

## Section 17

# ENERGY AND SCIENCE

This section presents statistics on fuel resources, energy production and consumption, the electric and gas utility industries, research and development, and scientific, engineering, and technological resources. Related series are cited in Sections 12 (utility employment), 14 (prices), and 18 (gasoline consumption).

Information on energy and science can be obtained from reports and records of the U.S. Department of Energy; U.S. Patent and Trademark Office; U.S. Bureau of Labor Statistics; National Science Foundation; Hawaii State Department of Taxation; Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy; Hawaii State Department of Business, Economic Development & Tourism, Energy Division; University of Hawaii, Institute of Astronomy; and individual utility companies. *Historical Statistics of Hawaii*, Section 19, presents data for earlier years. Data for the nation as a whole can be found in the *Statistical Abstract of the United States: 1997*, Sections 19 and 20.

**Table 17.01-- CONSUMPTION OF ENERGY, BY SOURCE  
(PHYSICAL UNITS): 1970 TO 1993**

Year	Petroleum 1/ (1,000 barrels)	Hydroelectric power 2/ (million kWh)	Geothermal energy (million kWh)	Coal (1,000 short tons)	Other 3/ (million kWh)
1970	34,129	108	0	0	24
1971	36,754	89	0	0	15
1972	37,755	91	0	0	18
1973	38,785	95	0	0	22
1974	36,698	92	0	0	30
1975	37,056	89	0	0	25
1976	37,990	93	0	0	29
1977	40,249	86	0	0	26
1978	40,851	84	0	0	0
1979	44,486	90	0	0	0
1980	43,505	86	0	0	0
1981	38,721	80	0	0	15
1982	35,637	90	0	47	26
1983	36,297	84	0	42	28
1984	37,252	82	21	38	28
1985	40,004	86	19	46	25
1986	38,931	78	18	16	0
1987	39,669	82	13	63	0
1988	46,133	81	16	50	0
1989	47,940	89	14	32	11
1990	48,606	89	0	28	6
1991	45,487	87	0	37	0
1992	44,357	76	0	47	0
1993	38,778	80	0	73	0

1/ For data by type of petroleum, see source.

2/ Includes industrial and electric utility production.

3/ Electricity generated for distribution from biomass fuels and wind, photovoltaic, and solar thermal energy sources. Excludes natural gas and nuclear electric power.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1993, Consumption Estimates* (July 1995), p. 95.

**Table 17.02-- CONSUMPTION OF ENERGY, BY SOURCE (TRILLION BTU):  
1970 TO 1993**

[Revised data, 1984-1990]

Year	Total energy consumed	Petroleum 1/	Hydro-electric power 2/	Geo-thermal energy	Coal	Natural gas	Other types 3/
1970	196.9	195.5	1.1	0.0	0.0	0.0	0.3
1971	211.6	210.5	0.9	0.0	0.0	0.0	0.2
1972	217.7	216.6	0.9	0.0	0.0	0.0	0.2
1973	223.7	222.5	1.0	0.0	0.0	0.0	0.2
1974	211.6	210.3	1.0	0.0	0.0	0.0	0.3
1975	213.9	212.7	0.9	0.0	0.0	0.0	0.3
1976	219.3	218.0	1.0	0.0	0.0	0.0	0.3
1977	232.6	231.5	0.9	0.0	0.0	0.0	0.3
1978	236.0	235.2	0.9	0.0	0.0	0.0	0.0
1979	255.2	254.3	0.9	0.0	0.0	0.0	0.0
1980	253.2	249.3	0.9	0.0	0.0	3.0	0.0
1981	226.4	222.6	0.8	0.0	0.0	2.8	0.2
1982	208.5	203.3	0.9	0.0	1.1	2.8	0.3
1983	210.3	205.4	0.9	0.0	1.0	2.7	0.3
1984	220.8	215.8	0.9	0.4	0.9	2.4	0.3
1985	237.4	232.1	0.9	0.4	1.1	2.7	0.3
1986	231.2	226.9	0.8	0.4	0.4	2.7	0.0
1987	236.0	230.5	0.9	0.3	1.6	2.8	0.0
1988	274.6	269.3	0.8	0.3	1.2	2.8	0.0
1989	284.6	279.6	0.9	0.3	0.8	2.9	0.1
1990	288.4	283.8	0.9	0.0	0.7	3.0	0.1
1991	269.6	264.9	0.9	0.0	0.9	2.9	0.0
1992	263.1	258.3	0.8	0.0	1.2	2.9	0.0
1993	229.3	223.8	0.8	0.0	1.8	2.8	0.0

1/ For data by type of petroleum, see source.

2/ Includes industrial and electric utility production.

3/ Electricity generated for distribution from biomass fuels and wind, photovoltaic, and solar thermal energy sources.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1993, Consumption Estimates* (July 1995), p. 95.

**Table 17.03-- CONSUMPTION OF ENERGY BY END-USE SECTOR:  
1970 TO 1993**

[Trillion Btu]

Year	Consumption				Input at electric utilities
	Residential	Commercial	Industrial	Transportation	
1970	16.4	11.6	43.6	125.3	43.2
1971	17.8	11.4	43.5	138.8	47.7
1972	19.6	12.7	48.9	136.5	54.1
1973	20.0	13.5	49.4	140.9	55.6
1974	20.3	13.3	49.4	128.7	57.5
1975	19.6	13.8	49.9	130.5	58.8
1976	21.3	15.3	51.0	131.7	62.5
1977	21.8	16.8	52.7	141.3	65.2
1978	21.8	17.4	52.2	144.6	66.8
1979	22.9	18.1	57.8	156.4	67.7
1980	23.2	20.8	62.4	146.7	69.7
1981	23.0	18.8	60.6	124.1	69.9
1982	21.5	17.6	67.1	102.2	66.9
1983	22.1	17.8	52.6	117.9	68.6
1984	21.0	19.5	50.9	129.3	70.6
1985	20.9	20.3	53.0	143.3	70.0
1986	21.3	22.8	60.2	126.9	72.9
1987	22.8	26.0	62.0	125.1	76.6
1988	23.9	39.2	69.4	142.1	81.9
1989	25.3	38.0	66.9	154.5	85.8
1990	25.1	34.3	72.3	156.7	86.1
1991	23.3	28.2	66.6	151.4	79.2
1992	23.1	32.8	64.3	142.9	74.6
1993	19.8	22.7	60.0	126.8	66.2

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1993, Consumption Estimates* (July 1995), pp. 96-100.

**Table 17.04-- PRIMARY ENERGY CONSUMPTION AND ELECTRICITY  
SALES, TOTAL AND PER CAPITA: 1986 TO 1996**

Year	Primary energy consumption		Electricity sales by utilities	
	Total (trillion Btu)	Per capita 1/ (million Btu)	Total (1,000 kWh)	Per capita 1/ (kWh)
1986	271.05620	232.168	7,025,739	6,018
1987	284.20420	239.532	7,298,178	6,151
1988	306.92120	255.682	7,719,029	6,430
1989 2/	315.08420	252.958	7,970,360	6,399
1990 2/	312.13040	248.314	8,310,537	6,611
1991 2/	322.95240	253.336	8,564,032	6,718
1992 2/	339.09120	267.127	8,643,562	6,809
1993 2/	307.74649	243.259	8,657,905	6,844
1994 2/	327.47780	254.332	8,948,458	6,950
1995 2/	315.11860	244.733	9,187,429	7,135
1996 3/	315.94920	243.262	9,378,962	7,221

1/ Based on estimated de facto population.

2/ Revised.

3/ Preliminary.

Source: Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records; Hawaii State Department of Commerce and Consumer Affairs, records.

**Table 17.05-- PRIMARY ENERGY CONSUMPTION, BY SOURCE:  
1986 TO 1996**

[Trillion Btu]

Year	Total		Petroleum	Biomass	Solar hot water
1986	271.0562		242.5857	23.9670	2.1644
1987	284.2042		256.4061	22.1840	2.1914
1988	306.9212		279.1052	22.7080	2.1931
1989 1/	315.0842		289.2301	20.8020	2.3310
1990 1/	312.1304		284.4906	18.1200	2.3400
1991 1/	322.9524		294.6222	17.9000	2.3000
1992 1/	339.0912		305.7758	16.9840	2.3000
1993 1/	307.7465		266.9516	16.8310	2.3000
1994 1/	327.4778		285.5010	16.3660	2.3000
1995 1/	315.1186		273.9590	11.8232	2.8386
1996 2/	315.9492		277.1298	10.3994	3.1225

  

Year	Hydroelectric	Coal	Wind	Geothermal	Solid waste
1986	1.0562	0.4970	0.6036	0.1823	-
1987	0.9670	1.4875	0.8236	0.1446	-
1988	0.9826	1.3509	0.4185	0.1629	-
1989 1/	1.0183	0.8715	0.4189	0.1435	0.2689
1990 1/	1.0700	0.8900	0.2900	-	4.9298
1991 1/	1.0000	0.8000	0.3060	-	6.0242
1992 1/	0.7226	6.9207	0.2573	0.0168	6.1140
1993 1/	0.8024	13.2237	0.2352	1.5988	5.8038
1994 1/	1.5300	13.5599	0.2251	1.8060	6.1898
1995 1/	1.0632	16.5249	0.2364	2.3045	6.3688
1996 2/	1.1332	16.9294	0.2244	2.3566	4.6539

1/ Revised.

2/ Preliminary.

Source: Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records; Hawaii State Department of Commerce and Consumer Affairs, records.

**Table 17.06-- ELECTRICITY GENERATION BY SOURCE: 1989 TO 1996**

[Millions of kWh generated]

<b>Year</b>	<b>Total</b>	<b>Petroleum</b>	<b>Biomass</b>	<b>MSW 1/</b>	<b>Hydroelectric</b>
1989	9,280	8,511	614	-	100
1990	9,566	8,589	538	-	105
1991	9,610	8,664	495	-	92
1992	10,104	8,556	460	-	67
1993	10,219	7,576	435	349	78
1994	10,341	7,793	423	379	148
1995	10,563	7,853	292	383	103
1996	10,742	8,027	270	326	110

  

<b>Year</b>	<b>Geothermal</b>	<b>Wind</b>	<b>Coal</b>	<b>PV 2/</b>	<b>Other 3/</b>
1989	14	41	-	-	(Z)
1990	-	28	-	-	306
1991	-	30	-	-	329
1992	1	21	-	-	999
1993	155	24	1,592	(Z)	10
1994	175	22	1,382	(Z)	19
1995	223	23	1,674	(Z)	12
1996	228	22	1,740	(Z)	19

Z Less than 500,000 kWh.

1/ Electricity generated from Honolulu municipal solid waste plant.

2/ Electricity generated from photovoltaic.

3/ From 1989 to 1992, includes electricity production by coal, geothermal (a test well which ceased operation in 1989), and photovoltaic.

Source: Hawaii State Department of Commerce and Consumer Affairs, records; Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records; Hawaii Agriculture Research Center, records.

**Table 17.07-- ELECTRICITY PRODUCTION, BY SOURCE, BY ISLANDS:  
1996**

[Million kWh]

<b>Island</b>	<b>Total</b>	<b>Petroleum</b>	<b>Biomass</b>	<b>MSW 1/</b>	<b>Hydroelectric</b>
State total	10,742	8,027	270	326	110
Hawaii	1,014	603	2	-	41
Maui	1,210	1,010	143	-	18
Lanai	28	28	-	-	-
Molokai	38	38	-	-	-
Oahu	7,958	5,999	31	326	-
Kauai	494	349	94	-	51
<b>Island</b>	<b>Wind</b>	<b>Geothermal</b>	<b>Coal</b>	<b>PV 2/</b>	<b>Other</b>
State total	22	228	1,740	-	19
Hawaii	19	228	121	(Z)	-
Maui	-	-	39	(Z)	-
Lanai	-	-	-	-	-
Molokai	-	-	-	-	-
Oahu	3	-	1,580	-	19
Kauai	-	-	-	-	-

Z Less than 500,000 kWh.

1/ Electricity generated from Honolulu municipal solid waste plant.

2/ Electricity generated from photovoltaic.

Source: Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records; Hawaii State Department of Commerce and Consumer Affairs, records.

**Table 17.08-- EXPENDITURES FOR FUELS AND ELECTRICITY, BY  
SOURCE: 1986 TO 1996**

[Millions of dollars]

Year	Total energy expenditures	Fuel expenditures			Less: electric utility fuel expenditures	Plus: electricity purchased by end-user
		Total	Electric utility	Other		
1986	1,564.0	1,147.3	224.6	922.7	224.6	641.3
1987	1,575.1	1,176.2	203.7	972.5	203.7	602.6
1988	1,664.1	1,314.6	238.0	1,076.6	238.0	587.5
1989	1,895.2	1,530.6	277.5	1,253.1	277.5	642.1
1990	2,204.4	1,807.0	352.5	1,454.5	352.5	749.9
1991	2,217.5	1,736.4	304.8	1,431.6	304.8	785.9
1992 1/	2,340.3	1,760.0	238.2	1,521.8	238.2	818.5
1993 1/	2,369.9	1,660.4	213.3	1,447.1	213.3	922.8
1994 1/	2,397.0	1,642.5	201.4	1,441.1	201.4	955.9
1995 1/	2,459.4	1,645.2	223.5	1,421.7	223.5	1,037.7
1996 2/	2,631.8	1,763.7	268.9	1,494.8	268.9	1,137.0

1/ Revised.

2/ Preliminary.

Source: Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records.

**Table 17.09-- ELECTRIC UTILITIES: 1987 TO 1997**

Year	Customers, Dec. 31 1/			Installed capacity 3/ (kW)	Power sold (1,000 kWh)		
	Total	Residential 2/	Other		Total	Residential 2/	Other
1987	347,085	299,758	47,327	1,535,700	7,297,905	2,069,859	5,228,046
1988	354,887	306,375	48,512	1,570,410	7,719,029	2,148,275	5,570,754
1989	362,281	312,347	49,934	1,517,500	7,969,694	2,238,874	5,730,820
1990	370,952	320,215	50,737	1,655,690	8,310,537	2,320,550	5,989,987
1991	380,963	328,899	52,064	1,572,349	8,460,186	2,363,726	6,076,697
1991 4/	380,963	328,899	52,064	1,572,349	8,524,088	2,385,276	6,178,756
1992 4/	385,055	332,863	52,192	1,650,639	8,666,889	2,430,152	6,213,410
1993 4/	395,402	341,471	53,931	1,717,914	8,657,903	2,453,830	6,204,075
1994 4/	403,595	346,977	56,618	1,710,224	8,948,458	2,551,240	6,397,218
1995 4/	409,983	352,589	57,394	1,714,729	9,187,430	2,597,010	6,590,419
1996 4/	413,830	356,205	57,625	(X)	9,378,962	2,669,654	6,709,308
1997 4/	415,964	358,683	57,281	(X)	9,345,281	2,659,248	6,686,033
Year	Average annual use (kWh 5/)		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential 2/	Other	Residential 2/	Other	Total	Residential 2/	Other
1987	6,905	110,466	0.09431	0.07792	602,553	195,198	407,355
1988	7,011	114,832	0.08829	0.07141	587,528	189,689	397,839
1989	7,168	114,772	0.09265	0.07585	642,101	207,436	434,665
1990	7,247	118,060	0.10261	0.08544	749,857	238,103	511,754
1991	7,187	116,716	0.10539	0.08726	779,382	249,104	530,278
1991 4/	7,252	117,524	0.10546	0.08733	785,896	251,553	534,343
1992 4/	7,301	119,049	0.10932	0.08898	818,525	265,667	552,858
1993 4/	7,186	115,037	0.12309	0.10005	922,796	302,054	620,743
1994 4/	7,353	112,989	0.12464	0.09972	955,907	317,984	637,923
1995 4/	7,366	114,828	0.13337	0.10490	1,037,702	346,359	691,343
1996 4/	7,495	116,431	0.14272	0.11268	1,137,045	381,011	756,034
1997 4/	7,414	116,723	0.14840	0.11585	1,169,188	394,620	774,568

X Not applicable.

1/ 1990 based on November data.

2/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

3/ As of December 31. Beginning with 1996, reported as system peak. A system peak is the maximum amount of energy required by the electrical system. The island electrical systems are not interconnected, therefore, peaks are reported separately for each island.

4/ Includes the effect of a change in the method of estimating unbilled kilowatt hour sales beginning in 1991 which increased power sold and revenues for all islands except Kauai and Molokai.

5/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.10-- ELECTRIC UTILITIES, BY ISLANDS: 1996**

[Includes the effect of a change in the method of estimating unbilled kilowatt hour sales beginning in 1991 which increased power sold and revenues for all islands except Kauai and Molokai]

County or island	Customers, Dec. 31			System peak 2/ (mW)	Power sold (1,000 kWh)		
	Total	Residential 1/	Other		Total	Residential 1/	Other
State total	413,830	356,205	57,625	(X)	9,378,962	2,669,654	6,709,308
Oahu	271,602	237,602	33,742	1,209.0	7,091,147	1,863,425	5,227,722
Hawaii	59,349	49,860	9,489	165.8	875,747	330,125	545,622
Kauai	29,128	22,409	6,719	70.4	387,737	129,245	258,492
Maui County	53,751	46,076	7,675	(X)	1,024,331	346,859	677,472
Lanai	1,345	1,179	166	5.0	26,365	6,346	20,019
Maui	49,590	42,578	7,012	174.8	963,625	327,562	636,063
Molokai	2,816	2,319	497	6.7	34,341	12,951	21,390
County or island	Average annual use (kWh) 3/		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
State total	7,495	116,431	0.14272	0.11268	1,137,045	381,011	756,034
Oahu	7,834	154,932	0.12944	0.10063	767,264	241,200	526,064
Hawaii	6,621	57,500	0.18918	0.16469	152,312	62,452	89,860
Kauai	5,768	38,472	0.19608	0.18450	73,034	25,342	47,692
Maui County	7,528	88,270	0.14996	0.13642	144,434	52,016	92,418
Lanai	5,383	120,596	0.18709	0.18715	4,934	1,187	3,747
Maui	7,693	90,711	0.14763	0.13319	133,074	48,359	84,715
Molokai	5,585	43,038	0.19072	0.18496	6,426	2,470	3,956

X Not applicable.

1/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

2/ The system peak is the maximum amount of energy required by the electrical system. The island electrical systems are not interconnected, therefore, peaks are reported separately for each island.

3/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1997**

[Includes the effect of a change in the method of estimating unbilled kilowatt hour sales beginning in 1991 which increased power sold and revenues for all islands except Kauai and Molokai]

County or island	Customers, Dec. 31			System peak 2/ (mW)	Power sold (1,000 kWh)		
	Total	Residential 1/	Other		Total	Residential 1/	Other
State total	415,964	358,683	57,281	(X)	9,345,281	2,659,248	6,686,033
Oahu	271,801	238,825	32,976	1,220.0	7,040,291	1,852,175	5,188,116
Hawaii	60,220	50,590	9,630	166.7	894,110	331,125	562,985
Kauai	29,338	22,589	6,749	71.4	382,112	128,248	253,864
Maui County	54,605	46,679	7,926	(X)	1,028,768	347,700	681,068
Lanai	1,362	1,181	181	5.0	26,050	6,442	19,608
Maui	50,385	43,159	7,226	174.7	969,170	328,582	640,587
Molokai	2,858	2,339	519	6.6	33,549	12,676	20,873
County or island	Average annual use (kWh) 3/		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
State total	7,414	116,723	0.14840	0.11585	1,169,188	394,620	774,568
Oahu	7,755	157,330	0.13360	0.10254	779,425	247,458	531,967
Hawaii	6,545	58,462	0.19672	0.16908	160,332	65,140	95,192
Kauai	5,677	37,615	0.21200	0.19939	77,806	27,188	50,618
Maui County	7,449	85,928	0.15770	0.14212	151,624	54,834	96,791
Lanai	5,455	108,332	0.19033	0.19428	5,036	1,226	3,810
Maui	7,613	88,650	0.15549	0.13885	140,035	51,092	88,943
Molokai	5,419	40,218	0.19844	0.19348	6,554	2,515	4,039

X Not applicable.

1/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

2/ The system peak is the maximum amount of energy required by the electrical system. The island electrical systems are not interconnected, therefore, peaks are reported separately for each island.

3/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.12-- GAS UTILITIES: 1987 TO 1997**

[Revised. Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
1987	33,895	30,198	3,697	32,408	5,880	26,528
1988	34,103	30,450	3,653	32,733	5,780	26,952
1989	34,304	30,661	3,643	33,865	5,896	27,969
1990	34,477	30,840	3,637	34,806	5,924	28,882
1991	34,973	31,378	3,595	33,974	5,775	28,199
1992	35,236	31,625	3,611	33,662	5,733	27,929
1993	35,908	32,293	3,615	33,268	5,750	27,518
1994	36,403	32,753	3,650	34,010	5,851	28,159
1995	36,619	32,950	3,669	33,740	5,793	27,948
1996	36,641	33,020	3,621	33,531	5,642	27,888
1997	36,575	32,977	3,598	32,980	5,603	27,377

  

Year	Average annual use (therms) 2/		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
1987	195	7,176	1.57204	1.10494	38,556	9,244	29,312
1988	189	7,378	1.54961	1.07840	38,023	8,957	29,066
1989	192	7,677	1.54200	1.06487	38,876	9,092	29,783
1990	192	7,941	1.62847	1.14834	42,813	9,646	33,167
1991	184	7,844	1.78649	1.25285	45,646	10,317	35,329
1992	181	7,735	1.79054	1.25466	45,307	10,265	35,042
1993	178	7,612	1.75962	1.22594	43,853	10,117	33,735
1994	179	7,715	1.71994	1.19455	43,700	10,064	33,637
1995	176	7,617	1.79670	1.25158	45,386	10,407	34,979
1996	171	7,702	2.10399	1.33578	49,124	11,872	37,252
1997	170	7,609	2.29075	1.40013	51,167	12,835	38,332

1/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

2/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.13-- GAS UTILITIES, BY ISLANDS: 1996**

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
State total	36,641	33,020	3,621	33,531	5,642	27,888
Oahu	33,840	30,599	3,241	30,339	5,203	25,136
Hawaii	1,702	1,388	314	2,360	267	2,094
Kauai	596	596	-	88	88	-
Maui	393	327	66	726	68	658
Molokai	110	110	-	17	17	-
Lanai	-	-	-	-	-	-

  

Island	Average annual use (therms) 2/		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
State total	171	7,702	2.10399	1.33578	49,124	11,872	37,252
Oahu	170	7,756	2.08540	1.34819	44,738	10,850	33,888
Hawaii	192	6,668	2.44655	1.23303	3,234	652	2,582
Kauai	147	-	2.27193	-	200	200	-
Maui	208	9,973	1.92138	1.18864	913	131	782
Molokai	155	-	2.28816	-	39	39	-
Lanai	-	-	-	-	-	-	-

1/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

2/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.14-- GAS UTILITIES, BY ISLANDS: 1997**

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
State total	36,575	32,977	3,598	32,980	5,603	27,377
Oahu	33,860	30,628	3,232	29,836	5,176	24,659
Hawaii	1,634	1,335	299	2,319	250	2,069
Kauai	598	598	-	86	86	-
Maui	392	325	67	720	70	649
Molokai	91	91	-	20	20	-
Lanai	-	-	-	-	-	-

  

Island	Average annual use (therms) 2/		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
State total	170	7,609	2.29075	1.40013	51,167	12,835	38,332
Oahu	169	7,630	2.24693	1.40989	46,398	11,631	34,767
Hawaii	188	6,919	3.05080	1.32979	3,515	764	2,751
Kauai	143	-	2.73559	-	234	234	-
Maui	217	9,691	2.22903	1.25364	971	157	814
Molokai	221	-	2.42358	-	49	49	-
Lanai	-	-	-	-	-	-	-

1/ Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

2/ Based on number of customers at end of year.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

**Table 17.15-- SERVICE PROVIDED BY HAWAIIAN ELECTRIC COMPANY, INC.,  
ON OAHU: 1989 TO 1997**

Year	Number of customers, Dec. 31		Net input 1/ (1,000 kWh)	Electricity sales (1,000 kWh)	Average annual residential use 2/ (kWh)	Average residential rate (dollars per kWh)	Generating capability Dec. 31 (kW)
	Total	Residential only					
1989	247,120	216,063	6,617,943	6,254,220	7,534	0.08308	1,271,000
1990	248,692	217,681	6,835,025	6,470,587	7,620	0.09228	1,262,000
1991	255,176	223,304	6,876,964	6,538,952	7,610	0.09354	1,440,000
1992	257,442	225,229	7,061,157	6,650,449	7,711	0.09925	1,666,000
1993	263,478	230,192	7,029,839	6,607,424	7,581	0.11414	1,669,000
1994	264,992	232,115	7,222,978	6,797,364	7,681	0.11342	1,669,000
1995	269,307	235,905	7,359,195	6,962,794	7,732	0.12302	1,669,000
1996	271,602	237,860	7,499,202	7,091,147	7,868	0.12944	1,669,000
1997	271,801	238,825	7,424,259	7,040,291	7,773	0.13360	1,669,000

1/ Net generation plus purchased power.

2/ Based on average number of customers during the year.

Source: Hawaiian Electric Company, Inc., records.

**Table 17.16-- GAS UTILITY SERVICE BY THE GAS COMPANY, INC.,  
FOR OAHU: 1989 TO 1994**

Calendar year	Customers, Dec. 31		Gas sold 1/ (1,000 therms)		Average annual residential usage 1/ (therms)
	Total	Residential	Total	Residential	
1989	31,812	28,539	30,776	5,446	191
1990	31,974	28,714	31,645	5,469	191
1991	32,487	29,278	30,866	5,331	182
1992	32,598	29,375	30,528	5,285	180
1993	33,206	29,984	30,029	5,287	176
1994	33,597	30,344	30,765	5,372	177

1/ Includes liquefied petroleum gas.

Source: The Gas Company, BHP Petroleum, records.

**Table 17.17-- LIQUID FUEL TAX BASE: 1987 TO 1997**

[In thousands of gallons]

Year reported 1/	All types		Gasoline	Diesel oil	
	Total	Excluding aviation		Non-hwy.	Hwy. use
1987	1,206,716	512,974	348,474	137,806	21,207
1988	1,216,828	515,273	357,986	131,292	21,057
1989	1,268,597	535,714	369,172	136,465	23,729
1990	1,307,887	557,097	375,382	151,095	24,763
1991	1,299,455	570,077	376,182	163,773	24,991
1992	1,286,118	574,716	381,118	162,983	26,289
1993	1,173,458	573,767	384,444	160,121	24,997
1994	1,240,366	578,758	392,404	152,628	29,692
1995	1,286,038	600,596	396,446	172,684	27,411
1996	1,147,866	588,896	394,989	160,102	29,864
1997	955,834	585,400	400,435	150,737	30,109

  

Year reported 1/	Liquefied petroleum gas		Aviation fuel	Small boats	
	Off-hwy.	Hwy. use		Gasoline	Diesel oil
1987	3,135	1,142	693,742	123	1,089
1988	3,012	1,071	701,555	63	792
1989	4,301	968	732,883	57	1,022
1990	4,757	834	750,790	78	188
1991	3,575	780	729,378	52	724
1992	3,644	532	711,402	48	102
1993	3,343	477	599,691	35	349
1994	3,210	566	661,608	60	198
1995	3,096	514	685,443	50	395
1996	3,249	413	558,969	50	228
1997	3,587	328	370,433	41	164

1/ Liquid fuel sold in a given month is usually reported the following month. Annual totals accordingly refer to fuel sold during a 12-month period ending November 30.

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base and Tax Collections" (annual report).

**Table 17.18-- LIQUID FUEL TAX BASE, BY COUNTIES: 1997**

[In thousands of gallons. Liquid fuel sold in a given month is usually reported the following month. Annual totals accordingly refer to fuel sold during a 12-month period ending November 30]

Type of fuel	State total	City and Co. of Honolulu	County of Maui	County of Hawaii	County of Kauai
Total	955,834	687,654	111,889	100,279	56,012
Gasoline	400,435	262,768	52,863	61,441	23,364
Diesel oil, non-hwy.	150,737	66,783	32,361	22,212	29,382
Diesel oil, hwy. use	30,109	19,229	3,743	5,718	1,419
Liq. pet. gas, off hwy.	3,587	2,049	609	641	288
Liq. pet. gas, hwy. use	328	277	21	16	13
Small boats, gasoline	41	41	-	-	-
Small boats, diesel oil	164	6	-	158	-
Aviation fuel	370,433	336,501	22,293	10,093	1,546

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base and Tax Collections, Calendar Year Ending December 31, 1997" (annual release).

**Table 17.19-- IMPORTS AND EXPORTS OF CRUDE OIL AND  
PETROLEUM PRODUCTS: 1996**

[1,000 barrels]

Product	Imports			Exports		
	Total	Domestic	Foreign	Total	Domestic	Foreign
Crude oil	52,043	18,149	33,894	-	-	-
Distillates	102	102	-	542	352	190
Jet fuel	3,586	1,052	2,534	95	95	-
Residual fuel oil	1,071	1,071	-	297	128	169
Naphtha	-	-	-	1,554	-	1,554
Other	672	672	-	2,724	956	1,768

Source: Hawaii State Department of Business, Economic Development & Tourism, Energy, Resources and Technology Division, records; Energy Information Administration, records.

**Table 17.20-- GASOLINE SERVICE STATIONS (SIC 554) WITH PAYROLL, BY  
COUNTIES: 1987, 1992, AND 1995**

Year	State total	City and County of Honolulu	Hawaii County	Kauai County	Maui County		
					Lanai	Maui	Molokai
1987	355	241	52	26	1	34	1
1992	326	212	57	21	-	35	1
1995	304	194	58	19	(1/)	1/ 33	(1/)

1/ Lanai and Molokai included with Maui.

Source: U.S. Bureau of the Census, *1987 Census of Retail Trade, Hawaii*, RC87-A-12 (May 1989), table 5; *1992 Census of Retail Trade, Hawaii*, RC92-A-12 (October 1994), table 4; and *County Business Patterns 1995, Hawaii*, CBP-95-13 (October 1997).

**Table 17.21-- BOILERS AND PRESSURE VESSELS, BY ISLANDS:  
DECEMBER 31, 1997**

<b>Island</b>	<b>Total</b>	<b>Power boilers</b>	<b>Heating boilers</b>	<b>Pressure vessels</b>
State total	10,126	660	2,803	6,663
Hawaii	1,288	91	235	962
Maui	1,083	75	273	735
Lanai	66	5	12	49
Molokai	64	7	29	28
Oahu	7,166	443	2,129	4,594
Kauai	459	39	125	295
Niihau	-	-	-	-

Source: Hawaii State Department of Labor and Industrial Relations, Division of Occupational Safety and Health, Boiler and Elevator Inspection Bureau, records.

**Table 17.22-- ENERGY GENERATED, PURCHASED, SOLD, AND USED BY  
SUGAR PLANTATIONS, BY ISLANDS: 1994 TO 1996**

Subject	State total	Hawaii	Kauai	Maui	Oahu
1994					
Electricity (millions of kilowatt-hours)					
Generated 1/	688.54	169.44	153.46	244.01	121.64
Purchased	26.29	1.62	5.63	7.33	11.71
Sold	359.60	117.22	74.89	104.72	62.77
Used	355.23	53.84	84.20	146.62	70.57
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	20,693	6,169	4,652	5,834	4,038
Bagasse 2/	15,888	4,455	3,815	4,726	2,891
Fossil fuels	4,577	1,714	836	1,108	918
Other fuels	228	-	-	-	228
1995					
Electricity (millions of kilowatt-hours)					
Generated 1/	510.88	11.42	142.37	274.07	83.02
Purchased	28.07	0.74	11.78	11.70	3.85
Sold	214.11	-	68.15	102.19	43.77
Used	324.84	12.16	85.99	183.59	43.10
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	15,101	1,278	3,961	7,134	2,728
Bagasse 2/	11,349	1,249	3,664	4,689	1,747
Fossil fuels	3,482	29	296	2,445	712
Other fuels	270	-	-	-	270

Footnotes and source on next page.

**Table 17.22-- ENERGY GENERATED, PURCHASED, SOLD, AND USED BY  
SUGAR PLANTATIONS, BY ISLANDS: 1994 TO 1996 -- Con.**

Subject	State total	Hawaii	Kauai	Maui	Oahu
1996					
Electricity (millions of kilowatt-hours)					
Generated 1/	464.22	1.80	155.13	255.52	51.77
Purchased	20.72	0.12	10.01	8.50	2.09
Sold	194.68	-	76.09	87.10	31.49
Used	290.26	1.92	89.05	176.92	22.37
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	13,230	249	4,479	6,606	1,898
Bagasse 2/	9,876	244	4,234	4,440	958
Fossil fuels	3,023	5	244	2,166	609
Other fuels	331	-	-	-	331

1/ Includes electricity generated by steam, hydroelectric and diesel engine.

2/ Includes bagasse transferred between factories.

Source: Hawaiian Sugar Planters' Association, *Energy Inventory of Hawaiian Sugar Plantations - 1994* (Energy Report 34, August 1995), pp. 10-11; Hawaiian Sugar Planters' Association, *Energy Inventory of Hawaiian Sugar Plantations - 1995* (Energy Report 35, August 1996), pp. 10-11; and Hawaii Agriculture Research Center, *Energy Inventory of Hawaiian Sugar Plantations - 1996* (Energy Report 36, January 1998), pp. 10-11.

**Table 17.23-- HIGH TECHNOLOGY COMPANIES, EMPLOYEES,  
AND REVENUES: 1995**

<b>Subject</b>	<b>All sectors</b>	<b>Manufacturing</b>	<b>Service</b>	<b>Support</b>
Number of companies 1/	195	24	155	16
Employees 2/	6,694	580	5,735	379
Revenues (million dollars) 2/	1,149	394	695	60

1/ Number responding to survey. The estimated total number of high tech companies in Hawaii was 400.

2/ Based on survey response, and excluding Hawaiian Electric.

Source: High Technology Development Corp., Mililani, Hawaii, 1995 survey.

**Table 17.24-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT AND R&D PLANT IN HAWAII: 1990 TO 1995**

[Millions of dollars. For fiscal years ended September 30]

Type of obligation	1990	1991	1992	1993	1994	1995
Obligations for R&D	100.0	112.6	150.7	113.0	140.3	480.4
Obligations for R&D plant	1.4	9.2	6.5	19.3	14.3	0.5

Source: National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1992, 1993 and 1994*, Volume 42, Detailed Statistical Tables, NSF 94-328 (1994), pp. 346-349; <http://www.nsf.gov/sbe/srs/nsf97327/tables.htm>

**Table 17.25-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING,  
FOR THE UNIVERSITY OF HAWAII: 1991-92 TO 1995-96**

[Research and non-research awards received through the Office of Research Services, University of Hawaii, and non-competitive awards from the U.S. Department of Agriculture]

Fiscal year	Total		Research		Non-research	
	Awards	Amount (dollars)	Awards	Amount (dollars)	Awards	Amount (dollars)
1991-92	1,221	124,876,638	703	65,791,624	518	59,085,014
1992-93	1,146	131,075,215	636	61,059,928	510	70,015,287
1993-94	1,322	142,563,794	755	77,763,782	567	64,800,012
1994-95	1,147	139,199,221	616	70,222,653	531	68,976,568
1995-96	1,191	134,469,155	697	76,698,552	494	57,770,603

Source: Office of Research Services, University of Hawaii, *1995-1996 Extramural Awards* (1996), p. i.

**Table 17.26-- RESEARCH AND DEVELOPMENT EXPENDITURES AT DOCTORATE-GRANTING INSTITUTIONS: 1991 TO 1995**

[Thousands of dollars. For fiscal years ended September 30]

<b>Type of expenditure</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>
Total R&D expenditures	78,166	80,258	73,961	70,079	78,429
Federally financed	44,857	47,684	41,362	39,392	44,238
All others	33,309	32,574	32,599	30,687	34,191

Source: National Science Foundation/SRS, *Survey of Scientific and Engineering Expenditures at Universities and Colleges, Fiscal Year 1995*.

**Table 17.27-- PATENTS ISSUED TO HAWAII RESIDENTS:  
1987 TO 1997**

[Revised. Data include design, plant, reissue patents]

<b>Fiscal year</b>	<b>Patents</b>	<b>Fiscal year</b>	<b>Patents</b>
1987	46	1993	106
1988	62	1994	99
1989	71	1995	84
1990	85	1996	104
1991	80	1997	1/ 93
1992	81		

1/ Hawaii ranked 46th among the 50 states.

Source: U.S. Department of Commerce, U.S. Patent and Trademark Office, *Patent Counts by Country/State and Year, All Patents, All Types, January 1, 1977 -- December 31, 1997* (May 1998) at [http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst\\_all.pdf](http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.pdf).

**Table 17.28-- ASTRONOMY AND RELATED FACILITIES AT  
THE SUMMITS OF MAUNA KEA AND HALEAKALA: 1997**

Facility (mirror diameter in meters)	Capital cost (\$ mil)	Annual operating cost (\$ mil)	Hawaii County based staff	Operational
Mauna Kea:				
UH 0.6-m (Optical)	0.3	(X)	(X)	1969
UH 2.2-m (Optical/Infrared)	5	0.75	8	1970
Canada-France-Hawaii 3.6-m (Optical/Infrared)	30	6.2	50	1979
NASA IRTF 3.0-m (Infrared)	10	3.0	12	1979
United Kingdom Infrared 3.8-m	5	2.7	31	1979
James Clerk Maxwell 15-m Submillimeter	32	3.5	43	1986
Caltech 10.4-m Submillimeter	10	2.1	10	1986
W.M. Keck Observatory (Keck I & II) 10-m x 2 (Optical/Infrared)	170	11.0	85	1992/96
VLBA Antenna 25-m (Radio)	7	0.25	2	1992
Submillimeter Array 8x6-m 1/	80	6.0	2/ 26	1999
Subaru (Japan National Large Telescope) 8-m (Optical/Infrared) 1/	170	8.0	2/ 30	1999
Gemini Northern 8-m (Optical/Infrared) 1/	100	5.0	2/ 30	1999
Mauna Kea Observatories Support Services	n/a	3/ 1.9	24	
<b>Total</b>	<b>619</b>	<b>48.5</b>	<b>351</b>	
Haleakala:				
Mees Solar Observatory	0.5	0.1	2	1964
Lunar Ranging Facility	3.3	0.7	7	1976/84
Haleakala Observatories Projects		0.5	4	
Maui Space Surveillance Site (MSSS) 4/ Advanced Electro-Optical System 3.7-m Telescope (AEOS)	200.0	16.0	120	
Haleakala Support Facilities	50.0	15.0	55	1997
<b>Total</b>	<b>253.8</b>	<b>32.43</b>	<b>194</b>	

X Not applicable.

1/ Under construction.

2/ Approximate expected number when in operation.

3/ Not included in the total since derived from facility operating funds.

4/ Formerly Air Force Maui Optical Station (AMOS).

Source: University of Hawaii at Manoa, Institute for Astronomy, *Fact Sheet*-- February 1, 1998.