%	6.0%	22.1%	0.1%	30.8%	100.0%
2011	23.3%	0.0%	16.7%	7.0%	25.4%	0.3%	27.3%	100.0%
2012	20.0%	0.0%	18.6%	8.2%	27.0%	0.3%	25.9%	100.0%
2013	20.6%	0.0%	17.2%	4.9%	31.5%	1.2%	24.6%	100.0%
2014	19.6%	0.0%	14.9%	5.5%	33.9%	2.3%	23.8%	100.0%
2015	18.8%	0.0%	13.5%	7.1%	35.9%	3.2%	21.6%	100.0%
2016	20.4%	0.0%	14.8%	5.2%	36.3%	5.0%	18.3%	100.0%
2017	16.7%	0.0%	18.4%	3.8%	30.4%	10.0%	20.7%	100.0%
2018	18.2%	0.0%	6.5%	5.7%	35.8%	11.0%	22.7%	100.0%
2019	18.5%	0.0%	0.0%	6.0%	33.5%	17.0%	25.0%	100.0%
2020	14.5%	0.0%	0.5%	5.6%	33.6%	27.5%	18.2%	100.0%

* Does not include customer-sited solar.

** Including non-biogenic municipal solid waste

Source: Energy Information Administration, Electricity, Detailed State Data

Based on the utility RPS and MFR, the renewable net generation share of total electricity sold can be calculated. Based on the RPS data, renewable electricity net generation accounted for about 40.0% of total electricity sold in 2021 (Table 5.3).

Table 5.3. Total Renewable Electricity Net Generation in Hawaii

	Renewable Electricity Net Generation (GWH)								Total	% of
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	Solar	Solar Cus*	Sold	Renewable
2005	716	403	0	221	82	7	-	2	10,539	6.8%
2006	865	470	0	212	97	82	-	4	10,568	8.2%
2007	945	392	1	230	72	242	-	8	10,585	8.9%
2008	976	413	2	234	78	237	-	12	10,390	9.4%
2009	963	399	5	168	107	250	1	33	10,126	9.5%
2010	950	359	3	202	70	261	2	53	10,013	9.5%
2011	1,186	365	59	233	90	344	4	90	9,962	11.9%
2012	1,324	342	23	266	104	388	12	190	9,639	13.7%
2013	1,708	416	30	281	74	504	48	356	9,501	18.0%
2014	1,989	433	37	255	85	578	68	532	9,406	21.1%
2015	2,199	422	53	230	107	613	92	681	9,389	23.4%
2016	2,466	473	38	260	89	657	122	827	9,284	26.6%
2017	2,526	427	56	323	61	533	212	914	9,136	27.6%
2018	2,520	439	62	110	92	602	217	998	9,140	27.6%
2019	2,725	461	60	-	88	523	322	1,272	9,201	29.6%
2020	3,079	415	75	10	88	595	516	1,381	8,536	36.1%
2021	3,476	412	72	183	105	701	522	1,481	8,696	40.0%

* Customer-sited grid-connected PV.

Source: Utility Renewable Portfolio Standard Status Report

Table 5.4 shows the shares of renewable electricity net generation by source based on the RPS data. From 2005 to 2021, the share of biomass decreased from 56.3% to 11.9%; the share of biofuels increased from 0.0% to 2.1%; the share of geothermal decreased from 30.9% to 5.3%; the share of hydro decreased from 11.5% to 3.0%; the share of wind increased from 1.0% to 20.2%, the share of solar (excluding customer-sited solar) increased from 0.0% to 15.0%; and the share of customer-sited solar increased from 0.3% to 42.6%.

Table 5.4. Share of Total Renewable Electricity Net Generation in Hawaii

	Share of Renewable Electricity Net Generation (%)							
Year	Total	Biomass	Biofuels	Geothermal	Hydro	Wind	Solar	Solar Cus*
2005	100%	56.3%	0.0%	30.9%	11.5%	1.0%	0.0%	0.3%
2006	100%	54.3%	0.0%	24.5%	11.2%	9.5%	0.0%	0.4%
2007	100%	41.5%	0.1%	24.3%	7.6%	25.6%	0.0%	0.8%
2008	100%	42.3%	0.2%	24.0%	7.9%	24.3%	0.0%	1.3%
2009	100%	41.4%	0.5%	17.4%	11.1%	26.0%	0.1%	3.5%
2010	100%	37.8%	0.3%	21.2%	7.4%	27.5%	0.2%	5.6%
2011	100%	30.8%	5.0%	19.6%	7.6%	29.0%	0.3%	7.6%
2012	100%	25.8%	1.7%	20.1%	7.9%	29.3%	0.9%	14.3%
2013	100%	24.3%	1.7%	16.5%	4.3%	29.5%	2.8%	20.8%
2014	100%	21.8%	1.9%	12.8%	4.3%	29.1%	3.4%	26.7%
2015	100%	19.2%	2.4%	10.5%	4.9%	27.9%	4.2%	31.0%
2016	100%	19.2%	1.6%	10.5%	3.6%	26.6%	4.9%	33.5%
2017	100%	16.9%	2.2%	12.8%	2.4%	21.1%	8.4%	36.2%
2018	100%	17.4%	2.5%	4.4%	3.7%	23.9%	8.6%	39.6%
2019	100%	16.9%	2.2%	0.0%	3.2%	19.2%	11.8%	46.7%
2020	100%	13.5%	2.4%	0.3%	2.9%	19.3%	16.8%	44.9%
2021	100%	11.9%	2.1%	5.3%	3.0%	20.2%	15.0%	42.6%

* Customer-sited grid-connected PV.

Source: Utility Renewable Portfolio Standard Status Report