

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: 1998*, Sections 19 and 20.

**Table 17.01-- CONSUMPTION OF ENERGY, BY SOURCE
(PHYSICAL UNITS): 1960 TO 1996**

Year	Petroleum 1/ (1,000 barrels)	Hydroelectric power 2/ (million kWh)	Biomass 3/ (million kWh)	Coal (1,000 short tons)	Natural gas 4/ (billion cubic feet)	Other 5/ (million kWh)
1960	16,864	27	0	0	0	0
1965	22,507	105	0	0	0	0
1970	34,129	108	24	0	0	0
1975	37,056	89	25	0	0	0
1980	43,505	86	0	0	3	0
1981	38,721	80	15	0	3	0
1982	35,637	90	26	47	3	0
1983	36,297	84	28	42	3	0
1984	37,252	82	28	38	2	21
1985	6/ 40,005	86	25	46	2	19
1986	38,931	78	0	16	2	18
1987	6/ 39,688	82	0	63	3	13
1988	6/ 46,122	81	0	50	3	16
1989	6/ 47,944	89	11	32	3	14
1990	6/ 48,655	7/ (NA)	7/ (NA)	28	3	7/ (NA)
1991	6/ 45,499	(NA)	(NA)	37	3	(NA)
1992	6/ 44,365	(NA)	(NA)	47	3	(NA)
1993	6/ 38,791	(NA)	(NA)	73	3	(NA)
1994	6/ 41,361	(NA)	(NA)	86	3	(NA)
1995	40,902	(NA)	(NA)	6/ 192	3	(NA)
1996	38,769	(NA)	(NA)	169	3	(NA)

NA Not available.

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

2/ Through 1989, includes all net imports of electricity; from 1990, includes only the portion of imports of electricity that is derived from hydroelectric power.

3/ Includes wood, waste, and ethanol.

4/ Includes supplemental gaseous fuels.

5/ Includes geothermal, wind, photovoltaic, and solar thermal energy.

6/ Revised.

7/ Discontinuity between 1989 and 1990 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1990.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1996, Consumption Estimates* (February 1999), p. 95.

**Table 17.02-- CONSUMPTION OF ENERGY, BY SOURCE (TRILLION BTU):
1960 TO 1996**

Year	Total	Petro- leum 1/	Hydro- electric power 2/	Biomass 3/	Coal	Natural gas 4/	Other 5/
1960	95.0	94.7	0.3	0.0	0.0	0.0	0.0
1965	130.6	129.5	1.1	0.0	0.0	0.0	0.0
1970	196.9	195.5	1.1	0.3	0.0	0.0	0.0
1975	213.9	212.7	0.9	0.3	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	0.2	0.0	2.8	0.0
1982	208.5	203.3	0.9	0.3	1.1	2.8	0.0
1983	210.3	205.4	0.9	0.3	1.0	2.7	0.0
1984	220.8	215.8	0.9	0.3	0.9	2.4	0.4
1985	237.4	232.1	0.9	0.3	1.1	2.7	0.4
1986	231.2	226.9	0.8	0.0	0.4	2.7	0.4
1987	6/ 236.1	6/ 230.6	0.9	0.0	1.6	2.8	0.3
1988	6/ 274.5	269.3	0.8	0.0	1.2	2.8	0.3
1989	6/ 284.7	279.6	0.9	0.1	0.8	2.9	0.3
1990	6/ 7/ 298.0	6/ 284.0	7/ 0.6	7/ 8.8	0.7	3.0	7/ 0.9
1991	278.6	264.9	0.5	8.2	0.9	2.9	1.2
1992	272.3	258.3	0.6	8.1	1.2	2.9	1.2
1993	241.5	223.8	0.6	8.0	1.8	2.8	4.5
1994	6/ 256.5	237.2	1.5	7.9	1.8	2.9	5.2
1995	6/ 256.3	234.8	1.0	7.1	6/ 4.1	2.9	6.3
1996	242.0	221.4	1.1	6.5	3.6	2.8	6.6

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

2/ Through 1989, includes all net imports of electricity; from 1990, includes only the portion of imports of electricity that is derived from hydroelectric power.

3/ Includes wood, waste and ethanol.

4/ Includes supplemental gaseous fuels.

5/ Includes geothermal, wind, photovoltaic, and solar thermal energy.

6/ Revised.

7/ Discontinuity between 1989 and 1990 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1990.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1996, Consumption Estimates* (February 1999), p. 95.

**Table 17.03-- CONSUMPTION OF ENERGY BY END-USE SECTOR:
1960 TO 1996**

[Trillion Btu]

Year	Consumption				Input at electric utilities
	Residential	Commercial	Industrial	Transportation	
1960	7.3	5.2	20.7	61.8	17.6
1965	10.1	6.8	34.7	79.0	27.6
1970	16.4	11.6	43.6	125.3	43.2
1975	19.6	13.8	49.9	130.5	58.8
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	2/ 125.2	76.6
1988	23.9	39.2	69.4	2/ 142.0	81.9
1989	25.3	38.0	66.9	154.5	85.8
1990	1/ 25.9	34.3	1/ 80.8	1/ 2/ 156.9	86.1
1991	24.2	28.2	74.8	151.4	79.2
1992	24.0	32.8	72.7	142.9	74.6
1993	20.7	22.7	71.3	126.8	66.2
1994	20.4	25.4	75.2	135.5	64.7
1995	20.8	24.4	2/ 75.2	135.8	66.5
1996	21.5	23.8	76.3	120.3	68.2

1/ Discontinuity between 1989 and 1990 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1990.

2/ Revised.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1996, Consumption Estimates* (February 1999), pp. 96-100.

Table 17.04-- PRIMARY ENERGY CONSUMPTION AND ELECTRICITY SALES, TOTAL AND PER CAPITA: 1987 TO 1997

Year	Primary energy consumption		Electricity sales by utilities	
	Total (trillion Btu)	Per capita 1/ (million Btu)	Total (1,000 kWh)	Per capita 1/ (kWh)
1987	284.20420	239.532	7,298,178	6,151
1988	306.92120	255.682	7,719,029	6,430
1989	315.08420	252.958	7,970,360	6,399
1990 2/	312.13040	248.393	8,310,537	6,614
1991 2/	322.95240	253.794	8,564,032	6,730
1992 2/	339.09120	267.887	8,643,562	6,829
1993 2/	307.74649	244.243	8,657,905	6,871
1994 2/	327.47780	255.523	8,948,458	6,982
1995 2/	315.11860	244.790	9,187,429	7,137
1996 2/	315.94920	244.372	9,378,962	7,254
1997 3/	315.99270	245.203	9,345,281	7,252

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:
1987 TO 1997**

[Trillion Btu]

Year	Total		Petroleum	Biomass	Solar hot water
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	315.9492		277.1298	10.3994	3.1225
1997 2/	315.9927		278.3480	8.9527	3.1225

Year	Hydroelectric	Coal	Wind	Geothermal	Solid waste
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	1.1332	16.9294	0.2244	2.3566	4.6539
1997 2/	0.9544	16.7772	0.1796	2.3633	5.2950

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 1997

[Millions of kWh generated]

Year	Total	Petroleum	Biomass	MSW 1/	Hydroelectric
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
1997	10,424	7,805	226	371	93

Year	Geothermal	Wind	Coal	PV 2/	Other 3/
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
1997	229	17	1,663	(Z)	20

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:
1997**

[Million kWh]

Island	Total	Petroleum	Biomass	MSW 1/	Hydroelectric
State total	10,422	7,805	225	371	92
Hawaii	1,028	608	-	-	51
Maui	1,199	1,006	133	-	24
Lanai	28	28	-	-	-
Molokai	37	37	-	-	-
Oahu	7,685	5,775	15	371	-
Kauai	445	351	77	-	17
Island	Wind	Geothermal	Coal	PV 2/	Other
State total	17	229	1,663	(Z)	20
Hawaii	17	229	123	(Z)	-
Maui	-	-	36	(Z)	-
Lanai	-	-	-	-	-
Molokai	-	-	-	-	-
Oahu	-	-	1,504	(Z)	20
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: 1987 TO 1997**

[Millions of dollars]

Year	Total energy expenditures	Fuel expenditures			Less: electric utility fuel expenditures	Plus: electricity purchased by end-user
		Total	Electric utility	Other		
1987	1,575.3	1,176.2	203.7	972.5	203.7	602.8
1988	1,664.1	1,314.6	238.0	1,076.6	238.0	587.5
1989	1,897.8	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/	2,712.0	1,843.9	268.9	1,575.0	268.9	1,137.0
1997 2/	2,756.5	1,863.6	276.2	1,587.4	276.2	1,169.2

1/ Revised.

2/ Preliminary.

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

Table 17.09-- ELECTRIC UTILITIES: 1988 TO 1998

Year	Customers, Dec. 31 1/			Installed capacity 3/ (kW)	Power sold (1,000 kWh)		
	Total	Residential 2/	Other		Total	Residential 2/	Other
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
1998 4/	418,989	361,429	57,560	(X)	9,261,070	2,634,172	6,626,899
Year	Average annual use (kWh 5/)		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential 2/	Other	Residential 2/	Other	Total	Residential 2/	Other
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	6/ 0.14839	6/ 0.11584	6/ 1,169,134	6/ 394,603	6/ 774,531
1998 4/	7,288	115,130	0.13884	0.10682	1,073,610	365,719	707,891

Footnotes and source on next page.

Table 17.09-- ELECTRIC UTILITIES: 1988 TO 1998 -- Con.

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. 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.

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.

6/ Revised.

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

Table 17.10-- 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	4/ 0.14839	4/ 0.11584	4/ 1,169,134	4/ 394,603	4/ 774,531
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	4/ 0.21186	4/ 0.19925	4/ 77,753	4/ 27,171	4/ 50,582
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.

4/ Revised.

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

Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1998

[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	418,989	361,429	57,560	(X)	9,261,070	2,634,172	6,626,899
Oahu	272,675	239,945	32,730	1,175.0	6,938,326	1,820,789	5,117,537
Hawaii	61,228	51,277	9,951	169.6	903,160	335,355	567,805
Kauai	29,800	22,975	6,825	72.0	391,029	130,286	260,744
Maui County	55,286	47,232	8,054	(X)	1,028,556	347,742	680,814
Lanai	1,381	1,200	181	5.2	26,085	6,577	19,508
Maui	51,035	43,694	7,341	176.0	967,760	328,598	639,162
Molokai	2,870	2,338	532	6.6	34,710	12,567	22,144
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	7,288	115,130	0.13884	0.10682	1,073,610	365,719	707,891
Oahu	7,588	156,356	0.12556	0.09437	711,561	228,621	482,939
Hawaii	6,540	57,060	0.18616	0.15995	153,249	62,429	90,820
Kauai	5,671	38,204	0.19437	0.17969	72,177	25,323	46,853
Maui County	7,362	84,531	0.14190	0.12820	136,623	49,345	87,278
Lanai	5,481	107,779	0.17967	0.18451	4,781	1,182	3,599
Maui	7,520	87,067	0.13956	0.12488	125,677	45,860	79,817
Molokai	5,375	41,623	0.18328	0.17440	6,165	2,303	3,862

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: 1988 TO 1998

[Revised. Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
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
1998	36,225	32,630	3,595	33,095	5,702	27,393

Year	Average annual use (therms) 2/		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
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
1998	175	7,620	2.16236	1.25934	46,826	12,329	34,497

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: 1998

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
State total	36,225	32,630	3,595	33,095	5,702	27,393
Oahu	33,515	30,298	3,217	29,930	5,284	24,647
Hawaii	1,611	1,310	301	2,307	242	2,064
Kauai	607	607	-	86	86	-
Maui	396	319	77	752	71	682
Molokai	96	96	-	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	175	7,620	2.16236	1.25934	46,826	12,329	34,497
Oahu	174	7,661	2.11568	1.26146	42,270	11,179	31,091
Hawaii	185	6,859	2.98452	1.24808	3,299	723	2,577
Kauai	141	-	2.68922	-	230	230	-
Maui	221	8,852	2.15527	1.21693	982	152	829
Molokai	205	-	2.31461	-	46	46	-
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-- SERVICE PROVIDED BY HAWAIIAN ELECTRIC COMPANY, INC.,
ON OAHU: 1989 TO 1998**

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 3/ (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
1998	272,675	239,945	7,299,149	6,938,326	7,603	0.12556	1,669,000

1/ Net generation plus purchased power.

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

3/ Includes firm purchase power.

Source: Hawaiian Electric Company, Inc., records.

**Table 17.15-- 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 17.16-- LIQUID FUEL TAX BASE: 1987 TO 1998

[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
1998	954,860	597,410	394,674	169,930	28,983

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
1998	3,280	383	357,450	9	151

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 17.17-- LIQUID FUEL TAX BASE, BY COUNTIES: 1998

[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	954,860	682,984	111,316	101,139	59,420
Gasoline	394,674	256,910	52,855	61,132	28,778
Diesel oil, non-hwy.	169,930	90,057	26,735	21,807	31,331
Diesel oil, hwy. use	28,983	17,662	3,987	6,084	1,250
Liq. pet. gas, off hwy.	3,280	1,803	560	582	335
Liq. pet. gas, hwy. use	382	326	22	23	11
Small boats, gasoline	9	9	-	-	-
Small boats, diesel oil	151	14	-	138	-
Aviation fuel	357,450	316,203	27,157	11,375	2,715

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base and Tax Collections, Calendar Year Ending December 31, 1998" (annual release).

**Table 17.18-- IMPORTS AND EXPORTS OF CRUDE OIL AND
PETROLEUM PRODUCTS: 1997**

[1,000 barrels]

Product	Imports			Exports		
	Total	Domestic	Foreign	Total	Domestic	Foreign
Crude oil	51,097	15,000	36,097	-	-	-
Distillates	63	63	-	679	668	11
Jet fuel	5,446	311	5,135	126	126	-
Residual fuel oil	-	-	-	457	42	415
Naphtha	-	-	-	1,201	-	1,201
Other	1,154	1,154	-	4,372	2,663	1,709

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

**Table 17.19-- GASOLINE SERVICE STATIONS (SIC 554) WITH PAYROLL, BY
COUNTIES: 1987, 1992, AND 1996.**

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
1996	302	190	59	19	(1/)	1/ 34	(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 1996, Hawaii*, CBP-96-13 (November 1998), tables 1b and 2.

**Table 17.20-- BOILERS AND PRESSURE VESSELS, BY ISLANDS:
DECEMBER 31, 1998**

Island	Total	Power boilers	Heating boilers	Pressure vessels
State total	10,242	668	2,825	6,749
Hawaii	1,295	92	234	969
Maui	1,090	75	272	743
Lanai	67	5	13	49
Molokai	66	7	31	28
Oahu	7,269	450	2,151	4,668
Kauai	455	39	124	292

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

**Table 17.21-- ENERGY GENERATED, PURCHASED, SOLD, AND USED BY
SUGAR PLANTATIONS, BY ISLANDS: 1997**

Subject	State total	Hawaii	Kauai	Maui	Oahu
1997					
Electricity (millions of kilowatt-hours)					
Generated 1/	347.88	-	103.53	244.34	-
Purchased	9.81	-	5.18	4.13	-
Sold	138.91	-	50.66	88.25	-
Used	218.78	-	58.06	160.72	-
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	11,089	-	3,685	7,405	-
Bagasse 2/	8,363	-	3,473	4,890	-
Fossil fuels	2,726	-	211	2,515	-
Other fuels	-	-	-	-	-

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

2/ Includes bagasse transferred between factories.

Source: Hawaii Agriculture Research Center, *Energy Inventory of Hawaiian Sugar Plantations-1997*
(Energy Report 37, July 1998), pp. 10-11.

**Table 17.22-- HIGH TECHNOLOGY COMPANIES, EMPLOYEES,
AND REVENUES: 1995**

Subject	All sectors	Manufacturing	Service	Support
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 17.23-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT
AND R&D PLANT IN HAWAII: 1992 TO 1997**

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

Type of obligation	1992	1993	1994	1995	1996	1997
Obligations for R&D	150.7	113.0	140.3	1/ 139.3	147.6	150.7
Obligations for R&D plant	6.5	19.3	14.3	0.5	1.7	3.0

1/ Revised.

Source: National Science Foundation/SRS, *Survey of Federal Funds for Research and Development: Fiscal Years 1997, 1998 and 1999*. Internet sites <http://www.nsf.gov/sbe/srs/nsf99333/tables/c110a.xls> and <http://www.nsf.gov/sbe/srs/nsf99333/tables/c111a.xls>.

**Table 17.24-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING,
FOR THE UNIVERSITY OF HAWAII: 1991-92 TO 1996-97**

[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
1996-97	1,255	160,859,800	724	89,131,636	531	71,728,164

Source: Office of Research Services, University of Hawaii, *1996-1997 Extramural Awards* (1997), p. i.

**Table 17.25-- RESEARCH AND DEVELOPMENT EXPENDITURES AT
DOCTORATE-GRANTING INSTITUTIONS: 1992 TO 1996**

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

Type of expenditure	1992	1993	1994	1995	1996
Total R&D expenditures	80,258	73,961	70,079	78,429	73,302
Federally financed	47,684	41,362	39,392	44,238	40,198
All others	32,574	32,599	30,687	34,191	33,104

Source: National Science Foundation/SRS, *Survey of Scientific and Engineering Expenditures at Universities and Colleges, Fiscal Year 1995*. <http://www.nsf.gov/sbe/srs/nsf98304/tables/b32.xls-total>.

**Table 17.26-- PATENTS ISSUED TO HAWAII RESIDENTS:
1987 TO 1998**

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

Fiscal year	Patents	Fiscal year	Patents
1987	46	1993	106
1988	62	1994	99
1989	71	1995	84
1990	85	1996	104
1991	80	1997	93
1992	81	1998	1/ 93

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, 1998* (March 1999) at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.pdf.

**Table 17.27-- ASTRONOMY AND RELATED FACILITIES AT
THE SUMMITS OF MAUNA KEA AND HALEAKALA: 1999**

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)	170	8.0	2/ 30	1999
Gemini Northern 8-m (Optical/Infrared)	100	5.0	2/ 30	1999
Mauna Kea Observatories Support Services	(NA)	3/ 1.9	24	
Total	619	48.5	351	
Haleakala:				
Mees Solar Observatory	0.5	0.1	2	1964
Lunar Ranging Facility	3.3	0.7	7	1976/84
Haleakala Observatories Projects	(NA)	0.5	4	
Maui Space Surveillance Site (MSSS) 4/ Advanced Electro-Optical System 3.7-m Telescope (AEOS)	200.0	16.0	120	1997
Haleakala Support Facilities	(NA)	0.13	6	
Total	253.8	32.43	194	

NA Not available.

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*.