

Section 17

ENERGY AND SCIENCE

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

Total energy consumption in 1987 amounted to 235 trillion British thermal units, compared with 233 trillion Btu a decade earlier. Transportation, including aviation fuels, accounted for 54 percent of the 1987 total. Total expenditures for fuels and electricity in 1986 were \$1.56 billion.

Electricity sales amounted to 7.7 billion kilowatt-hours in 1988, a total that has increased 29 percent since 1978. Manufactured gas sales reached 33 million therms in 1988, six percent below the figure ten years earlier. Residential rates in 1988 averaged 8.8 cents per kilowatt-hour and \$1.55 per therm, both significantly less than the corresponding rates a few years earlier. Average residential use (7,011 kWh and 189 therms in 1988) has declined since the early 1970s. By 1986, almost 11 percent of the housing units in the State had solar heating devices.

The liquid fuel tax base for 1988 was approximately 1.2 billion gallons, compared with 917 million in 1978. The 1988 total included 358 million gallons of gasoline, 702 million of aviation fuel, and 152 million of diesel oil. The average price for automotive gasoline was \$1.29 per gallon during 1988.

The State is well served with scientific resources. Especially noteworthy is the cluster of large telescopes used for astronomical observations at the summits of Mauna Kea and Haleakala--twelve major facilities, including those under construction. Federal research and development obligations in Hawaii totaled \$64 million in 1987. Fifty-two patents were granted to Hawaii residents in 1987.

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 DBED 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: 1989, Sections 19 and 20.

Table 461.-- CONSUMPTION OF ENERGY, BY SOURCE (PHYSICAL UNITS):
1960 TO 1987

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)
1960	17,497	27	0	0	0
1961	20,721	24	0	0	0
1962	19,733	20	0	0	0
1963	20,705	23	0	0	0
1964	22,117	115	0	0	0
1965	23,177	105	0	0	0
1966	25,804	112	0	0	2
1967	29,081	108	0	0	0
1968	32,363	94	0	0	30
1969	33,815	100	0		29
1970	34,768	108	0	0	24
1971	37,416	89	0	0	15
1972	38,372	91	0	0	18
1973	39,339	95	0	0	22
1974	37,265	92	0	0	30
1975	37,588	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	44,594	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	36,932	82	21	38	28
1985	39,351	86	19	46	25
1986	38,905	78	18	16	0
1987	39,459	82	13	63	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. Excludes natural gas and nuclear electric power.

Source: U.S. Department of Energy, Energy Information Administration, State Energy Data Report, Consumption Estimates, 1960-1987 (April 1989), p. 93.

Table 462.-- CONSUMPTION OF ENERGY, BY SOURCE (TRILLION BTU):
1960 TO 1987

Year	Total energy consumed <u>1/</u>	Petroleum <u>2/</u>	Hydro-electric power <u>3/</u>	Geo-thermal energy	Coal	Natural gas	Other types <u>4/</u>
1960	98.4	98.1	0.3	0.0	0.0	0.0	0.0
1961	117.3	117.0	0.3	0.0	0.0	0.0	0.0
1962	112.2	112.0	0.2	0.0	0.0	0.0	0.0
1963	118.3	118.0	0.2	0.0	0.0	0.0	0.0
1964	127.9	126.7	1.2	0.0	0.0	0.0	0.0
1965	134.2	133.1	1.1	0.0	0.0	0.0	0.0
1966	149.1	147.9	1.2	0.0	0.0	0.0	(Z)
1967	168.1	167.0	1.1	0.0	0.0	0.0	0.0
1968	187.3	186.0	1.0	0.0	0.0	0.0	0.3
1969	194.8	193.5	1.0	0.0	0.0	0.0	0.3
1970	200.4	199.0	1.1	0.0	0.0	0.0	0.3
1971	215.1	214.0	0.9	0.0	0.0	0.0	0.2
1972	221.0	219.9	0.9	0.0	0.0	0.0	0.2
1973	226.7	225.5	1.0	0.0	0.0	0.0	0.2
1974	214.6	213.3	1.0	0.0	0.0	0.0	0.3
1975	216.7	215.5	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	255.9	255.0	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	218.7	213.8	0.8	0.4	0.9	2.4	0.3
1985	233.3	227.9	0.9	0.4	1.1	2.7	0.3
1986	230.9	226.7	0.8	0.4	0.4	2.7	0.0
1987	234.6	229.1	0.8	0.3	1.6	2.8	0.0

Z Less than 0.05.

1/ Totals may not equal sum of components due to independent rounding.

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

3/ Includes industrial and electric utility production.

4/ 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, Consumption Estimates, 1960-1987 (April 1989), p. 93.

Table 463.-- CONSUMPTION OF ENERGY BY END-USE SECTOR: 1960 TO 1987

[Trillion Btu. Revised from Data Book 1988, table 492]

Year	Consumption ^{1/}				Input at electric utilities
	Residential	Commercial	Industrial	Transportation	
1960	7.3	5.2	20.7	65.2	17.6
1961	7.5	5.4	26.9	77.4	19.4
1962	8.0	5.5	28.9	69.8	21.4
1963	8.9	6.0	29.8	73.5	24.2
1964	9.6	6.6	32.4	79.2	26.7
1965	10.1	6.8	34.7	82.6	27.6
1966	10.8	7.4	35.8	95.1	29.7
1967	12.1	8.0	38.8	109.2	31.3
1968	13.1	8.8	38.7	126.7	35.0
1969	14.9	9.8	40.8	129.2	38.7
1970	16.4	11.6	43.6	128.8	43.2
1971	17.8	11.4	43.5	142.4	47.7
1972	19.6	12.7	48.9	139.8	54.1
1973	20.0	13.5	49.4	143.8	55.6
1974	20.3	13.3	49.4	131.7	57.5
1975	19.6	13.8	49.9	133.4	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	58.5	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	117.8	68.6
1984	21.0	18.6	47.5	131.7	70.6
1985	20.7	19.3	48.4	144.9	70.0
1986	20.6	23.1	57.8	129.5	72.9
1987	22.1	29.4	57.4	125.7	76.6

^{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, Consumption Estimates, 1960-1987 (April 1989), pp. 94-98.

Table 464.-- PER CAPITA ENERGY CONSUMPTION, RESIDENT AND DE FACTO:
1960 TO 1988

[For definitions of resident and de facto population, see
table 3, footnotes 1 and 3]

Year	Total energy consumed (trillion Btu)	Electricity sales (1,000 kWh)	Per capita consumption			
			Total energy (million Btu)		Electricity (kWh)	
			De facto	Resident	De facto	Resident
1960	99.15316	1,602,197	152.3	154.6	2,460	2,498
1961	116.97162	1,766,031	175.0	177.6	2,643	2,681
1962	111.79039	1,966,105	161.2	163.6	2,834	2,876
1963	117.84984	2,077,571	169.7	172.7	2,991	3,045
1964	127.23438	2,284,275	178.9	181.8	3,212	3,264
1965	132.72839	2,445,025	185.5	188.6	3,418	3,474
1966	147.99105	2,639,866	204.2	208.3	3,643	3,716
1967	167.45867	2,832,469	225.5	231.8	3,814	3,920
1968	186.50628	3,109,256	245.8	253.9	4,097	4,233
1969	193.83665	3,426,052	248.9	258.4	4,399	4,567
1970	198.62790	3,758,094	248.7	257.4	4,706	4,870
1971	213.94859	4,167,127	256.8	266.9	5,002	5,198
1972	219.48417	4,562,568	252.3	265.0	5,245	5,508
1973	224.98611	4,867,850	249.6	264.2	5,401	5,716
1974	213.57387	5,113,906	231.2	246.1	5,536	5,892
1975	238.35719	5,334,755	252.6	269.0	5,654	6,020
1976	240.51954	5,615,210	247.9	266.0	5,787	6,210
1977	254.54840	5,831,610	256.5	277.2	5,877	6,351
1978	259.11475	6,004,891	255.5	278.1	5,920	6,446
1979	278.45009	6,197,426	267.0	292.1	5,944	6,501
1980	273.88094	6,345,531	259.4	282.7	6,010	6,549
1981	273.32263	6,424,016	256.8	278.8	6,035	6,554
1982	272.11290	6,332,707	250.0	272.8	5,819	6,348
1983	279.03031	6,425,578	250.2	273.9	5,762	6,308
1984	276.36995	6,606,255	242.7	266.8	5,802	6,377
1985	266.21778	6,635,158	231.6	253.2	5,773	6,310
1986	271.05620	7,025,739	229.9	254.6	5,959	6,599
1987	282.71678	7,298,178	235.8	261.2	6,088	6,742
1988	312.77000	7,719,029	256.6	284.8	6,333	7,029

Source: Hawaii State Department of Business and Economic Development, State Energy Resources Coordinator Annual Report, July 1, 1987 to June 30, 1988, tables 21 and 23, and records.

Table 465.-- PRIMARY ENERGY USE, BY SOURCE: 1986 AND 1987

[Thousands of barrels of oil equivalent]

Year	All sources	Petroleum	Biomass	Solar water heating	Hydro electricity	Coal	Geothermal	Wind
1986	46,869	42,341	3,812	344	168	79	29	96
1987	49,023	44,837	3,529	349	154	-	23	131

Source: Hawaii State Department of Commerce and Consumer Affairs, records; Hawaii State Department of Business and Economic Development, records; Hawaiian Sugar Planters' Association, records.

Table 466.-- ENERGY CONSUMPTION, BY SOURCE: 1973 TO 1988

[Trillion Btu]

Year	Total	Petroleum	Biomass	Solar water heating	Hydro-electricity	Coal	Wind	Geothermal
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	0.9000	-	0.0595	-	-
1978 ...	259.1148	233.5357	24.4000	0.9000	-	0.2791	-	-
1979 ...	278.4501	253.0344	24.0000	0.9000	-	0.5157	-	-
1980 ...	273.8809	248.0109	24.2000	0.9000	-	0.7700	-	-
1981 ...	273.3226	245.5086	24.0900	0.7356	-	1.1185	-	1.8700
1982 ...	272.1129	244.3151	23.9200	1.0939	0.1572	1.3567	-	1.2700
1983 ...	279.0303	250.6283	24.8500	0.8865	0.1886	1.5269	-	0.9500
1984 ...	276.3700	248.4026	24.3650	0.7796	0.2075	1.7683	-	0.8470
1985 ...	266.2178	238.6470	23.1430	0.9808	0.1886	2.1327	0.1697	0.9560
1986 ...	271.0562	242.5857	23.9670	1.0562	0.1823	2.1644	0.6036	0.4970
1987 ...	282.7168	256.4061	22.1840	0.9670	0.1446	2.1914	0.8236	-
1988 ...	312.7693	285.4040	23.5990	0.9887	0.1639	2.1931	0.4211	-

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

Table 467.-- ELECTRICITY GENERATION BY SOURCE: 1981 TO 1988

[Millions of kWh generated]

Year	Total	Petroleum	Biomass	Hydro-electric	Geo-thermal	Wind	Coal
1981	7,615	6,913	628	74	-	-	-
1982	7,467	6,729	612	110	16	-	-
1983	7,689	6,914	667	89	19	-	-
1984	7,841	7,073	669	78	21	-	-
1985	7,821	7,001	670	98	19	17	16
1986	8,251	7,412	646	100	18	58	17
1987	8,368	7,577	605	93	14	79	-
1988	8,952	8,115	681	98	16	42	-

Source: Hawaii State Department of Commerce and Consumer Affairs, records; Hawaii State Department of Business and Economic Development, records; Hawaiian Sugar Planters' Association, records.

Table 468.-- ELECTRICITY PRODUCTION, BY SOURCE, BY ISLANDS: 1988

[Million kWh]

Island	Total	Petroleum	Biomass	Hydro-electric	Wind	Geothermal
State total ...	8,952	8,115	681	98	42	16
Hawaii	701	417	230	16	21	16
Maui	906	702	178	26	(Z)	-
Lanai	5	5	-	-	-	-
Molokai	30	29	1	-	-	-
Oahu	6,860	6,728	111	-	21	-
Kauai	450	234	161	55	(Z)	-

Z Less than 500,000 kWh.

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

Table 469.-- EXPENDITURES FOR FUELS AND ELECTRICITY, BY SOURCE:
1970 TO 1988

[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	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	100.4	499.6	100.4	236
1977	844.5	696.5	123.5	573	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	906.7	177	354.6
1980	1,721.3	1,529.8	267.8	1,262	267.8	459.3
1981	2,195.2	1,947.7	451.5	1,496.2	451.5	699
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 <u>1/</u> .	1,664.1	1,314.6	238.0	1,076.6	238.0	587.5

1/ Provisional.

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

Table 470.-- EXPENDITURES FOR FUELS AND ELECTRICITY, BY SECTORS:
1970 TO 1986

[Millions of dollars]

Year	Total fuel	Residential		Commercial and industrial		Transport: fuel	Electric utilities: fuel
		Fuel	Elect.	Fuel	Elect.		
1970	215.9	5.5	34.1	18.9	50.0	174.2	17.3
1971	246.8	8.7	38.8	17.9	60.0	195.4	24.8
1972	250.4	6.1	42.6	20.5	66.7	196.5	27.3
1973	300.9	10.5	48.7	24.4	77.8	229.7	36.3
1974	443.2	10.4	57.1	44.7	94.0	328.3	49.8
1975	546.1	7.4	76.9	45.8	138.8	401.0	91.9
1976	600.0	12.7	84.0	45.9	152.0	441.0	100.4
1977	696.5	13.9	92.9	55.0	178.6	504.1	123.5
1978	767.8	13.3	105.8	52.6	207.9	552.6	149.3
1979	1,083.7	26.2	118.9	102.4	235.7	778.1	177.0
1980	1,529.8	19.5	146.4	135.4	312.9	1,107.1	267.8
1981	1,947.7	20.6	214.6	232.4	484.4	1,243.2	451.5
1982	1,869.6	26.2	222.4	283.6	501.2	1,120.4	439.4
1983	1,730.1	22.9	205.9	288.1	453.2	1,049.8	369.3
1984	1,724.8	20.6	217.4	192.1	485.5	1,132.8	379.3
1985	1,586.6	20.6	213.5	100.8	459.1	1,127.6	337.6
1986	1,147.3	13.8	195.8	65.8	445.6	843.1	224.6

Source: Hawaii State Department of Business and Economic Development, Division of Energy, unpublished estimates.

Table 471.-- ELECTRIC UTILITIES: 1978 TO 1988

Year	Customers, Dec. 31			Installed capacity, Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential	Other		Total	Residential	Other
1978 ..	284,064	244,863	39,201	1,487,490	6,004,891	1,799,024	4,205,867
1979 ..	293,061	252,898	40,163	1,502,840	6,197,426	1,851,457	4,345,969
1980 ..	301,544	260,358	41,186	1,514,180	6,345,531	1,852,984	4,492,547
1981 ..	305,927	265,042	40,885	1,652,380	6,424,016	1,855,837	4,568,179
1982 ..	313,009	270,712	42,297	1,644,980	6,332,707	1,801,297	4,531,410
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
Year	Average annual use (kWh) <u>1/</u>		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential	Other	Residential	Other	Total	Residential	Other
1978 ..	7,347	107,290	.05883	.04943	313,722	105,846	207,876
1979 ..	7,321	108,208	.06420	.05424	354,595	118,862	235,733
1980 ..	7,117	109,079	.07901	.06964	459,251	146,397	312,854
1981 ..	7,002	111,732	.11563	.10605	699,031	214,584	484,447
1982 ..	6,654	107,133	.12348	.11061	723,622	222,423	501,199
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

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

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

Table 472.-- ELECTRIC UTILITIES, BY ISLANDS: 1988

County or island	Customers, Dec. 31			Installed capacity, Dec. 31 (kW)	Power sold (1,000 kWh)		
	Total	Residential	Other		Total	Residential	Other
State total	354,887	306,375	48,512	1,570,410	7,719,029	2,148,275	5,570,754
Oahu	244,965	214,429	30,536	1,258,000	6,095,707	1,570,898	4,524,809
Hawaii	46,301	38,412	7,889	116,500	612,330	242,855	369,475
Kauai	21,548	18,069	3,479	59,800	308,094	103,494	204,600
Maui County	42,073	35,465	6,608	136,110	702,898	231,028	471,869
Lanai	894	773	121	3,710	8,608	3,743	4,865
Maui	38,550	32,544	6,006	121,200	668,028	216,529	451,498
Molokai	2,629	2,148	481	11,200	26,262	10,756	15,506
County or island	Average annual use (kWh) <u>1/</u>		Average rate (dollars per kWh)		Revenues (\$1,000)		
	Residential	Other	Residential	Other	Total	Residential	Other
State total	7,011	114,832	0.08829	0.07141	587,528	189,689	397,839
Oahu	7,325	148,179	0.07972	0.06410	415,317	125,245	290,071
Hawaii	6,322	46,834	0.11371	0.10381	65,974	27,616	38,358
Kauai	5,727	58,810	0.12088	0.11842	36,740	12,511	24,229
Maui County	6,514	71,408	0.10525	0.09574	69,497	24,316	45,181
Lanai	4,841	40,206	0.15588	0.14427	1,285	583	702
Maui	6,653	75,174	0.09972	0.09153	62,922	21,592	41,330
Molokai	5,007	32,237	0.19900	0.20308	5,290	2,141	3,149

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

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

Table 473.-- GAS UTILITIES: 1978 TO 1988

[Excludes bottled gas]

Year	Customers, Dec. 31			Gas sold (1,000 therms)		
	Total	Residential	Other	Total	Residential	Other
1978 ...	33,413	29,091	4,322	34,919	7,388	27,532
1979 ...	33,309	29,014	4,295	35,264	7,326	27,937
1980 ...	33,019	28,825	4,194	34,705	7,030	27,675
1981 ...	32,421	28,343	4,078	32,396	6,422	25,975
1982 ...	32,905	28,979	3,926	32,224	6,329	25,895
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

Year	Average annual use (therms) <u>1/</u>		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residen- tial	Other	Residen- tial	Other	Total	Residen- tial	Other
1978 ...	254	6,370	.91647	.71792	26,536	6,770	19,766
1979 ...	253	6,505	1.09260	.89221	32,931	8,006	24,925
1980 ...	244	6,599	1.46583	1.25951	45,162	10,305	34,857
1981 ...	227	6,369	1.72585	1.50091	50,069	11,083	38,986
1982 ...	218	6,596	1.73311	1.43891	48,229	10,969	37,260
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

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

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

Table 474.-- GAS UTILITIES, BY ISLANDS: 1988

[Excludes bottled gas]

Island	Customers, Dec. 31			Gas sold (therms)			
	Total	Residential	Other	Total	Residential	Other	
State total	34,103	30,450	3,653	32,732,633	5,780,362	26,952,271	
Oahu	31,613	28,331	3,282	29,689,364	5,341,799	24,347,565	
Hawaii	1,850	1,540	310	2,183,745	326,809	1,857,936	
Kauai	277	277	-	56,922	56,922	-	
Maui	363	302	61	802,602	54,832	747,770	
Molokai	-	-	-	-	-	-	
Lanai	-	-	-	-	-	-	
Island	Average annual use (therms) ^{1/}		Average rate (dollars per therm)		Revenues (\$1,000)		
	Residential	Other	Residential	Other	Total	Residential	Other
State total	189	7,378	1.54961	1.07840	38,023	8,957	29,066
Oahu	188	7,418	1.56757	1.08791	34,862	8,374	26,488
Hawaii	212	5,990	1.32453	1.00575	2,300	433	1,868
Kauai	205	-	1.36795	-	78	78	-
Maui	181	12,258	1.32977	0.94918	783	73	710
Molokai	-	-	-	-	-	-	-
Lanai	-	-	-	-	-	-	-

^{1/} Based on number of customers at end of year.

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

Table 475.-- SERVICE PROVIDED BY HAWAIIAN ELECTRIC CO., INC., ON OAHU:
1982 TO 1988

Year	Number of customers, Dec. 31		Net input 1/ (1,000 kWh)	Power sold (1,000 kWh)	Average annual residential use 2/ (kWh)	Average residential rate (dollars per kWh)	Generating capability (kW) Dec. 31
	Total	Residential only					
1982 ..	222,636	194,468	5,441,941	5,164,332	7,068	0.12066	1,347,000
1983 ..	226,070	197,400	5,546,600	5,230,658	7,030	0.10631	1,283,000
1984 ..	228,606	199,722	5,633,940	5,330,931	6,960	0.11032	1,283,000
1985 ..	231,912	202,222	5,637,678	5,336,262	6,997	0.10417	1,283,000
1986 ..	235,742	205,636	5,933,569	5,625,398	7,113	0.08328	1,277,000
1987 ..	241,426	211,277	6,135,382	5,804,298	7,322	0.08591	1,277,000
1988 ..	244,965	214,429	6,439,768	6,095,707	7,386	0.07973	1,258,000

1/ Net generated plus purchased power.

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

Source: Hawaiian Electric Co., Inc., records.

Table 476.-- GAS UTILITY SERVICE BY GASCO, INC., FOR OAHU: 1983 TO 1988

Calendar year	Customers, Dec. 31		Gas sold 1/ (1,000 therms)		Average annual residential usage 1/ (therms)
	Total	Residential	Total	Residential	
1983 ...	30,305	26,674	28,795	5,849	219
1984 ...	30,041	26,636	28,190	5,389	202
1985 ...	30,442	27,085	28,255	5,436	201
1986 ...	30,831	27,516	28,137	5,318	193
1987 ...	31,398	28,069	29,345	5,435	194
1988 ...	31,613	28,331	29,689	5,342	189

1/ Includes liquefied petroleum gas.

Source: Gasco, Inc., records.

Table 477.-- LIQUID FUEL TAX BASE: 1978 TO 1988

[In thousands of gallons]

Year reported ^{1/}	All types		Gasoline	Diesel oil	
	Total	Excluding aviation		Non-hwy.	Hwy. use
1978	917,380	444,110	324,702	99,755	15,233
1979	960,837	454,012	324,337	108,460	16,596
1980	939,766	437,222	312,896	101,719	17,765
1981	918,437	428,886	305,886	101,212	15,771
1982	893,288	418,811	308,600	88,312	17,303
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
Year reported ^{1/}	Liquefied petroleum gas		Aviation fuel	Small boats	
	Off-hwy.	Hwy. use		Gasoline	Diesel oil
1978	1,821	1,216	473,270	445	938
1979	2,213	1,140	506,825	410	856
1980	2,448	1,140	502,544	338	917
1981	2,378	1,136	489,551	424	2,079
1982	2,628	960	474,477	207	802
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

^{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 Distribution" (annual report).

Table 478.-- LIQUID FUEL TAX BASE, BY COUNTIES: 1988

[In thousands of gallons]

Type of fuel	State total	City and Co. of Honolulu	County of Maui	County of Hawaii	County of Kauai
Total	1,216,828	1,002,784	92,766	74,210	47,067
Gasoline	357,986	245,931	41,676	47,519	22,860
Diesel oil, non-hwy. ...	131,292	61,631	30,989	15,673	22,999
Diesel oil, hwy. use ...	21,057	15,126	2,102	3,131	698
Liq. pet. gas, off hwy.	3,012	1,921	450	490	152
Liq. pet. gas, hwy. use	1,071	908	74	56	33
Small boats, gasoline ..	63	57	-	6	-
Small boats, diesel oil	792	75	-	717	-
Aviation fuel	701,555	677,135	17,477	6,618	326

Source: Hawaii State Department of Taxation, "Liquid Fuel Tax Base, Collections and Distribution, Calendar Year Ending December 31, 1988" (annual release).

Table 479.-- IMPORTS AND EXPORTS OF CRUDE OIL AND PETROLEUM PRODUCTS: 1988

[1,000 barrels]

Product	Imports			Exports		
	Total	Domestic	Foreign	Total	Domestic	Foreign
Crude oil	41,218	20,755	20,463	-	-	-
Refined products	6,651	3,353	3,298	6,829	3,331	3,498
Motor gasoline	193	193	-	187	187	-
Distillates	217	217	-	1,658	1,067	591
Jet fuel 1/	2,677	1,119	1,559	2,160	104	2,056
Residual fuel oil ..	3,563	1,824	1,739	2,524	1,673	851
Other	-	-	-	300	300	-

1/ Excludes imports of 3,686,500 barrels of unknown origin.

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

Table 480.-- GASOLINE SERVICE STATIONS (SIC 554)
WITH PAYROLL, BY COUNTIES: 1982 AND 1987

Year	State total	City and Co. of Honolulu	Hawaii County	Kauai County	Maui County		
					Lanai	Maui	Molokai
1982 ^{1/} ...	366	251	60	22	-	31	2
1987	355	241	52	26	1	34	1

^{1/} Unrevised data. The revised Statewide total, not available for counties, was 389.

Source: U.S. Bureau of the Census, Census of Retail Trade, Hawaii for 1982 (RC82-A-12, table 8) and 1987 (RC87-A-12, table 5).

Table 481.-- GASOLINE AVERAGE PRICES PER GALLON, FOR OAHU:
ANNUAL AVERAGES, 1984 TO 1988

[In dollars. Average prices include all applicable federal, state, and county taxes. For earlier years, 1903-1983, see Data Book 1984, tables 497 and 498]

Period	All types ^{1/}	Leaded regular	Unleaded regular	Unleaded premium
1984	1.450	1.367	1.443	(NA)
1985	1.392	1.274	1.396	(NA)
1986	1.206	1.077	1.221	1.346
1987	1.233	1.099	1.254	1.372
1988	^{2/} 1.293	1.204	1.273	1.413

NA Not available.

^{1/} Includes types not shown separately.

^{2/} The U.S. city average for 1988 was \$0.964.

Source: Based on data in the U.S. Bureau of Labor Statistics, CPI Detailed Report (monthly). The 1984-1986 Honolulu prices and 1988 U.S. average are actual values; the 1987 and 1988 Honolulu prices are estimates based on actual prices for the last half of 1986 and CPI(U) changes for gasoline for subsequent years.

Table 482.-- BOILERS AND PRESSURE VESSELS: 1987 AND 1988

Date	Total	Power boilers	Heating boilers	Pressure vessels
1987: Dec. 31 ...	8,517	585	2,479	5,453
1988: Dec. 31 ...	8,508	567	2,458	5,422

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

Table 483.-- ENERGY GENERATED, PURCHASED, SOLD, AND USED BY SUGAR PLANTATIONS, BY ISLANDS: 1987

Subject	State total	Hawaii	Kauai	Maui	Oahu
Electricity (millions of kilowatt-hours)					
Generated <u>1/</u>	816	201	222	253	40
Purchased	20.44	2.51	2.71	5.92	9.30
Sold	398.94	144.37	106.76	105.17	42.64
Used <u>2/</u>	439.30	58.72	118.03	155.62	106.93
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	28,239	9,196	6,575	8,100	4,368
Bagasse	23,512	7,879	5,717	6,384	3,532
Fuel oil	4,253	1,314	839	1,495	606
Other fuels	473	3	19	222	230

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 - 1987 (Energy Report 26, February 27, 1989), pp. 5-8.

Table 484.-- STATE TAX CREDITS FOR RESIDENTIAL SOLAR AND HEAT PUMP WATER HEATING SYSTEMS: 1975 TO 1987

[The State allows individual income tax credits for solar energy devices installed after 1974 and heat pump systems installed after 1980. Data exclude commercial, military, and government systems, those installed previously, and those for which no State tax credit was made. Devices in condominiums may be claimed on a pro-rata basis for each housing unit. Federal solar tax credit was discontinued in 1986]

Year installed	Number of claims		Cumulative number of claims		Average solar device cost (dollars)	Total tax credit allowed (\$1,000)	
	Solar devices	Heat pumps	Solar devices	Heat pumps		Solar devices	Heat pumps
1975-77	1,101	...	1,101	...	2,135	230	...
1978	4,061	...	5,162	...	2,907	1,120	...
1979	4,375	...	9,537	...	3,031	1,250	...
1980	4,704	...	14,241	...	3,346	1,493	...
1981	6,445	2,013	20,686	2,013	3,500	2,107	164
1982	4,407	3,122	25,093	5,135	3,695	1,512	154
1983	3,148	665	28,241	5,800	3,601	1,076	40
1984	4,464	257	32,705	6,057	3,519	1,482	13
1985	6,740	12	39,445	6,069	3,897	2,616	1
1986	592	22	40,037	6,091	2,230	198	4
1987	354	137	40,391	6,228	3,213	149	14

Source: Hawaii State Department of Taxation, Tax Credits Claimed by Hawaii Residents for 1977-1987.

Table 485.-- PERCENT OF HOUSING UNITS WITH SOLAR OR HEAT PUMP WATER HEATING SYSTEMS: 1977 TO 1987

System	1977	1979	1981	1983	1985	1986	1987
Solar	0.3	2.9	5.9	7.9	10.6	10.6	10.5
Heat pump	(NA)	(NA)	0.6	1.6	1.6	1.6	1.6

NA Not available.

Source: Calculated from cumulative totals (as of Dec. 31) in table 484 and DBED estimates of total housing stock on following April 1 in table 601.

Table 486.-- FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT
IN HAWAII: 1982 TO 1987

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

Type of obligation	1982	1983	1984	1985	1986	1987
Total obligations for R&D	44.5	71.4	53.4	58.7	58.7	64.4
Obligations for R&D plant	0.1	0.1	0.6	0.9	0.6	0.6

Source: National Science Foundation, Federal Funds for Research and Development: Fiscal Years 1987, 1988, and 1989, Volume XXXVII, NSF 89-304 (1989), pp. 100-101.

Table 487.-- R & D EXPENDITURES BY STATE GOVERNMENT: 1987 AND 1988

[\$1,000. Fiscal years ended June 30]

State agency	All sources		State sources		Other sources	
	1987	1988	1987	1988	1987	1988
All State govt. ...	116,270	129,424	42,131	44,388	74,139	85,036
University of Hawaii ...	62,231	70,023	23,214	25,284	39,017	44,739
Research Corp. of UH ...	42,000	49,000	8,000	10,000	34,000	39,000
Other State govt.	12,039	10,401	10,917	9,104	1,122	1,297

Source: Hawaii State Department of Business and Economic Development, unpublished survey.

Table 488.-- RESEARCH AND DEVELOPMENT EXPENDITURES AT
DOCTORATE-GRANTING INSTITUTIONS: 1983 TO 1987

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

Type of expenditure	1983	1984	1985	1986	1987
Total R&D expenditures	45,401	51,051	54,025	57,383	57,345
Federally financed	27,633	32,701	34,886	35,322	34,472

Source: National Science Foundation, Academic Science/Engineering: R and D Funds, Fiscal Year 1987, NSF 89-311, table B-22 and table B-23.

Table 489.-- RESEARCH AND NON-RESEARCH EXTRAMURAL FUNDING,
FOR THE UNIVERSITY OF HAWAII: 1984-85 TO 1988-89

[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)
1984-85 ...	628	53,270,256	385	36,699,412	243	16,570,844
1985-86 ...	643	53,976,468	354	35,750,696	289	18,225,772
1986-87 ...	643	52,360,382	378	35,787,240	265	16,573,142
1987-88 ...	678	61,476,926	417	39,410,637	261	22,066,289
1988-89 ...	777	71,898,382	466	46,990,238	311	24,908,144

Source: Office of Research Administration, University of Hawaii,
1988-1989 Extramural Awards (1989), p. i.

Table 490.-- TELESCOPES AT THE SUMMITS OF MAUNA KEA AND
HALEAKALA: 1988

Location and telescope (diameter in meters)	Year com- pleted	Capital costs (millions of 1986 dollars)	Operating costs, 1988 (million dollars)	Local staff (persons)
Mauna Kea:				
UH 0.61-m.	1969	0.3	}	}
UH 0.61-m.	1969	0.3		
UH 2.24-m.	1970	8.0	1.2	13
Canada-France-Hawaii (CFHT) ..	1979	45.0	3.5	43
NASA IRTF 3.0-m.	1979	15.0	1.8	10
UK (UKIRT) 3.8-m.	1979	15.0	1.5	29
James Clerk Maxwell (JCMT) ...	1986	20.0	1.0	20
Caltech Submillimeter (CSO) 10.4-m.	1986	10.0	1.5	11
W.M. Keck Observatory Optical/IR 10.0-m. <u>1/</u>	1991	85.0	2.3	35
Haleakala (on UH land):				
Mees Solar Observatory	1956	0.5	0.3	6
Lunar Ranging Facility	1976/84	3.25	0.7	9
Gamma Ray Facility	1985	2.0	0.2	1

1/ Under construction. Figures are projected.

Source: University of Hawaii at Manoa, Institute for Astronomy, data provided July 18, 1988.

Table 491.-- PATENTS ISSUED TO HAWAII
RESIDENTS: 1981 TO 1988

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

Fiscal year	Patents	Fiscal year	Patents
1981	49	1985	33
1982	31	1986	37
1983	30	1987	52
1984	43	1988	62

Source: U.S. Department of Commerce, Patent and
Trademark Office, Commissioner of Patents and
Trademarks Annual Report, Fiscal Year '88, p. 57.

Table 492.-- COMPUTER USE BY OAHU RESIDENTS EMPLOYED OUTSIDE
THEIR HOMES: 1988 AND 1989

[Percent. As of March]

Subject	1988	1989
Use of personal computer at place of work	100	100
Always	22	27
Frequently	14	13
Occasionally	15	16
Never	50	44
Facsimile machine (FAX) at place of work	100	100
Yes	41	52
No	46	44
Don't know	13	5
Own a personal computer for use at home	100	100
Yes	25	33
No	75	67

Source: Omnitrak/Hawaii Inc. Polls (400 telephone interviews each)
reported in Honolulu Star-Bulletin, May 23, 1989 (p. C-1), May 30, 1989
(p. D-1), and June 6, 1989 (p. D-1).