

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 (on utility employment), 14 (prices), and 18 (gasoline consumption).

Total energy consumption in 1992 amounted to 322 trillion British thermal units, compared with 272 trillion Btu a decade earlier. Fully 90 percent in 1992 was provided by petroleum. Transportation, accounted for 57 percent of the total. Total expenditures for fuels and electricity in 1992 were \$2.3 billion.

Electricity sales amounted to 8.7 billion kilowatt-hours in 1993, a total that has increased 35 percent since 1983. Manufactured gas sales reached 33 million therms in 1993, six percent above the figure ten years earlier. Residential rates in 1993 averaged 12.3 cents per kilowatt-hour and \$1.76 per therm. Average residential use (7,197 kWh and 178 therms in 1993) has declined since the early 1970s.

The liquid fuel tax base for 1993 was approximately 1.2 billion gallons, compared with 920 million in 1993. The 1993 total included 384 million gallons of gasoline, 600 million of aviation fuel, and 185 million of diesel oil. The average price for automotive gasoline was \$1.56 per gallon during 1991.

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 \$100 million in 1990. Eighty-five patents were granted to Hawaii residents in 1992.

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: 1993*, Sections 19 and 20.

**Table 17.1-- CONSUMPTION OF ENERGY, BY SOURCE (PHYSICAL UNITS):
1970 TO 1991**

Year	Petroleum ^{1/} (1,000 barrels)	Hydro- electric power ^{2/} (million kWh)	Geothermal energy (million kWh)	Coal (1,000 short tons)	Other ^{3/} (million kWh)
1970	34,129	108	0	0	24
1971	36,754	89	0	0	15
1972	37,755	91	0	0	18
1973	38,785	95	0	0	22
1974	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	45,858	87	0	37	0

^{1/} For data by type of petroleum, see source. Revised data, 1987-1990.

^{2/} Includes industrial and electric utility production.

^{3/} Wood, waste, wind, photovoltaic, and solar thermal energy sources consumed at electric utilities to produce electricity. Excludes natural gas and nuclear electric power.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1991, Consumption Estimates* (May 1993), p. 105.

**Table 17.2-- CONSUMPTION OF ENERGY, BY SOURCE (TRILLION BTU):
1970 TO 1991**

[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	231.8	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	271.6	266.9	0.9	0.0	0.9	2.9	0.0

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

2/ Includes industrial and electric utility production.

3/ Wood, waste, wind, photovoltaic, and solar thermal energy sources consumed at electric utilities to produce electricity.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1991, Consumption Estimates* (May 1993), p. 105.

**Table 17.3-- CONSUMPTION OF ENERGY BY END-USE SECTOR:
1970 TO 1991**

[Trillion Btu. Revised data for 1987-1990]

Year	Consumption ^{1/}				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	153.4	79.2

^{1/} Excludes small quantities of energy sources for which consistent historical data are not available, such as solar energy obtained by the use of thermal and photovoltaic collectors; wind energy; and geothermal, biomass, and waste energy other than that consumed at the electric utilities.

Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1991, Consumption Estimates* (May 1993), pp. 106-110.

**Table 17.4-- PRIMARY ENERGY CONSUMPTION AND ELECTRICITY SALES,
TOTAL AND PER CAPITA: 1970 TO 1992**

Year	Primary energy consumption		Electricity sales by utilities	
	Total (trillion Btu)	Per capita ^{1/} (million Btu)	Total (1,000 kWh)	Per capita ^{1/} (kWh)
1970	225.22990	282.031	3,758,094	4,706
1971	241.09159	289.391	4,167,127	5,002
1972	245.12817	281.821	4,562,568	5,246
1973	250.54211	277.979	4,867,850	5,401
1974	237.26587	256.865	5,113,906	5,536
1975	238.35719	252.631	5,334,755	5,654
1976	240.51954	247.882	5,615,210	5,787
1977	254.54840	256.524	5,831,610	5,877
1978	259.11475	255.462	6,004,891	5,920
1979	278.45009	267.047	6,197,426	5,944
1980	273.88094	259.504	6,345,531	6,012
1981	273.32263	257.221	6,424,016	6,046
1982	272.11290	250.888	6,332,707	5,839
1983	279.03031	251.560	6,425,578	5,793
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	282.71678	238.278	7,298,178	6,151
1988	306.72360	255.518	7,719,029	6,430
1989	314.96310	252.861	7,970,360	6,399
1990	306.70400	243.803	8,310,537	6,606
1991	315.50600	246.952	8,524,088	6,672
1992 ^{2/}	321.72220	247.364	8,666,889	6,664

^{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 17.5-- PRIMARY ENERGY CONSUMPTION, BY SOURCE: 1970 TO 1992

[Trillion Btu]

Year	Total	Petroleum	Biomass ^{1/}	Solar water heating	Hydro-electricity	Coal	Wind	Geo-thermal
1970	225.2299	197.2279	26.9020	-	1.1000	-	-	-
1971	241.0916	212.8486	27.3430	-	0.9000	-	-	-
1972	245.1282	218.3842	25.8440	-	0.9000	-	-	-
1973	250.5421	223.7861	25.7560	-	1.0000	-	-	-
1974	237.2659	212.2739	23.9920	-	1.0000	-	-	-
1975	238.3572	213.4572	24.0000	-	0.9000	-	-	-
1976	240.5195	215.5195	24.0000	-	1.0000	-	-	-
1977	254.5484	229.5889	24.0000	0.0595	0.9000	-	-	-
1978	259.1148	233.5357	24.4000	0.2791	0.9000	-	-	-
1979	278.4501	253.0344	24.0000	0.5157	0.9000	-	-	-
1980	273.8809	248.0109	24.2000	0.7700	0.9000	-	-	-
1981	273.3226	245.5086	24.0900	1.1185	0.7356	1.8700	-	-
1982	272.1129	244.3151	23.9200	1.3567	1.0939	1.2700	-	0.1572
1983	279.0303	250.6283	24.8500	1.5269	0.8865	0.9500	-	0.1886
1984	276.3700	248.4026	24.3650	1.7683	0.7796	0.8470	-	0.2075
1985	266.2178	238.6470	23.1430	2.1327	0.9808	0.9560	0.1697	0.1886
1986	271.0562	242.5857	23.9670	2.1644	1.0562	0.4970	0.6036	0.1823
1987	284.2043	256.4061	22.1840	2.1914	0.9670	1.4875	0.8236	0.1446
1988	306.9212	279.1052	22.7080	2.1931	0.9826	1.3509	0.4185	0.1629
1989	314.9631	289.2301	20.9498	2.3310	1.0183	0.8715	0.4189	0.1435
1990	306.7040	280.8740	21.2400	2.3400	1.0700	0.8900	0.2900	-
1991	315.5060	289.9000	21.2000	2.3000	1.0000	0.8000	0.3060	-
1992 ^{2/}	321.7222	290.8500	20.6548	2.3000	0.7226	6.9207	0.2573	0.0168

^{1/} Beginning 1989, includes solid waste.

^{2/} Preliminary.

Source: U.S. Energy Information Administration; Hawaii State Department of Business, Economic Development & Tourism, Energy Division, records.

Table 17.6-- ELECTRICITY GENERATION BY SOURCE: 1987 TO 1992

[Millions of kWh generated]

Year	Total	Petroleum	Biomass	Hydro-electric	Geo-thermal	Wind	Other <u>1/</u>
1987	8,368	7,577	605	93	14	79	-
1988	8,952	8,115	681	98	16	42	-
1989	9,280	8,511	614	100	14	41	(Z)
1990	9,565	8,589	538	105	-	28	306
1991	9,610	8,664	495	92	-	30	329
1992	10,104	8,556	460	67	1	21	999

Z Less than 500,000 kWh.

1/ Coal, photovoltaic, and solid waste.

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 17.7-- ELECTRICITY PRODUCTION, BY SOURCE, BY ISLANDS: 1992

[Million kWh]

Island	Total	Petroleum	Biomass <u>1/</u>	Hydro-electric	Wind	Other <u>2/</u>
State total..	10,103.8	8,556.2	833.2	66.5	20.7	627.2
Hawaii.....	962.0	764.0	142.7	12.7	15.0	27.6
Maui.....	1,087.8	862.7	157.1	20.3	-	47.7
Lanai.....	26.6	26.6	-	-	-	-
Molokai.....	33.4	32.7	-	-	0.7	-
Oahu.....	7,558.6	6,547.0	454.7	-	5.0	551.9
Kauai.....	435.4	323.2	78.7	33.5	-	-

1/ Includes generation from Honolulu municipal solid waste plant.

2/ Coal, geothermal (ceased operation in 1989), and photovoltaic.

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

**Table 17.8-- EXPENDITURES FOR FUELS AND ELECTRICITY, BY SOURCE:
1970 TO 1992**

[Millions of dollars]

Year	Total energy expend.	Fuel expenditures			Less: electric utility fuel expend.	Plus: electric purch. by end-user
		Total	Electric utility	Other		
1970	282.7	215.9	17.3	198.6	17.3	84.1
1971	320.8	246.8	24.8	222.0	24.8	98.8
1972	332.4	250.4	27.3	223.1	27.3	109.3
1973	391.1	300.9	36.3	264.6	36.3	126.5
1974	534.5	433.2	49.8	383.4	49.8	151.1
1975	669.9	546.1	91.9	454.2	91.9	215.7
1976	735.6	600.0	100.4	499.6	100.4	236.0
1977	844.5	696.5	123.5	573.0	123.5	271.5
1978	932.2	767.8	149.3	618.5	149.3	313.7
1979	1,261.3	1,083.7	177.0	906.7	177.0	354.6
1980	1,721.3	1,529.8	267.8	1,262.0	267.8	459.3
1981	2,195.2	1,947.7	451.5	1,496.2	451.5	699.0
1982	2,153.8	1,869.6	439.4	1,430.2	439.4	723.6
1983	2,019.9	1,730.1	369.3	1,360.8	369.3	659.1
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 ^{1/}	2,262.0	1,681.2	238.2	1,443.0	238.2	819.0

^{1/} Preliminary.

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

Table 17.9-- ELECTRIC UTILITIES: 1983 TO 1993

Year	Customers, Dec. 31 ^{1/}			Installed capacity (nameplate), Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential ^{2/}	Other		Total	Residential ^{2/}	Other
1983	319,449	276,194	43,255	1,578,780	6,425,578	1,814,336	4,611,242
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 ^{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/} .	394,825	340,932	53,893	1,717,914	8,657,903	2,453,830	6,204,075
Year	Average annual use (kWh ^{3/})		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential ^{2/}	Other	Residential ^{2/}	Other	Total	Residential ^{2/}	Other
1983	6,569	106,606	.11348	.09828	659,089	205,889	453,200
1984	6,552	108,702	.11831	.10181	702,899	217,447	485,452
1985	6,590	105,015	.11361	.09653	672,600	213,478	459,122
1986	6,728	109,326	.09294	.07505	562,345	182,110	380,234
1987	6,905	110,466	.09431	.07792	602,553	195,198	407,355
1988	7,011	114,832	.08829	.07141	587,528	189,689	397,839
1989	7,168	114,772	.09265	.07585	642,101	207,436	434,665
1990	7,247	118,060	.10261	.08544	749,857	238,103	511,754
1991	7,187	116,716	.10539	.08726	779,382	249,104	530,278
1991 ^{4/} .	7,252	117,524	.10546	.08733	785,896	251,553	534,343
1992 ^{4/} .	7,301	119,049	.10932	.08898	818,525	265,667	552,858
1993 ^{4/} .	7,197	115,118	.12309	.10005	922,796	302,054	620,743

^{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.

Table 17.10-- ELECTRIC UTILITIES, BY ISLANDS: 1992

[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.....	385,055	332,863	52,192	1,650,639	8,666,889	2,430,152	6,213,410
Oahu.....	257,442	225,229	32,213	1,188,600	6,650,449	1,730,537	4,919,912
Hawaii.....	55,412	46,144	9,268	184,700	790,731	301,079	489,652
Kauai.....	21,938	18,678	3,260	110,550	335,028	108,892	226,136
Maui County.....	50,263	42,812	7,451	166,789	890,681	289,644	577,710
Lanai.....	1,259	1,107	152	10,760	23,327	5,504	17,823
Maui.....	46,233	39,422	6,811	151,029	837,513	277,617	559,896
Molokai.....	2,771	2,283	488	5,000	29,841	12,027	17,814

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Table 17.10-- ELECTRIC UTILITIES, BY ISLANDS: 1992 - 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.....	7,301	119,049	0.10932	0.08898	818,525	265,667	552,858
Oahu.....	7,683	152,731	0.09925	0.07984	564,574	171,756	392,818
Hawaii.....	6,525	52,833	0.14210	0.12598	104,470	42,784	61,686
Kauai.....	5,830	69,367	0.13645	0.13476	45,332	14,859	30,473
Maui County.....	6,765	77,535	0.12522	0.11750	104,149	36,268	67,881
Lanai.....	4,972	117,257	0.15388	0.13643	3,279	847	2,432
Maui.....	7,042	82,205	0.11992	0.11120	95,554	33,291	62,263
Molokai.....	5,268	36,504	0.17713	0.17891	5,317	2,130	3,187

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. Hawaiian Electric Company, Inc., *1992-1987 Financial and Statistical Data Booklet* (June 14, 1993).

Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1993

[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.....	394,825	340,932	53,893	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.....	55,979	46,713	9,266	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

Continued on next page.

Table 17.11-- ELECTRIC UTILITIES, BY ISLANDS: 1993 - 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	7,197	115,118	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	6,650	53,037	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.

Table 17.12-- GAS UTILITIES: 1983 TO 1993

[Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residen- tial ^{1/}	Other	Total	Residen- tial ^{1/}	Other
1983	32,880	28,933	3,947	31,307	6,338	24,970
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	32,295	3,613	33,268	5,750	27,518

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
1983	219	6,326	1.79719	1.44022	47,352	11,390	35,962
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	7,616	1.75962	1.22594	43,853	10,117	33,735

^{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: 1992

[Excludes bottled gas]

Island	Customers, December 31			Gas sold (1,000 therms)		
	Total	Residential ^{1/}	Other	Total	Residential ^{1/}	Other
State total	35,236	31,625	3,611	33,662	5,733	27,929
Oahu.....	32,598	29,375	3,223	30,528	5,285	25,243
Hawaii.....	1,781	1,461	320	2,278	310	1,969
Kauai	426	426	-	69	69	-
Maui.....	402	334	68	784	67	717
Molokai ^{3/}	29	29	-	3	3	-
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	181	7,735	1.79054	1.25466	45,307	10,265	35,042
Oahu.....	180	7,832	1.81127	1.26372	41,473	9,573	31,900
Hawaii.....	212	6,153	1.53474	1.17955	2,798	475	2,322
Kauai	161	-	1.61156	-	111	111	-
Maui.....	200	10,548	1.49967	1.14186	919	100	819
Molokai ^{3/}	135	-	2.31088	-	6	6	-
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.

^{3/} Utility service to Molokai began in May 1992; annual usage estimated.

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

Table 17.14-- GAS UTILITIES, BY ISLANDS: 1993

[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	35,908	32,295	3,613	33,268	5,750	27,518
Oahu.....	33,206	29,984	3,222	30,027	5,287	24,739
Hawaii.....	1,780	1,458	322	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) <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	178	7,616	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.....	211	6,410	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 17.15-- SERVICE PROVIDED BY HAWAIIAN ELECTRIC COMPANY, INC., ON OAHU: 1988 TO 1993

Year	Number of customers, Dec. 31		Net input ^{1/} (1,000 kWh)	Electricity sales (1,000 kWh)	Average annual residential use ^{2/} (kWh)	Average residential rate (dollars per kWh)	Generating capability Dec. 31 (kW)
	Total	Residential only					
1988	244,965	214,429	6,439,768	6,095,707	7,386	0.07973	1,258,000
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

^{1/} Net generation plus purchased power.

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

^{3/} Including firm purchase power.

Source: Hawaiian Electric Company, Inc., records.

Table 17.16-- GAS UTILITY SERVICE BY GAS COMPANY, INC., FOR OAHU: 1988 TO 1993

Calendar year	Customers, Dec. 31		Gas sold ^{1/} (1,000 therms)		Average annual residential usage ^{1/} (therms)
	Total	Residential	Total	Residential	
1988	31,613	28,331	29,689	5,342	189
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

^{1/} Includes liquefied petroleum gas.

Source: The Gas Company, BHP Petroleum, records.

Table 17.17-- LIQUID FUEL TAX BASE: 1983 TO 1993

[In thousands of gallons]

Year reported <u>1/</u>	All types		Gasoline	Diesel oil	
	Total	Excluding aviation		Non-hwy.	Hwy. use
1983.....	919,865	418,217	310,085	86,790	16,440
1984.....	925,871	440,061	322,410	95,956	17,892
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

Year reported <u>1/</u>	Liquefied petroleum gas		Aviation fuel	Small boats	
	Off-hwy.	Hwy. use		Gasoline	Diesel oil
1983.....	3,013	1,052	501,648	213	624
1984.....	2,600	873	485,810	114	215
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

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, Collections and Distributions" (annual report).

Table 17.18-- LIQUID FUEL TAX BASE, BY COUNTIES: 1993

[In thousands of gallons]

Type of fuel	State total	City and Co. of Honolulu	County of Maui	County of Hawaii	County of Kauai
Total	1,173,458	927,930	92,744	96,702	56,082
Gasoline.....	384,444	256,027	48,211	57,542	22,664
Diesel oil, non-hwy.....	160,121	62,130	38,421	27,909	31,660
Diesel oil, hwy. use.....	24,987	16,702	2,616	4,633	1,045
Liq. pet. gas, off hwy.....	3,343	1,993	515	542	293
Liq. pet. gas, hwy. use.....	477	383	36	32	27
Small boats, gasoline.....	35	35	-	-	-
Small boats, diesel oil.....	349	12	-	337	-
Aviation fuel.....	599,691	590,647	2,944	5,707	393

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base, Collections & Distributions, Calendar Year Ending December 31, 1993" (annual release).

Table 17.19-- IMPORTS AND EXPORTS OF CRUDE OIL AND PETROLEUM PRODUCTS: 1992

[1,000 barrels]

Product	Imports			Exports		
	Total	Domestic	Foreign	Total	Domestic	Foreign
Crude oil.....	48,199	21,698	26,501	-	-	-
Distillates.....	358	242	116	971	971	-
Jet fuel 1/.....	3,968	2,984	984	199	199	-
Residual fuel oil.....	1,995	636	1,359	1,935	485	1,450
Naphtha.....	0.2	0.2	-	993	320	673
Motor gasoline.....	33.1	33.1	-	1,804	1,164	640

1/ Excludes imports of unknown origin (3,686,500 in 1988).

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 AND 1991

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
1991	331	217	56	23	(1/)	35	(1/)

1/ Included with Maui.

Source: U.S. Bureau of the Census, *1987 Census of Retail Trade, Hawaii* RC87-A-12 (May 1989), table 5, and *County Business Patterns 1991, Hawaii*, CBP-91-13 (December 1993), tables 1b and 2.

Table 17.21-- GASOLINE AVERAGE PRICES PER GALLON, FOR ALL U.S. CITIES AND OAHU: ANNUAL AVERAGES, 1984 TO 1991

[In dollars. Average prices include all applicable federal, state, and county taxes. For earlier years, 1903-1983, see Robert C. Schmitt, *What People Paid to Travel* (Hawaiian Historical Society, 1991), p. 33]

Year	U.S.	Oahu	Year	U.S.	Oahu
1984	1.198	1.450	1988	0.964	1.293
1985	1.196	1.392	1989	1.060	1.365
1986	0.931	1.206	1990	1.217	1.479
1987	0.957	1.233	1991	1.196	1.560

Source: Based on data in the U.S. Bureau of Labor Statistics, *CPI Detailed Report* (monthly). The 1984-1986 Honolulu prices and all U.S. averages are actual values; the 1987-1991 Honolulu prices are estimates based on actual prices for the last half of 1986 and CPI (U) changes for gasoline for subsequent years.

Table 17.22-- BOILERS AND PRESSURE VESSELS: 1992 AND 1993

Date	Total	Power boilers	Heating boilers	Pressure vessels
1992: Dec. 31.....	9,052	613	2,564	5,875
1993: Dec. 31.....	9,110	615	2,582	5,913

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

Table 17.23-- ENERGY GENERATED, PURCHASED, SOLD, AND USED BY SUGAR PLANTATIONS, BY ISLANDS: 1992

Subject	State total	Hawaii	Kauai	Maui	Oahu
Electricity (millions of kilowatt-hours)					
Generated ^{1/}	755.27	231.92	149.35	253.93	120.08
Purchase	24.17	1.21	4.42	3.87	14.67
Sold	389.66	164.10	81.31	106.13	38.11
Used ^{2/}	389.78	69.02	72.45	151.68	96.63
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	21,836	7,429	4,124	6,344	3,938
Bagasse	16,068	5,809	3,353	4,562	2,344
Fuel oil	4,852	1,621	739	1,604	889
Other fuels	916	-	32	178	706

^{1/} Includes electricity generated by steam and by hydroelectric or diesel engine generators.

^{2/} Includes transmission losses and electricity used to operate power plant auxiliaries.

Source: Hawaiian Sugar Planters' Association, *Energy Inventory of Hawaiian Sugar Plantations - 1992* (Energy Report 32, July 1993), pp. 7-10.

Table 17.24-- HIGH TECHNOLOGY COMPANIES, EMPLOYEES, AND REVENUES: 1990-1991

Characteristics	Companies ^{1/}	Employees ^{1/}	Revenues ^{2/} (\$1,000)
All companies	300	12,204	988,112
Excluding GTE Hawaiian Tel....	299	8,004	448,829
Type of company:			
Products	91	3,946	192,581
Services.....	137	6,549	725,344
Support.....	72	1,709	70,187
Year established:			
Before 1984.....	166	10,512	902,411
1984 to 1987.....	84	1,156	49,107
1988 to 1990.....	50	536	36,594

^{1/} As of late 1990 or early 1991.

^{2/} Annual total for 1990. Excludes 82 companies not reporting revenues.

Source: High Technology Development Corporation, *The Hawaii High Technology Business Directory 1991* (1991), and records.

Table 17.25-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT AND R&D PLANT IN HAWAII: 1985 TO 1990

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

Type of obligation	1985	1986	1987	1988	1989	1990
Obligations for R&D.....	58.2	54.7	63.9	82.2	97.4	100.0
Obligations for R&D plant....	0.9	0.6	0.6	6.9	0.4	1.4

Source: National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1990, 1991, and 1992*, Volume XL, NSF 92-322 (July 1992), pp. 283-284.

**Table 17.26-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING,
FOR THE UNIVERSITY OF HAWAII: 1988-89 TO 1992-93**

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

Fiscal year	Total		Research		Non-research	
	Awards	Amount (dollars)	Awards	Amount (dollars)	Awards	Amount (dollars)
1988-89	777	71,898,382	466	46,990,238	311	24,908,144
1989-90	851	83,689,450	488	49,362,792	363	34,326,658
1990-91	910	106,095,750	510	58,058,097	400	48,037,653
1991-92	1,108	120,150,263	595	61,725,694	513	58,424,569
1992-93	1,093	128,575,372	584	58,454,596	509	70,120,776

Source: Office of Research Administration, University of Hawaii, *1992-1993 Extramural Awards* (1993), p. i.

**Table 17.27-- RESEARCH AND DEVELOPMENT EXPENDITURES AT
DOCTORATE-GRANTING INSTITUTIONS: 1987 TO 1991**

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

Type of expenditure	1987	1988	1989	1990	1991
Total R&D expenditures.....	57,345	64,278	70,733	76,525	78,166
Federally financed.....	34,472	38,560	40,574	42,665	44,857

Source: National Science Foundation, *Academic Science and Engineering: R&D Expenditures, Fiscal Year 1991*, NSF 93-308, Detailed Statistical Tables (July 1993), tables B-23 and B-24.

**Table 17.28-- TELESCOPES AT THE SUMMITS OF MAUNA KEA AND
HALEAKALA: 1991**

Location and facility	Mirror size (meters)	Year completed	Primary use	Local staff ^{1/}
Mauna Kea:				
UH 24-inch Telescope #1	0.61	1968	Optical	} 12
UH 24-inch Telescope #2	0.61	1969	Optical	
UH 88-inch Telescope	2.24	1970	Optical/infrared	
NASA Infrared Telescope Facility	3.0	1979	Infrared	15
Canada-France-Hawaii Telescope	3.6	1979	Optical/infrared	51
United Kingdom Infrared Telescope	3.8	1979	Infrared	29
Caltech Submillimeter Observatory	10.4	1986	mm/submm	11
James Clerk Maxwell Telescope	15.0	1986	mm/submm	37
W.M. Keck Observatory	10.0	1991	Optical/infrared	40
Haleakala (on UH land):				
Mees Solar Observatory	1956	...	9
Lunar Ranging Facility	1976/84	...	8
Gamma Ray Facility	1985	...	1

^{1/} Based in same county as observatory.

Source: University of Hawaii at Manoa, Institute for Astronomy, *Fact Sheet--1991-92* (July 1991).

**Table 17.29-- PATENTS ISSUED TO HAWAII RESIDENTS:
1984 TO 1992**

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

Fiscal year	Patents	Fiscal year	Patents
1984	43	1989	74
1985	33	1990	78
1986	37	1991	78
1987	52	1992	^{1/} 85
1988	62		

^{1/} Hawaii ranked 46th among the 50 States.

Source: U.S. Department of Commerce, Patent and Trademark Office, *Commissioner of Patents and Trademarks Annual Report, Fiscal Year '92*, pp. 62-63, and earlier editions.