













Section 17: Energy and Science

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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; 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: 1999*, Sections 19 and 20.

**Table 17.01-- CONSUMPTION OF ENERGY, BY SOURCE
(PHYSICAL UNITS): 1960 TO 1997**

Year	Petroleum 1/ (1,000 barrels)	Hydroelectric power (million kWh)	Biomass 2/ (million kWh)	Coal (1,000 short tons)	Natural gas 3/ (billion cubic feet)	Other 4/ (million kWh)
1960	16,864	(NA)	0	0	0	(NA)
1965	22,507	(NA)	0	0	0	(NA)
1970	34,129	(NA)	24	0	0	(NA)
1975	37,056	(NA)	25	0	0	(NA)
1980	43,505	(NA)	0	0	3	(NA)
1981	38,721	(NA)	15	0	3	(NA)
1982	35,637	(NA)	26	47	3	(NA)
1983	36,297	(NA)	28	42	3	(NA)
1984	37,252	(NA)	28	38	2	(NA)
1985	40,005	(NA)	25	46	2	(NA)
1986	38,931	(NA)	0	16	2	(NA)
1987	39,688	(NA)	0	63	3	(NA)
1988	46,122	(NA)	0	50	3	(NA)
1989	47,944	(NA)	5/ (NA)	32	3	(NA)
1990	48,655	(NA)	(NA)	28	3	(NA)
1991	45,499	(NA)	(NA)	37	3	(NA)
1992	44,365	(NA)	(NA)	47	3	(NA)
1993	38,791	(NA)	(NA)	73	3	(NA)
1994	41,361	(NA)	(NA)	86	3	(NA)
1995	40,902	(NA)	(NA)	192	3	(NA)
1996	38,769	(NA)	(NA)	169	3	(NA)
1997	38,203	(NA)	(NA)	145	3	(NA)

NA Not available.

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

2/ Includes wood, waste, and ethanol.

3/ Includes supplemental gaseous fuels.

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

5/ Discontinuity between 1988 and 1989 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1989.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1997, Consumption Estimates* (February 2000), p. 95.

**Table 17.02-- CONSUMPTION OF ENERGY, BY SOURCE (TRILLION BTU):
1960 TO 1997**

Year	Total	Petro- leum 1/	Hydro- electric power	Biomass 2/	Coal	Natural gas 3/	Other 4/
1960	95.0	94.7	0.3	0.0	0.0	0.0	0.0
1965	5/ 130.8	129.5	1.1	5/ 0.2	0.0	0.0	0.0
1970	5/ 197.1	195.5	1.1	5/ 0.4	0.0	0.0	0.0
1975	5/ 214.2	212.7	0.9	5/ 0.6	0.0	0.0	0.0
1980	5/ 265.1	249.3	0.9	5/ 11.9	0.0	3.0	0.0
1985	5/ 251.4	232.1	0.9	5/ 14.2	1.1	2.7	0.4
1986	5/ 237.9	226.9	0.8	5/ 6.7	0.4	2.7	0.4
1987	5/ 242.8	230.6	0.9	5/ 6.7	1.6	2.8	0.3
1988	5/ 281.5	269.3	0.8	5/ 7.0	1.2	2.8	0.3
1989	5/ 6/ 297.1	279.6	6/ 0.6	5/ 6/ 12.0	0.8	2.9	6/ 1.2
1990	5/ 300.1	284.0	0.6	5/ 10.9	0.7	3.0	0.9
1991	5/ 277.0	264.9	0.5	5/ 6.6	0.9	2.9	1.2
1992	5/ 270.5	258.3	0.6	5/ 6.4	1.2	2.9	1.2
1993	5/ 240.1	223.8	0.6	5/ 6.5	1.8	2.8	4.5
1994	5/ 257.4	237.2	1.5	5/ 8.7	1.8	2.9	5.2
1995	5/ 257.5	234.8	1.0	5/ 8.2	4.1	2.9	6.3
1996	5/ 243.9	221.4	1.1	5/ 8.3	3.6	2.8	6.6
1997	239.5	217.8	1.2	7.9	3.3	2.7	6.6

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

2/ Includes wood, waste and ethanol.

3/ Includes supplemental gaseous fuels.

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

5/ Revised.

6/ Discontinuity between 1988 and 1989 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1989.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1997, Consumption Estimates* (February 2000), p. 95.

**Table 17.03-- CONSUMPTION OF ENERGY BY END-USE SECTOR:
1960 TO 1997**

[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	2/ 34.9	79.0	27.6
1970	16.4	11.6	2/ 43.8	125.3	43.2
1975	19.6	13.8	2/ 50.2	130.5	58.8
1980	23.2	20.8	2/ 74.3	146.7	69.7
1985	20.9	20.3	2/ 67.0	143.3	70.0
1986	21.3	22.8	2/ 66.9	126.9	72.9
1987	22.8	26.0	2/ 68.7	125.2	76.6
1988	23.9	39.2	2/ 76.3	142.0	81.9
1989	1/ 2/ 26.0	38.0	1/ 2/ 78.6	1/ 154.5	85.8
1990	25.9	34.3	2/ 82.9	156.9	86.1
1991	24.2	28.2	2/ 73.2	151.4	79.2
1992	24.0	32.8	2/ 70.9	142.9	74.6
1993	20.7	22.7	2/ 69.9	126.8	66.2
1994	20.4	25.4	2/ 76.0	135.5	64.7
1995	20.8	24.4	2/ 76.4	135.8	66.5
1996	21.5	23.8	2/ 78.2	120.3	68.2
1997	21.2	24.1	77.3	117.0	67.0

1/ Discontinuity between 1988 and 1989 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1989.

2/ Revised.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1997, Consumption Estimates* (February 2000), pp. 96-100.

Table 17.04-- PRIMARY ENERGY CONSUMPTION AND ELECTRICITY SALES, TOTAL AND PER CAPITA: 1988 TO 1998

Year	Primary energy consumption		Electricity sales by utilities	
	Total (trillion Btu)	Per capita 1/ (million Btu)	Total (1,000 kWh)	Per capita 1/ (kWh)
1988	306.92120	255.682	7,719,029	6,430
1989	315.08420	252.958	7,970,360	6,399
1990	312.13040	2/ 248.339	8,310,537	2/ 6,612
1991	322.95240	2/ 253.686	8,564,032	2/ 6,727
1992	339.09120	2/ 267.495	8,643,562	2/ 6,819
1993	307.74649	2/ 243.573	8,657,905	2/ 6,852
1994	327.47780	2/ 254.829	8,948,458	2/ 6,963
1995	315.11860	2/ 243.982	9,187,429	2/ 7,113
1996	315.94920	2/ 243.562	9,378,962	2/ 7,230
1997	315.99270	2/ 240.414	9,345,281	2/ 7,110
1998 3/	302.87730	229.262	9,261,071	7,010

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:
1985 TO 1998**

[Trillion Btu]

Year	Total	Petroleum	Biomass	Solar hot water
1985	266.2178	238.6470	23.1430	2.1327
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	315.0842	289.2301	20.8020	2.3310
1990	312.1304	284.4906	18.1200	2.3400
1991	322.9524	294.6222	17.9000	2.3000
1992	339.0912	305.7758	16.9840	2.3000
1993	307.7465	266.9516	16.8310	2.3000
1994	327.4778	285.5010	16.3660	2.3000
1995	315.1186	273.9590	11.8232	2.8386
1996	315.9492	277.1298	10.3994	3.1225
1997	315.9927	278.3480	8.9527	3.1225
1998 1/	302.8773	269.1272	7.5220	3.1225

Year	Hydroelectric	Coal	Wind	Geothermal	Solid waste
1985	0.9808	0.9560	0.1697	0.1886	-
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	1.0183	0.8715	0.4189	0.1435	0.2689
1990	1.0700	0.8900	0.2900	-	4.9298
1991	1.0000	0.8000	0.3060	-	6.0242
1992	0.7226	6.9207	0.2573	0.0168	6.1140
1993	0.8024	13.2237	0.2352	1.5988	5.8038
1994	1.5300	13.5599	0.2251	1.8060	6.1898
1995	1.0632	16.5249	0.2364	2.3045	6.3688
1996	1.1332	16.9294	0.2244	2.3566	4.6539
1997	0.9544	16.7772	0.1796	2.3633	5.2950
1998 1/	0.7654	14.7665	0.2159	2.2782	5.0796

1/ 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 1998

[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
1998 4/	10,455	8,009	178	364	87

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
1998 4/	220	21	1,553	(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.

4/ 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; Hawaii Agriculture Research Center, records.

**Table 17.07-- ELECTRICITY PRODUCTION, BY SOURCE, BY ISLANDS:
1998**

[Million kWh]

Island	Total	Petroleum	Biomass	MSW 1/	Hydroelectric
State total	10,455	8,010	178	364	87
Hawaii	1,040	627	-	-	49
Maui	1,171	1,008	112	-	21
Lanai	28	28	-	-	-
Molokai	38	38	-	-	-
Oahu	7,723	5,937	-	364	-
Kauai	455	372	66	-	17

Island	Wind	Geothermal	Coal	PV 2/	Other
State total	21	220	1,555	(Z)	20
Hawaii	21	220	123	(Z)	-
Maui	-	-	30	(Z)	-
Lanai	-	-	-	-	-
Molokai	-	-	-	-	-
Oahu	-	-	1,402	(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: 1988 TO 1998**

[Millions of dollars]

Year	Total energy expenditures	Fuel expenditures			Less: electric utility fuel expenditures	Plus: electricity purchased by end-user
		Total	Electric utility	Other		
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	2,340.3	1,760.0	238.2	1,521.8	238.2	818.5
1993	2,369.9	1,660.4	213.3	1,447.1	213.3	922.8
1994	2,397.0	1,642.5	201.4	1,441.1	201.4	955.9
1995	2,459.4	1,645.2	223.5	1,421.7	223.5	1,037.7
1996 1/	2,712.0	1,843.9	268.9	1,575.0	268.9	1,137.0
1997	2,756.5	1,863.6	276.2	1,587.4	276.2	1,169.2
1998 2/	2,442.9	1,580.2	210.9	1,369.3	210.9	1,073.6

1/ Revised.

2/ Preliminary.

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

Table 17.09-- ELECTRIC UTILITIES: 1989 TO 1999

Year	Customers, Dec. 31 1/			Power sold (1,000 kWh)		
	Total	Residen- tial 2/	Other	Total	Residen- tial 2/	Other
1989	362,281	312,347	49,934	7,969,694	2,238,874	5,730,820
1990	370,952	320,215	50,737	8,310,537	2,320,550	5,989,987
1991	380,963	328,899	52,064	8,460,186	2,363,726	6,076,697
1991 3/	380,963	328,899	52,064	8,524,088	2,385,276	6,178,756
1992	385,055	332,863	52,192	8,666,889	2,430,152	6,213,410
1993	395,402	341,471	53,931	8,657,903	2,453,830	6,204,075
1994	403,595	346,977	56,618	8,948,458	2,551,240	6,397,218
1995	409,983	352,589	57,394	9,187,430	2,597,010	6,590,419
1996	413,830	356,205	57,625	9,378,962	2,669,654	6,709,308
1997	415,964	358,683	57,281	9,345,281	2,659,248	6,686,033
1998	418,989	361,429	57,560	9,261,070	2,634,172	6,626,899
1999	424,603	366,273	58,330	9,379,808	2,683,408	6,696,400

Year	Average annual use (kWh 4/)		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residen- tial 2/	Other	Residen- tial 2/	Other	Total	Residen- tial 2/	Other
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 3/	7,252	117,524	0.10546	0.08733	785,896	251,553	534,343
1992	7,301	119,049	0.10932	0.08898	818,525	265,667	552,858
1993	7,186	115,037	0.12309	0.10005	922,796	302,054	620,743
1994	7,353	112,989	0.12464	0.09972	955,907	317,984	637,923
1995	7,366	114,828	0.13337	0.10490	1,037,702	346,359	691,343
1996	7,495	116,431	0.14272	0.11268	1,137,045	381,011	756,034
1997	7,414	116,723	0.14839	0.11584	1,169,134	394,603	774,531
1998	7,288	115,130	0.13884	0.10682	1,073,610	365,719	707,891
1999	7,326	114,802	0.14312	0.11037	1,123,126	384,043	739,083

Footnotes and source on next page.

Table 17.09-- ELECTRIC UTILITIES: 1989 TO 1999 -- Con.

1/ 1990 based on November data for Oahu.

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/ 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 for that year.

4/ 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: 1999

County or island	Customers, Dec. 31			Power sold (1,000 kWh)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
State total	424,603	366,273	58,330	9,379,808	2,683,408	6,696,400
Oahu	275,467	242,579	32,888	6,997,936	1,845,973	5,151,963
Hawaii	62,478	52,277	10,201	922,352	345,343	577,008
Kauai	30,248	23,316	6,932	394,781	132,849	261,933
Maui County	56,410	48,101	8,309	1,064,739	359,243	705,496
Lanai	1,420	1,227	193	26,569	6,620	19,949
Maui	52,079	44,510	7,569	1,002,594	340,071	662,523
Molokai	2,911	2,364	547	35,576	12,551	23,025

County or island	Average annual use (kWh) 2/		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
State total	7,326	114,802	0.14312	0.11037	1,123,126	384,043	739,083
Oahu	7,610	156,652	0.12741	0.09596	729,557	235,195	494,362
Hawaii	6,606	56,564	0.18768	0.16316	158,962	64,815	94,147
Kauai	5,698	37,786	0.20634	0.19236	77,798	27,412	50,387
Maui County	7,469	84,907	0.15761	0.14201	156,808	56,621	100,187
Lanai	5,396	103,361	0.19478	0.19737	5,227	1,290	3,937
Maui	7,640	87,531	0.15549	0.13866	144,741	52,878	91,863
Molokai	5,309	42,093	0.19547	0.19053	6,840	2,453	4,387

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 17.11-- GAS UTILITIES: 1989 TO 1999

[Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
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
1999	36,363	32,757	3,606	34,099	5,577	28,522

Year	Average annual use (therms) 2/		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential 1/	Other	Residential 1/	Other	Total	Residential 1/	Other
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
1999	170	7,910	2.17266	1.24026	47,491	12,116	35,375

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 17.12-- GAS UTILITIES, BY ISLANDS: 1999

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residential 1/	Other	Total	Residential 1/	Other
State total	36,363	32,757	3,606	34,099	5,577	28,522
Oahu	33,614	30,384	3,230	30,830	5,154	25,676
Hawaii	1,609	1,312	297	2,276	241	2,034
Kauai	643	643	-	88	88	-
Maui	405	326	79	887	74	813
Molokai	92	92	-	19	19	-
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	7,910	2.17266	1.24026	47,491	12,116	35,375
Oahu	170	7,949	2.13296	1.24793	43,035	10,994	32,041
Hawaii	184	6,849	2.91320	1.18246	3,108	703	2,405
Kauai	137	-	2.61043	-	230	230	-
Maui	228	10,285	1.98769	1.14251	1,076	148	928
Molokai	206	-	2.23825	-	42	42	-
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 17.13-- SERVICE PROVIDED BY HAWAIIAN ELECTRIC COMPANY, INC.,
ON OAHU: 1989 TO 1999**

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
1999	275,467	242,579	7,356,725	6,997,936	7,654	0.12741	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 17.14-- SERVICE PROVIDED BY THE GAS COMPANY, INC.,
ON OAHU: 1989 TO 1998**

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	2/ 31,133	5,446	191
1990	31,974	28,714	2/ 31,952	5,469	2/ 190
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	2/ 30,027	5,287	176
1994	33,597	30,344	2/ 30,762	5,372	177
1995	33,472	30,492	30,582	5,332	175
1996	33,914	30,668	30,339	5,203	170
1997	33,800	30,574	29,836	5,176	169
1998	33,705	30,497	29,930	5,284	173

1/ Includes liquefied petroleum gas.

2/ Revised.

Source: The Gas Company, records.

Table 17.15-- LIQUID FUEL TAX BASE: 1989 TO 1999

[In thousands of gallons]

Year reported 1/	All types		Gasoline	Diesel oil	
	Total	Excluding aviation		Non-hwy.	Hwy. use
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
1999	969,434	621,832	384,260	201,664	32,098
Year reported 1/	Liquefied petroleum gas		Aviation fuel	Small boats	
	Off-hwy.	Hwy. use		Gasoline	Diesel oil
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
1999	3,326	360	347,602	4	119

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 17.16-- LIQUID FUEL TAX BASE, BY COUNTIES: 1999

[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	969,434	677,069	125,852	103,985	62,528
Gasoline	384,260	245,623	54,543	60,252	23,842
Diesel oil, non-hwy.	201,664	117,998	31,191	20,972	31,503
Diesel oil, hwy. use	32,098	17,087	4,564	8,109	2,338
Liq. pet. gas, off hwy.	3,326	1,806	603	562	356
Liq. pet. gas, hwy. use	360	315	20	12	13
Small boats, gasoline	4	4	-	-	-
Small boats, diesel oil	119	5	-	113	-
Aviation fuel	347,602	294,231	34,931	13,963	4,476

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base and Tax Collections, Calendar Year Ending December 31, 1999" (annual release).

**Table 17.17-- 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 17.18-- GASOLINE SERVICE STATIONS WITH PAYROLL, BY
COUNTIES: 1987, 1992, AND 1997**

Year	State total	City and County of Honolulu	Hawaii County	Kauai County	Maui County
1987 1/	355	241	52	26	36
1992 1/	326	212	57	21	36
1997 2/	360	230	67	19	44

1/ Data are for Gasoline Service Stations (SIC 554).

2/ NAICS 447 includes Gasoline Service Stations (SIC 554) and Convenience Stores with gas (SIC 5411 pt.).

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 *1997 Economic Census, Retail Trade, Hawaii*, EC97R44A-HI (November 1999), tables 1 and 3.

**Table 17.19-- BOILERS AND PRESSURE VESSELS, BY ISLANDS:
DECEMBER 31, 1999**

Island	Total	Power boilers	Heating boilers	Pressure vessels
State total	10,021	624	2,679	6,718
Hawaii	1,322	97	305	920
Maui	1,352	96	359	897
Lanai	31	3	6	22
Molokai	47	7	11	29
Oahu	6,748	377	1,898	4,473
Kauai	521	44	100	377

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

**Table 17.20-- 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 17.21-- ESTIMATED EMPLOYMENT AND REVENUE IN HIGH TECHNOLOGY AND SUPPORT INDUSTRIES IN THE STATE OF HAWAII: 1998

	Number of organizations in survey	Number of employees working 20+ hours				Gross revenues for 1998			
		Number of organizations providing information	Average for organizations providing information	Total for organizations in survey 1/	State-wide estimate 2/	Number of organizations providing information	Average for organizations providing information (\$)	organizations in survey 1/ (\$million) 3/	State-wide estimate 2/ (\$million) 3/
High technology organizations									
Manufacturing	17	12	22.7	385	816	10	4,261,412	72	153
Communications	33	29	56.6	1,866	3,951	23	7,158,447	236	500
Computer & software services	130	114	27.4	3,560	7,538	88	2,179,636	283	600
Science, research & development	54	48	14.0	756	1,601	39	1,290,485	70	148
Engineering services	63	56	20.4	1,288	2,727	46	3,211,587	202	428
Total	297	259	-	7,856	16,633	206	-	864	1,829
High technology support and administration									
Technology support	10	6	23.0	138	292	6	14,191,667	142	300
Administration of economic programs/ public-funded technology	10	9	161.1	1,450	3,070	6	9,093,000	191	193
Total	20	15	-	1,588	3,362	12	-	233	493
All high tech-related organizations	317	274	-	9,444	19,995	218	-	1,097	2,322

1/ Average for organizations providing information times number of organizations in survey.

2/ Total for high technology-related organizations in survey projected to organizations statewide through multiplying by population to sample ratio.

3/ Data rounded to nearest million dollars. Totals may not add due to rounding or residual categories.

Source: 1998 High Tech Business Survey, High Technology Development Corporation. <http://www.htdc.org/bussurvey/index98.htm>.

**Table 17.22-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT
AND R&D PLANT IN HAWAII: 1993 TO 1998**

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

Type of obligation	1993	1994	1995	1996	1997	1998
Obligations for R&D	113.0	140.3	139.3	147.6	150.7	160.8
Obligations for R&D plant	19.3	14.3	0.5	1.7	3.0	3.9

Source: National Science Foundation/Division of Science Resources Studies, *Survey of Federal Funds for Research and Development: Fiscal Years 1998, 1999 and 2000*. Internet site <http://www.nsf.gov/sbe/srs/nsf00317/pdf/sectc.pdf>. Tables C-110a and C-111a.

**Table 17.23-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING,
FOR THE UNIVERSITY OF HAWAII: 1991-92 TO 1999-00**

[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
1997-98	1,300	159,948,612	763	91,746,988	537	68,201,624
1998-99	1,254	164,168,101	707	92,737,645	547	71,430,456
1999-00	1,379	180,629,855	767	102,845,010	612	77,784,845

Source: Office of Research Services, University of Hawaii, *1999-2000 Extramural Awards* (2000), p. i.

**Table 17.24-- RESEARCH AND DEVELOPMENT EXPENDITURES AT
DOCTORATE-GRANTING INSTITUTIONS: 1993 TO 1997**

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

Type of expenditure	1993	1994	1995	1996 1/	1997
Total R&D expenditures	73,961	70,079	78,429	111,202	120,107
Federally financed	41,362	39,392	44,238	66,902	72,421
All others	32,599	30,687	34,191	44,300	47,686

1/ Revised.

Source: National Science Foundation/SRS, *Survey of Scientific and Engineering Expenditures at Universities and Colleges, Fiscal Year 1997*. <http://www.nsf.gov/sbe/srs/nsf99336/pdf/nsf9936.pdf>.

**Table 17.25-- PATENTS ISSUED TO HAWAII RESIDENTS:
1988 TO 1999**

[Data include utility, design, plant, and reissue patents]

Fiscal year	Patents	Fiscal year	Patents
1988	62	1994	99
1989	71	1995	84
1990	85	1996	104
1991	80	1997	93
1992	81	1998	93
1993	106	1999	1/ 97

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, 1999* (March 2000) at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.pdf.

**Table 17.26-- 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/ Subaru (Japan National Large Telescope) 8-m (Optical/Infrared)	80	6.0	2/ 26	1999
	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	
	50.0	15.0	55	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*.