
Section 7

ENERGY & SCIENCE

The increase in Maui County's population has been reflected in the utilities. Consumption and use of electricity, gas, utilities, and water have all increased dramatically over the last decade. Statistics on electricity, gas, water production and consumption are covered. Almost 24% of the electric power used on the island is generated by the sugar companies.

Ongoing scientific endeavors include observation of astronomical and man-made space objects from the summit of Mt. Haleakala.

7.1.1

**ELECTRIC COMPANY RESIDENTIAL CUSTOMERS,
MAUI COUNTY BY DISTRICTS**

	1990	1991	1992	1993	1994	1995
State Total	326,038	328,899	332,863	340,932	346,977	NA
Maui County¹	39,924	41,222	42,812	43,543	44,725	47,820
Hana	580	592	597	602	600	603
Makawao	7,192	7,948	8,780	8,856	8,920	9,405
Wailuku	21,654	21,875	22,127	22,415	23,025	25,182
Lahaina	7,297	7,617	7,918	8,203	8,640	9,010
Lanai	1,004	972	1,107	1,167	1,120	1,140
Molokai	2,197	2,218	2,283	2,300	2,420	2,480

¹ Kalawao County included with Maui County.

SOURCE: Compiled by the Hawaii State Department of Business, Economic Development & Tourism from the Hawaiian Electric Co., Inc., Hawaii Electric Light Co., Inc., Maui Electric Co., Ltd., and Molokai Electric Co., Ltd., with additional data for 1994 and 1995 from Maui Electric Co., Inc.

7.1.2

**ELECTRIC UTILITIES,
MAUI COUNTY**

	1993	1994	1995	1996	1997
CUSTOMERS, DEC. 31					
<i>Total</i>					
Maui Island	47,035	48,388	49,194	49,590	50,385
Molokai	2,766	2,798	2,812	2,816	2,858
Lanai	1,263	1,297	1,333	1,345	1,362
Maui County	51,064	52,483	53,339	53,751	54,605
<i>Residential¹</i>					
Maui Island	40,163	41,292	42,004	42,578	43,159
Molokai	2,270	2,302	2,308	2,319	2,339
Lanai	1,110	1,131	1,162	1,179	1,181
Maui County	43,543	44,725	45,474	46,076	46,679
<i>Other</i>					
Maui Island	6,872	7,096	7,190	7,012	7,226
Molokai	496	496	504	497	519
Lanai	153	166	171	166	181
Maui County	7,521	7,758	7,865	7,675	7,926
GENERATING AND FIRM PURCHASED CAPABILITY, DEC. 31 (MW)					
Maui Island	217.3	217.3	217.3	207.5	207.5
Molokai	8.7	8.7	8.7	9.8	12.1
Lanai	9.7	9.7	9.7	14.1	10.4
Maui County	235.7	235.7	235.7	231.4	230.0
PEAK DEMAND (MW)²					
Maui Island	156.7	163.2	170.7	174.8	174.7
Molokai	6.1	6.4	7.0	6.8	6.6
Lanai	4.5	4.7	4.8	5.0	5.0
POWER SOLD (1,000 kWh)					
<i>Total</i>					
Maui Island	861,002	901,235	937,143	963,625	969,170
Molokai	30,842	33,064	33,920	34,341	33,549
Lanai	23,879	25,818	26,053	26,365	26,050
Maui County	915,723	960,117	997,116	1,024,331	1,028,768
<i>Residential</i>					
Maui Island	286,013	302,085	313,521	327,562	328,582
Molokai	12,199	12,557	12,774	12,951	12,676
Lanai	5,916	5,963	6,147	6,346	6,442
Maui County	304,128	320,605	332,443	346,859	347,700
<i>Other</i>					
Maui Island	574,990	599,151	623,621	636,063	640,587
Molokai	18,643	20,506	21,145	21,390	20,873
Lanai	17,963	19,856	19,906	20,019	19,608
Maui County	611,596	639,513	664,673	677,472	681,068

7.1.2

CONTINUED

	1993	1994	1995	1996	1997
AVERAGE ANNUAL USE (kWh)³					
<i>Residential</i>					
Maui Island	7,121	7,316	7,464	7,693	7,613
Molokai	5,374	5,455	5,535	5,585	5,419
Lanai	5,330	5,272	5,290	5,383	5,455
Maui County	6,985	7,168	7,311	7,528	7,449
<i>Other</i>					
Maui Island	83,671	84,435	86,735	90,711	88,650
Molokai	37,587	41,343	41,955	43,038	40,218
Lanai	117,405	119,611	116,410	120,596	108,332
Maui County	81,318	82,433	84,510	88,270	85,928
AVERAGE RATE (dollars per kWh)					
<i>Residential</i>					
Maui Island	0.12752	0.12985	0.13426	0.14763	0.15549
Molokai	0.17719	0.16465	0.17570	0.19072	0.19844
Lanai	0.16802	0.16618	0.17463	0.18709	0.19033
Maui County	0.13031	0.13189	0.13660	0.14996	0.15770
<i>Other</i>					
Maui Island	0.11715	0.11861	0.12008	0.13319	0.13885
Molokai	0.17768	0.16375	0.17461	0.18496	0.19348
Lanai	0.15087	0.15609	0.16538	0.18715	0.19428
Maui County	0.11999	0.12122	0.12318	0.13642	0.14212
REVENUES (\$1,000)					
<i>Total</i>					
Maui Island	103,839	110,289	116,982	133,074	140,035
Molokai	5,474	5,426	5,937	6,426	6,554
Lanai	3,704	4,090	4,366	4,934	5,036
Maui County	113,017	119,805	127,284	144,434	151,624
<i>Residential</i>					
Maui Island	36,476	39,226	42,095	48,359	51,092
Molokai	2,162	2,068	2,244	2,470	2,515
Lanai	994	991	1,073	1,187	1,226
Maui County	39,632	42,284	45,412	52,016	54,834
<i>Other</i>					
Maui Island	67,363	71,063	74,887	84,715	88,943
Molokai	3,312	3,358	3,692	3,956	4,039
Lanai	2,710	3,099	3,292	3,747	3,810
Maui County	73,385	77,520	81,872	92,418	96,791

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 Peak demand is the maximum amount of energy required from the electrical system. The islands' electrical systems are not interconnected, so no peaks are reported for Maui County as a whole.

³ Based on number of customers at end of year.

SOURCE: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records; capacity and peak demand: Hawaiian Electric Industries, Inc., Securities and Exchange Commission 10-K filings, 1993-1997.

7.1.3

**ENERGY GENERATED, PURCHASED, SOLD
AND USED BY SUGAR PLANTATIONS,
MAUI COUNTY**

Electricity (million kWh)	Generated¹	Purchased	Sold	Used²
1984	249.39	9.76	61.43	197.72
1985	249.06	9.92	94.96	164.02
19.86	272.99	7.40	124.76	155.62
1987	253.00	5.92	105.17	155.62
1988	254.00	5.09	97.56	155.62
1989	247.00	24.56	99.72	172.19
1990	223.68	0.20	96.21	127.68
1991	259.00	2.00	104.68	156.14
1992	253.93	3.87	106.13	151.68
1993	250.32	6.07	104.03	152.36
1994	244.01	7.33	104.72	146.62
1995	274.07	11.70	102.19	183.59
1996	255.52	8.50	87.10	176.92

Gross Heat Values of Boiler Fuels (billions of BTUs)	All Fuels	Bagasse	Fuel Oil	Other Fuels
1984	8,080	6,409	1,530	141
1985	7,477	6,127	1,277	72
1986	8,318	6,460	1,785	73
1987	8,100	6,384	1,495	222
1988	7,925	6,325	1,523	26
1989	7,366	5,448	1,629	289
1990	NA	NA	NA	NA
1991	7,293	4,774	2,294	225
1992	6,344	4,562	1,604	178
1993	7,268	5,007	2,049	212
1994	5,834	4,726	1,108	-
1995	7,134	4,689	2,445	-
1996	6,606	4,440	2,166	-

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.

NA Not available.

SOURCE: Hawaiian Sugar Planters' Association, *Energy Inventory of Hawaii Sugar Plantations 1984-1995* (Energy Reports 24-35, annual); Hawaii Agricultural Research Center, *Energy Inventory of Hawaii Sugar Plantations 1996* (Energy Report 36, annual).

7.1.4

GAS UTILITIES, MAUI COUNTY

Excludes bottled gas

	1993	1994	1995	1996	1997
Island of Maui					
Customers (December 31)					
Residential ¹	325	328	326	327	325
Other	69	69	68	66	67
Total	394	397	394	393	392
Gas Sold (1,000 therms)					
Residential	67	71	67	68	70
Other	715	736	667	658	649
Total	782	806	734	726	720
Average Annual Use (therms)					
Residential	206	216	205	208	217
Other	10,360	10,659	9,812	9,973	9,691
Average Rate (\$ per therm)²					
Residential	1.47629	1.46822	1.52513	1.92138	2.22903
Other	1.11795	1.13238	1.16273	1.18864	1.25364
Revenues (\$1,000)					
Residential	99	104	102	131	157
Other	799	833	776	782	814
Total	898	937	878	913	971
Island of Molokai					
Customers (December 31)					
Total/Residential	27	56	52	110	91
Gas Sold (1,000 therms)					
Total/Residential	5	10	10	17	20
Average Annual Use (therms)					
Total/Residential	174	181	189	155	221
Average Rate (\$ per therm)²					
Total/Residential	2.26418	2.21664	2.28182	2.28816	2.42358
Revenues (\$1,000)					
Total/Residential	11	22	22	39	49

¹ Residential refers to single-metered residential customers which may include condominiums for visitor use, but excludes residential master-metered apartment and condominium buildings 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.

7.1.5

**HAWAII STATE ENERGY DATA REPORT,
CONSUMPTION OF ENERGY
BY END-USE SECTOR**

In trillion BTU

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	25.9r ²	34.3	80.8r ²	156.7	86.1
1991	24.2r	28.2	74.8r	151.4	79.2
1992	24.0r	32.8	72.7	142.9	74.6
1993	20.7r	22.7	71.3	126.8	66.2
1994	20.4r	25.4	75.2	135.5	64.7
1995	20.8	24.4	73.7	135.8	66.5

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.

² There is a discontinuity in this time series between 1989 and 1990 due to the expanded coverage of non-electric utility use of renewable energy beginning in 1990.

r: Revised.

SOURCE: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1995, Consumption Estimates* (November 1997), pp. 96-100.

7.1.6

WATER SERVICES AND CONSUMPTION, MAUI COUNTY

Years ending June 30

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NUMBER OF SERVICES											
State Total	205,442	209,475	213,194	216,001	219,596	222,569	226,998	229,989	230,952	233,043	NA
Maui County	23,735	24,279	24,931	25,408	26,522	27,021	27,460	27,918	28,306	28,720	29,333
Maui	22,372	22,886	23,513	23,957	25,042	25,531	25,960	26,409	26,795	27,205	27,809
Molokai	1,363	1,393	1,418	1,451	1,480	1,490	1,500	1,509	1,511	1,515	1,524
CONSUMPTION (million gallons)											
State Total	68,543	70,088	72,642	74,118	73,338	73,732	74,990	75,389	71,810	73,301	NA
Maui County	8,814	9,158	10,158	10,399	10,311	11,177	11,494	11,477	11,485	11,729	12,547
Maui	8,510	8,849	9,838	10,071	9,990	10,822	11,150	11,138	11,110	11,399	12,199
Molokai	304	309	320	328	321	355	344	339	330	369	348

SOURCES: 1998-1999: Maui Department of Water Supply, *Annual Report*. 1989-1997: Data compiled by Hawaii State Department of Business and Economic Development from Honolulu Board of Water Supply, Hawaii County Department of Water Supply, Kauai Department of Water, and Maui Department of Water Supply.

7.2.1

TELESCOPES AT THE SUMMITS OF MAUNA KEA AND HALEAKALA

Location and Facility	Mirror Size (meters)	Year Completed	Primary Use	Local Staff ¹
Mauna Kea				
UH 24-inch Telescope	0.6	1968	Optical	
UH 88-inch Telescope	2.2	1970	Optical/infrared	8
NASA Infrared Telescope Facility	3.0	1979	Infrared	12
Canada-France-Hawaii Telescope	3.6	1979	Optical/infrared	50
United Kingdom Infrared Telescope	3.8	1979	Infrared	31
W. M. Keck Observatory (Keck I)	10	1992	Optical/infrared	
W. M. Keck Observatory (Keck II)	10	1996	Optical/infrared	85 (total)
Subaru	8	1999	Optical/infrared	30
Gemini Northern 8-meter Telescope	8	1999	Optical/infrared	30
Caltech Submillimeter Observatory	10.4	1986	mm/submm	10
James Clerk Maxwell Telescope	15	1986	mm/submm	43
Submillimeter Array	8 antennae @ 6 m	1999	submillimeter	26
Very Long Baseline Array	25	1992	centimeter	2
Haleakala (on University of Hawaii land)				
Mees Solar Observatory		1956	Measure solar emissions	2
Lunar Ranging Facility		1976/84	Laser ranging	7
Maui Space Surveillance Site				120
Tracking Telescope (compensated)	1.6	1968	Image near earth objects	
Dual Tracking Telescope	1.2	1968	Track satellites	
Coudé Beam Director	0.8	1987	Project laser beams	
Beam Director	0.6	1975	Project laser beams	
Advanced Electro-Optical System (AEOS)	3.7	1999	Track satellites	55
GEODSS			Track deep space objects	
Primary	1	1982		
Secondary	1	1982		
Auxiliary	0.4	1982		

¹ Based in same county as observatory.

SOURCE: University of Hawaii at Manoa, Institute for Astronomy, 1998 Fact Sheet.