

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, 14, and 18.

Total energy consumption in 1994 amounted to 310 trillion British thermal units, compared with 276 trillion Btu a decade earlier. Fully 87.3 percent in 1994 was provided by petroleum. Total expenditures for fuels and electricity in 1994 were \$2.3 billion.

Electricity sales amounted to 8.9 billion kilowatt-hours in 1994, a total that has increased 35 percent since 1984. Manufactured gas sales reached 34 million therms in 1994, ten percent above the figure ten years earlier. Residential rates in 1994 averaged 12.5 cents per kilowatt-hour and \$1.72 per therm. Average residential use (7,353 kWh and 179 therms in 1994) has declined since the early 1970s.

The liquid fuel tax base for 1995 was approximately 1.3 billion gallons, compared with 971 million in 1985. The 1995 total included 396 million gallons of gasoline, 685 million of aviation fuel, and 200 million of diesel oil.

The State is well served with scientific resources. Especially noteworthy is the cluster of large astronomical telescopes at the summits of Mauna Kea and Haleakala--twelve major facilities, including the world's most powerful. Federal research and development obligations in Hawaii totaled \$151 million in 1992. Some 116 patents were granted to Hawaii residents in 1994.

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 and its Division of Consumer Advocacy, the DBEDT Energy Division, UH Institute for 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: 1995*, Sections 19 and 20.

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

Year	Petroleum <u>1/</u> (1,000 barrels)	Hydro- electric power <u>2/</u> (million kWh)	Geothermal energy (million kWh)	Coal (1,000 short tons)	Other <u>3/</u> (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 <u>1/</u>	Hydro-electric power <u>2/</u>	Geo-thermal energy	Coal	Natural gas	Other types <u>3/</u>
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: 1984 TO 1994**

Year	Primary energy consumption		Electricity sales by utilities	
	Total (trillion Btu)	Per capita <u>1/</u> (million Btu)	Total (1,000 kWh)	Per capita <u>1/</u> (kWh)
1984.....	276.36995	244.467	6,606,255	5,844
1985.....	266.21778	233.976	6,635,158	5,832
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.....	314.96310	252.861	7,970,360	6,399
1990.....	306.70400	243.997	8,310,537	6,611
1991.....	315.50600	247.281	8,564,032	6,712
1992.....	321.72220	252.906	8,643,562	6,795
1993.....	304.79578	239.770	8,657,905	6,811
1994 <u>2/</u>	310.17460	241.062	8,948,458	6,955

1/ Based on estimated de facto population.

2/ Preliminary.

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

**Table 17.05-- PRIMARY ENERGY CONSUMPTION, BY SOURCE:
1984 TO 1994**

[Trillion Btu]

Year	Total	Petroleum	Biomass	Solar hot water	Hydro-electric
1984.....	276.3700	248.4026	24.3650	1.7683	0.7796
1985.....	266.2178	238.6470	23.1430	2.1327	0.9808
1986.....	271.0562	242.5857	23.9670	2.1644	1.0562
1987.....	284.2042	256.4061	22.1840	2.1914	0.9670
1988.....	306.9212	279.1052	22.7080	2.1931	0.9826
1989.....	314.9631	289.2301	20.8020	2.3310	1.0183
1990.....	306.7040	280.8740	18.1200	2.3400	1.0700
1991.....	315.5060	289.9000	17.9000	2.3000	1.0000
1992.....	321.7222	290.8500	16.9840	2.3000	0.7226
1993.....	304.7958	266.6563	16.8310	2.3000	0.8024
1994 <u>1/</u>	310.1746	270.8428	16.1160	2.3000	1.5300

Year	Coal	Wind	Geothermal	Solid waste
1984.....	0.8470	-	0.2075	-
1985.....	0.9560	0.1697	0.1886	-
1986.....	0.4970	0.6036	0.1823	-
1987.....	1.4875	0.8236	0.1446	-
1988.....	1.3509	0.4185	0.1629	-
1989.....	0.8715	0.4189	0.1435	0.1478
1990.....	0.8900	0.2900	-	3.1200
1991.....	0.8000	0.3060	-	3.3000
1992.....	6.9207	0.2573	0.0168	3.6708
1993.....	13.2237	0.2352	1.5988	3.1484
1994 <u>1/</u>	13.5599	0.2251	1.8060	3.7948

1/ Preliminary.

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

Table 17.06-- ELECTRICITY GENERATION BY SOURCE: 1988 TO 1994

[Millions of kWh generated]

Year	Total	Petroleum	Biomass	MSW <u>1/</u>	Hydro-electric
1988.....	8,952	8,115	681	-	98
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

Year	Geo-thermal	Wind	Coal	PV <u>2/</u>	Other <u>3/</u>
1988.....	16	42	-	-	-
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

Z Less than 500,000 kWh.

1/ Electricity generated from Honolulu municipal solid waste plant.

2/ Electricity generated from photovoltaic.

3/ From 1987 to 1992, includes electricity production by coal, geothermal (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 Division, records; Hawaiian Sugar Planters' Association, records.

**Table 17.07-- ELECTRICITY PRODUCTION, BY SOURCE, BY ISLANDS:
1994**

[Million kWh)

Island	Total	Petroleum	Biomass	MSW <u>1/</u>	Hydro-electric
State total....	10,341	7,793	423	379	148
Hawaii	999	592	97	-	68
Maui	1,114	924	162	-	28
Lanai	27	27	-	-	-
Molokai	36	36	-	-	-
Oahu	7,707	5,884	88	379	-
Kauai.....	458	330	76	-	52
Island	Wind	Geothermal	Coal	PV <u>2/</u>	Other
State total....	22	175	1,382	(Z)	19
Hawaii	19	175	48	-	-
Maui	-	-	-	(Z)	-
Lanai	-	-	-	-	-
Molokai	-	-	-	-	-
Oahu	3	-	1,334	-	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 Division, records; Hawaii State Department of Commerce and Consumer Affairs, records.

**Table 17.08-- EXPENDITURES FOR FUELS AND ELECTRICITY, BY
SOURCE: 1984 TO 1994**

[Millions of dollars]

Year	Total energy expend.	Fuel expenditures			Less: electric utility fuel expend.	Plus: electric purch. by end-user
		Total	Electric utility	Other		
1984.....	2,048.4	1,724.8	379.3	1,345.5	379.3	702.9
1985.....	1,921.6	1,586.6	337.6	1,249.0	337.6	672.6
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.....	2,261.5	1,681.2	238.2	1,443.0	238.2	818.5
1993.....	2,353.2	1,643.7	213.3	1,430.4	213.3	922.8
1994 <u>1/</u>	2,334.3	1,579.8	201.4	1,378.4	201.4	955.9

1/ Preliminary.

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

Table 17.09-- ELECTRIC UTILITIES: 1984 TO 1994

Year	Customers, Dec. 31 <u>1/</u>			Installed capacity (nameplate), Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential <u>2/</u>	Other		Total	Residential <u>2/</u>	Other
1984	324,384	280,518	43,866	1,578,780	6,606,255	1,837,954	4,768,301
1985	330,407	285,117	45,290	1,567,230	6,635,158	1,879,027	4,756,131
1986	337,563	291,222	46,341	1,553,580	7,025,739	1,959,447	5,066,292
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 <u>4/</u>	380,963	328,899	52,064	1,572,349	8,524,088	2,385,276	6,178,756
1992 <u>4/</u>	385,055	332,863	52,192	1,650,639	8,666,889	2,430,152	6,213,410
1993 <u>4/</u>	395,402	341,471	53,931	1,717,914	8,657,903	2,453,830	6,204,075
1994 <u>4/</u>	403,595	346,977	56,618	1,710,224	8,948,458	2,551,240	6,397,218
Year	Average annual use (kWh <u>3/</u>)		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential <u>2/</u>	Other	Residential <u>2/</u>	Other	Total	Residential <u>2/</u>	Other
1984	6,552	108,702	0.11831	0.10181	702,899	217,447	485,452
1985	6,590	105,015	0.11361	0.09653	672,600	213,478	459,122
1986	6,728	109,326	0.09294	0.07505	562,345	182,110	380,234
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 <u>4/</u>	7,252	117,524	0.10546	0.08733	785,896	251,553	534,343
1992 <u>4/</u>	7,301	119,049	0.10932	0.08898	818,525	265,667	552,858
1993 <u>4/</u>	7,186	115,037	0.12309	0.10005	922,796	302,054	620,743
1994 <u>4/</u>	7,353	112,989	0.12464	0.09972	955,907	317,984	637,923

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/ Based on number of customers at end of year.

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.

Source: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records. Revised October 1995.

Table 17.10-- ELECTRIC UTILITIES, BY ISLANDS: 1993

[Revised. 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			Installed capacity (nameplate) Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential ^{1/}	Other		Total	Residential ^{1/}	Other
State total.....	395,402	341,471	53,931	1,717,914	8,657,903	2,453,830	6,204,075
Oahu.....	263,478	230,192	33,286	1,188,600	6,607,424	1,725,507	4,881,917
Hawaii.....	56,556	47,252	9,304	210,095	802,079	310,642	491,437
Kauai.....	24,304	20,484	3,820	110,550	332,677	113,553	219,125
Maui County.....	51,064	43,543	7,521	208,669	915,723	304,128	611,596
Lanai.....	1,263	1,110	153	10,760	23,879	5,916	17,963
Maui.....	47,035	40,163	6,872	189,029	861,002	286,013	574,990
Molokai.....	2,766	2,270	496	8,880	30,842	12,199	18,643

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Table 17.10-- ELECTRIC UTILITIES, BY ISLANDS: 1993 - Con.

County or island	Average annual use (kWh) <u>2/</u>		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential <u>1/</u>	Other	Residential <u>1/</u>	Other	Total	Residential <u>1/</u>	Other
State total.....	7,186	115,037	0.12309	0.10005	922,796	302,054	620,743
Oahu.....	7,496	146,666	0.11414	0.09158	644,029	196,952	447,077
Hawaii.....	6,574	52,820	0.15155	0.13407	112,967	47,078	65,889
Kauai	5,543	57,363	0.16197	0.15695	52,783	18,392	34,391
Maui County	6,985	81,318	0.13031	0.11999	113,017	39,632	73,385
Lanai.....	5,330	117,405	0.16802	0.15087	3,704	994	2,710
Maui.....	7,121	83,671	0.12752	0.11715	103,839	36,476	67,363
Molokai	5,374	37,587	0.17719	0.17768	5,474	2,162	3,312

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. Revised October 1995.

Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1994

[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			Installed capacity (nameplate) Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential <u>1/</u>	Other		Total	Residential <u>1/</u>	Other
State total.....	403,595	346,977	56,618	1,710,224	8,948,458	2,551,240	6,397,218
Oahu.....	264,992	232,115	32,877	1,188,910	6,797,364	1,782,043	5,015,321
Hawaii.....	58,017	48,655	9,362	202,095	835,666	324,879	510,787
Kauai.....	28,103	21,482	6,621	110,550	355,311	123,713	231,598
Maui County	52,483	44,725	7,758	208,669	960,117	320,605	639,513
Lanai.....	1,297	1,131	166	10,760	25,818	5,963	19,856
Maui.....	48,388	41,292	7,096	189,029	901,235	302,085	599,151
Molokai	2,798	2,302	496	8,880	33,064	12,557	20,506

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Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1994 - Con.

County or island	Average annual use (kWh) <u>2/</u>		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residen- tial <u>1/</u>	Other	Residen- tial <u>1/</u>	Other	Total	Residen- tial <u>1/</u>	Other
State total.....	7,353	112,989	0.12464	0.09972	955,907	317,984	637,923
Oahu.....	7,677	152,548	0.11342	0.08979	652,442	202,124	450,319
Hawaii.....	6,677	54,560	0.16491	0.14621	128,259	53,576	74,683
Kauai	5,759	34,979	0.16166	0.15286	55,401	20,000	35,401
Maui County	7,168	82,433	0.13189	0.12122	119,805	42,284	77,520
Lanai	5,272	119,611	0.16618	0.15609	4,090	991	3,099
Maui.....	7,316	84,435	0.12985	0.11861	110,289	39,226	71,063
Molokai	5,455	41,343	0.16465	0.16375	5,426	2,068	3,358

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: 1984 TO 1994

[Revised. Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residen- tial ^{1/}	Other	Total	Residen- tial ^{1/}	Other
1984	32,643	28,859	3,784	30,928	5,853	25,075
1985	32,988	29,253	3,735	31,203	5,911	25,292
1986	33,369	29,678	3,691	31,122	5,762	25,360
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

Year	Average annual use (therms) ^{2/}		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residen- tial ^{1/}	Other	Residen- tial ^{1/}	Other	Total	Residen- tial ^{1/}	Other
1984	203	6,627	1.78958	1.37488	44,949	10,474	34,475
1985	202	6,772	1.76934	1.33821	44,305	10,459	33,846
1986	194	6,871	1.57151	1.12027	37,465	9,055	28,410
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

^{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: 1993

[Revised. Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residen- tial ^{1/}	Other	Total	Residen- tial ^{1/}	Other
State total.....	35,908	32,293	3,615	33,268	5,750	27,518
Oahu.....	33,206	29,984	3,222	30,027	5,287	24,739
Hawaii.....	1,780	1,456	324	2,372	308	2,064
Kauai.....	501	501	-	83	83	-
Maui.....	394	325	69	782	67	715
Molokai.....	27	27	-	5	5	-
Lanai.....	-	-	-	-	-	-

Island	Average annual use (therms) ^{2/}		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residen- tial ^{1/}	Other	Residen- tial ^{1/}	Other	Total	Residen- tial ^{1/}	Other
State total.....	178	7,612	1.75962	1.22594	43,853	10,117	33,735
Oahu.....	176	7,678	1.77992	1.23456	39,953	9,411	30,542
Hawaii.....	212	6,370	1.50929	1.16002	2,859	465	2,394
Kauai.....	165	-	1.59599	-	132	132	-
Maui.....	206	10,360	1.47629	1.11795	898	99	799
Molokai.....	174	-	2.26418	-	11	11	-
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: 1994

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residen- tial <u>1/</u>	Other	Total	Residen- tial <u>1/</u>	Other
State total.....	36,403	32,753	3,650	34,010	5,851	28,159
Oahu	33,597	30,344	3,253	30,762	5,372	25,391
Hawaii	1,786	1,458	328	2,338	305	2,032
Kauai.....	567	567	-	93	93	-
Maui.....	397	328	69	806	71	736
Molokai	56	56	-	10	10	-
Lanai.....	-	-	-	-	-	-

Island	Average annual use (therms) <u>2/</u>		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residen- tial <u>1/</u>	Other	Residen- tial <u>1/</u>	Other	Total	Residen- tial <u>1/</u>	Other
State total.....	179	7,715	1.71994	1.19455	43,700	10,064	33,637
Oahu	177	7,805	1.73535	1.19818	39,744	9,322	30,423
Hawaii	209	6,196	1.52038	1.17165	2,845	464	2,381
Kauai.....	165	-	1.62303	-	152	152	-
Maui.....	216	10,659	1.46822	1.13238	937	104	833
Molokai	181	-	2.21664	-	22	22	-
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 1994**

Year	Number of customers, Dec. 31		Net input <u>1/</u> (1,000 kWh)	Electricity sales (1,000 kWh)	Average annual residential use <u>2/</u> (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

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 <u>1/</u> (1,000 therms)		Average annual residential usage <u>1/</u> (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: 1985 TO 1995

[In thousands of gallons]

Year reported <u>1/</u>	All types		Gasoline	Diesel oil	
	Total	Excluding aviation		Non-hwy.	Hwy. use
1985	970,555	432,500	327,021	83,147	17,636
1986	1,059,180	456,013	336,559	95,022	19,354
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

Year reported <u>1/</u>	Liquefied petroleum gas		Aviation fuel	Small boats	
	Off-hwy.	Hwy. use		Gasoline	Diesel oil
1985	2,804	1,028	538,055	187	676
1986	2,969	1,031	603,167	163	916
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

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 ended 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: 1995

[In thousands of gallons]

Type of fuel	State total	City and Co. of Honolulu	County of Maui	County of Hawaii	County of Kauai
Total.....	1,286,038	1,027,024	108,258	93,159	57,597
Gasoline	396,446	262,614	50,852	59,544	23,436
Diesel oil, non-hwy.....	172,684	83,966	37,482	19,786	31,450
Diesel oil, hwy. use.....	27,411	16,996	2,920	6,013	1,481
Liq. pet. gas, off hwy.....	3,096	1,810	547	483	256
Liq. pet. gas, hwy. use	514	429	30	29	26
Small boats, gasoline.....	50	50	-	-	-
Small boats, diesel oil.....	395	3	-	393	-
Aviation fuel	685,443	661,157	16,426	6,911	948

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base and Tax Collections, Calendar Year Ending December 31, 1995" (annual release).

Table 17.19-- IMPORTS AND EXPORTS OF CRUDE OIL AND PETROLEUM PRODUCTS: 1994

[1,000 barrels]

Product	Imports			Exports		
	Total	Domestic	Foreign	Total	Domestic	Foreign
Crude oil.....	54,471	21,018	33,453	31	31	-
Distillates.....	330	330	-	92	88	4
Jet fuel <u>1/</u>	1,076	614	462	-	-	-
Residual fuel oil.....	414	2	412	1,123	555	568
Naphtha.....	-	-	-	908	163	745
Other.....	-	-	-	730	178	552

1/ Excludes imports of unknown origin.

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

Table 17.20-- GASOLINE SERVICE STATIONS (SIC 554) WITH PAYROLL, BY COUNTIES: 1987, 1992, AND 1993

Year	State total	City and Co. 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
1993.....	315	204	58	20	(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 1993, Hawaii*, CBP-93-13 (August 1995).

Table 17.21-- BOILERS AND PRESSURE VESSELS, BY ISLANDS: DECEMBER 31, 1994

Island	Total	Power boilers	Heating boilers	Pressure vessels
State total	9,404	633	2,657	6,114
Hawaii	1,176	84	219	873
Maui	977	74	244	659
Lanai	65	5	11	49
Molokai	61	7	28	26
Oahu	6,696	426	2,024	4,246
Kauai.....	429	37	131	261
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: 1993

Subject	State total	Hawaii	Kauai	Maui	Oahu
Electricity (millions of kilowatt-hours)					
Generated <u>1/</u>	687.63	179.23	124.92	250.32	133.15
Purchased	33.33	1.80	14.82	6.07	10.64
Sold.....	335.74	116.23	71.02	104.03	44.46
Used.....	385.21	64.80	68.72	152.36	99.33
Gross heat values of boiler fuels (billions of Btu's)					
All fuels.....	22,204	6,353	4,166	7,268	4,417
Bagasse	15,998	4,840	3,549	5,007	2,603
Fuel oil	5,373	1,514	591	2,049	1,220
Other fuels	833	-	27	212	594

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

Source: Hawaiian Sugar Planters' Association, *Energy Inventory of Hawaiian Sugar Plantations - 1993* (Energy Report 33, May 1994), pp. 10-11.

Table 17.23-- HIGH TECHNOLOGY COMPANIES, EMPLOYEES, AND REVENUES: 1993

Subject	All sectors	Manufacturing	Service	Support
Number of companies <u>1/</u>	248	18	186	44
Employees <u>2/</u>	7,125	991	4,281	1,853
Revenues (million dollars) <u>2/</u>	958	388	376	194

1/ Number responding to survey. The estimated total number of high tech companies in Hawaii was 300.

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

Source: High Technology Development Corp., Mililani, Hawaii, 1993 survey.

Table 17.24-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT AND R&D PLANT IN HAWAII: 1987 TO 1992

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

Type of obligation	1987	1988	1989	1990	1991	1992
Obligations for R&D.....	63.9	82.2	97.4	100.0	112.6	150.7
Obligations for R&D plant...	0.6	6.9	0.4	1.4	9.2	6.5

Source: National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1992, 1993, and 1994*, Volume 42, Detailed Statistical Tables, NSF 94-328 (1993), pp. 346-349.

Table 17.25-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING, FOR THE UNIVERSITY OF HAWAII: 1990-91 TO 1994-95

[Research and non-research awards received through the Office of Research Administration, University of Hawaii]

Scope of survey and fiscal year ^{1/}	Total		Research		Non-research	
	Awards	Amount (dollars)	Awards	Amount (dollars)	Awards	Amount (dollars)
Including U.S.D.A.:						
1990-91	1,041	110,763,992	622	62,870,814	418	47,868,825
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

^{1/} Earlier reports excluded non-competitive awards from the U.S. Department of Agriculture.

Source: Office of Research Administration, University of Hawaii, *1994-1995 Extramural Awards* (1995), p. i.

Table 17.26-- RESEARCH AND DEVELOPMENT EXPENDITURES AT DOCTORATE-GRANTING INSTITUTIONS: 1988 TO 1992

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

Type of expenditure	1988	1989	1990	1991	1992
Total R&D expenditures	64,278	70,733	76,525	78,166	80,258
Federally financed.....	38,560	40,574	42,665	44,857	47,684
All others.....	25,718	30,159	33,860	33,309	32,574

Source: National Science Foundation, *Academic Science and Engineering: R&D Expenditures, Fiscal Year 1992*, NSF 94-324, Detailed Statistical Tables (1994), tables B-23 and B-24.

Table 17.27-- PATENTS ISSUED TO HAWAII RESIDENTS: 1984 TO 1994

[Fiscal years ended September 30. Data include design, plant, and reissue patents]

Fiscal year	Patents	Fiscal year	Patents
1984.....	43	1990.....	78
1985.....	33	1991.....	78
1986.....	37	1992.....	85
1987.....	52	1993.....	88
1988.....	62	1994.....	<u>1/</u> 116
1989.....	74		

1/ Hawaii ranked 45th among the 50 States.

Source: U.S. Department of Commerce, Patent and Trademark Office, *Working for Our Customers: a Patent and Trademark Office Review, Fiscal Year 1994*, p. 66, and *Annual Report for 1984-1993*.

**Table 17.28-- TELESCOPES AT THE SUMMITS OF MAUNA KEA AND
HALEAKALA: 1994**

Location and facility	Mirror size (meters)	Year completed	Costs (mil. dol.)		Local staff <u>1/</u>	
			Capital	Operating		
Mauna Kea:						
UH 24-inch Telescope #1	0.61	1968	}	5	1.2	11
UH 24-inch Telescope #2	0.61	1969				
UH 88-inch Telescope	2.24	1970				
NASA Infrared Telescope Facility	3.0	1979	10	2.5	11	
Canada-France-Hawaii Telescope	3.6	1979	30	6.0	52	
United Kingdom Infrared Telescope ..	3.8	1979	5	2.7	27	
Caltech Submillimeter Observatory...	10	1986	6	2.0	11	
James Clerk Maxwell Submillimeter..	15	1986	32	3.5	39	
W.M. Keck Observatory	10	1992	94	5.0	35	
VLBA Antenna (Radio)	25	1992	7	0.25	3	
W.M. Keck Observatory (Keck II)	10	1996	93	5.0	35	
Japan National Large Telescope (Subaru)	8	1999	170	10.0	50	
Haleakala (on UH land):						
Mees Solar Observatory .....	...	1956	0.5	0.5	9
Lunar Ranging Facility .....	...	1976/84	3.3	0.6	8
Maui Space Surveillance Site .....	...	...	200	11.0	120

1/ Based in same county as observatory.

Source: University of Hawaii at Manoa, Institute for Astronomy, *Fact Sheet--1993-1994* (February 1994).