

ENERGY SELF-SUFFICIENCY FOR THE
COUNTY OF KAUAI

VOLUME 1: ENERGY DATA

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INTRODUCTION

This initial report provides important information necessary in the development of a comprehensive energy self-sufficiency plan for Kauai County. The document is restricted to a number of comparative analyses, an extensive representation of the present energy situation, and projected future trends in the County.

This study is Phase I of the over-all program being conducted by the Kauai County Energy Self-Sufficiency Committee (KESCO). Composed of members from the local community, KESCO is examining the technical, economic, environmental, sociological, and political factors associated with the present and future energy situation on Kauai. KESCO is preparing the County's comprehensive energy self-sufficiency plan which will serve as a guide for the County in its development of appropriate indigenous energy resources and its implementations of an energy conservation program.

GENERAL INFORMATION

Kauai County includes the islands of Kauai and Niihau, and the tiny uninhabited islands of Kaula and Lehua. Kauai is the third largest island in the State, but least populous of the four counties, with a total resident population of about 33,800, representing about 4 percent of the State's total. Niihau is a privately owned island under Kauai County government jurisdiction. Table 1 presents the physical characteristics of the two major islands. The depths and distances between the major islands of Kauai County and Oahu are shown in Table 2.

Geologically, Kauai is the oldest of the major islands of the State. The preservation and enhancement of its cultural heritage is of especial import since Kauai may have been the State's first inhabited island. Figure 1 locates many of the important, better known, or accessible archaeological sites. The ancient district (mokuaina) boundaries are shown as they probably were around A. D. 1778. The land ownership has drastically changed since ancient times. The current land ownership is presented in Table 3. Private landowners hold 61.9 percent of the total land area, while the State owns 33.2 percent, followed by Hawaiian Homes Land with 4.3 percent and Federal Government, 0.6 percent.

Table 1. Area and Coastline of Kauai County

Island	Total Area		Inland Water		General Coastline	
	miles ²	km ²	miles ²	km ²	miles	km
Kauai	553.2	1433.1	15.0	38.9	90.0	144.8
Niihau	73.0	189.1	4.6	11.9	45.0	72.4

1 Square Mile = 640 acres

1 Square Kilometer = 100 hectares (ha)

1 hectarces = 2.47 acres

Source: [1]

Table 2. Maximum Depth and Minimum Distance Between the Islands of Kauai County and Oahu

	Oahu	Kauai	Niihau	
Oahu		73.3		D i s t a n c e (miles)
Kauai	10,890		17.6	
Niihau		4,200		
Depth (feet)				

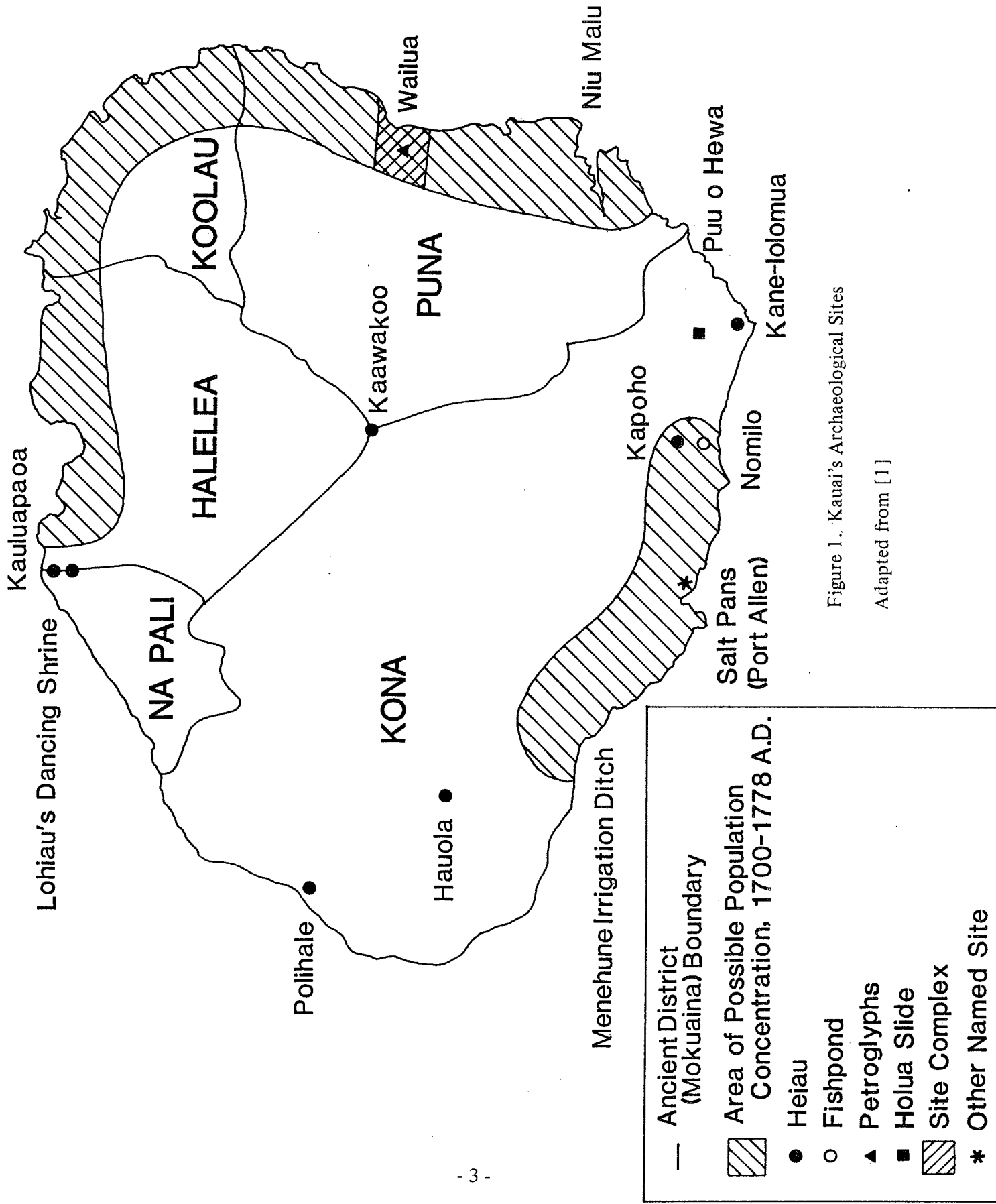


Figure 1. Kauai's Archaeological Sites

Adapted from [1]

Table 3. Land Ownership on Kauai County, 1972

Landowner	Area		Percentage
	miles ²	km ²	
State Owned	292.1	757.3	33.2
Gay and Robinson (includes Niihau)	223.7	579.4	25.4
Amfac, Inc.	65.4	169.4	7.4
Grove Farm Co. Ltd.	49.2	127.4	5.6
Alexander and Baldwin, Inc.	46.5	120.4	5.3
Hawaiian Homes Land	37.7	97.6	4.3
Bishop Estate	25.4	65.8	2.8
Knudsen Trust	12.6	32.6	1.3
W. H. Rice, Ltd.	6.6	17.1	0.8
Federal Government	4.9	12.7	0.6
C. Brewer and Co., Ltd.	3.3	8.6	0.4
Others	113.2	293.2	12.9
TOTAL	880.9	2281.5	100.0

1 Square Mile = 640 acres

Source [2]

Kauai has an almost ideal climate with an average coastal temperature of 71 degrees fahrenheit from February to March and 79 degrees fahrenheit in August and September. Rainfall varies widely depending on the location. The summit of Mount Waialeale is the wettest spot in the United States with a recorded rainfall of 486 inches per year, while only 20 miles away on the southern coast, an average rainfall of 20 inches per year is normal. Figure 2 shows the median annual rainfall isohyets (lines of equal rainfall) for Kauai.

Sugar is the major agricultural product on Kauai. Its principal by-products are bagasse and molasses, which annually accounts for approximately 299,000 dry tons and 65,300 tons, respectively. Cattle is raised both on Kauai and Niihau. The cultivation of wetland taro continues in Hanalei, Wailua, Hanapepe, and Waimea Valley. The possibilities in aquaculture are receiving much attention, while interest in papayas, bananas, and guavas has grown in recent years.

The sugar industry directly accounts for 1,300 of the 14,800 total County employment. The 1977 average annual unemployment rate on Kauai was 7.1 percent.

Tourism has grown rapidly in recent years. A decade ago Kauai had 1,115 hotel rooms and 275,461 westbound visitors. In 1977, these figures were 3,657 and 740,501, respectively. Figure 3 displays Kauai's growth in resident population and hotel rooms.

The State administers and collects taxes under a centralized system. There are no personal property taxes or special local levies. In 1969, under new charters, Kauai County changed to a Mayor - seven-member County Council form of government, thereby streamlining local government.

Kauai Electric Company distributes the electricity for domestic and industrial uses. The Kauai sugar mills also generate electricity from sugarcane residuals (bagasse) for in-house use and sales to Kauai Electric Company. Isle Gas Division of Gasco, Inc. handles the cylinder and bulk gas distribution.

Local airlines provide Kauai with flights each day to and from Honolulu and other island airports. Deep water ports at Nawiliwili and Port Allen furnish overseas freight service as well as inter-island barge service.

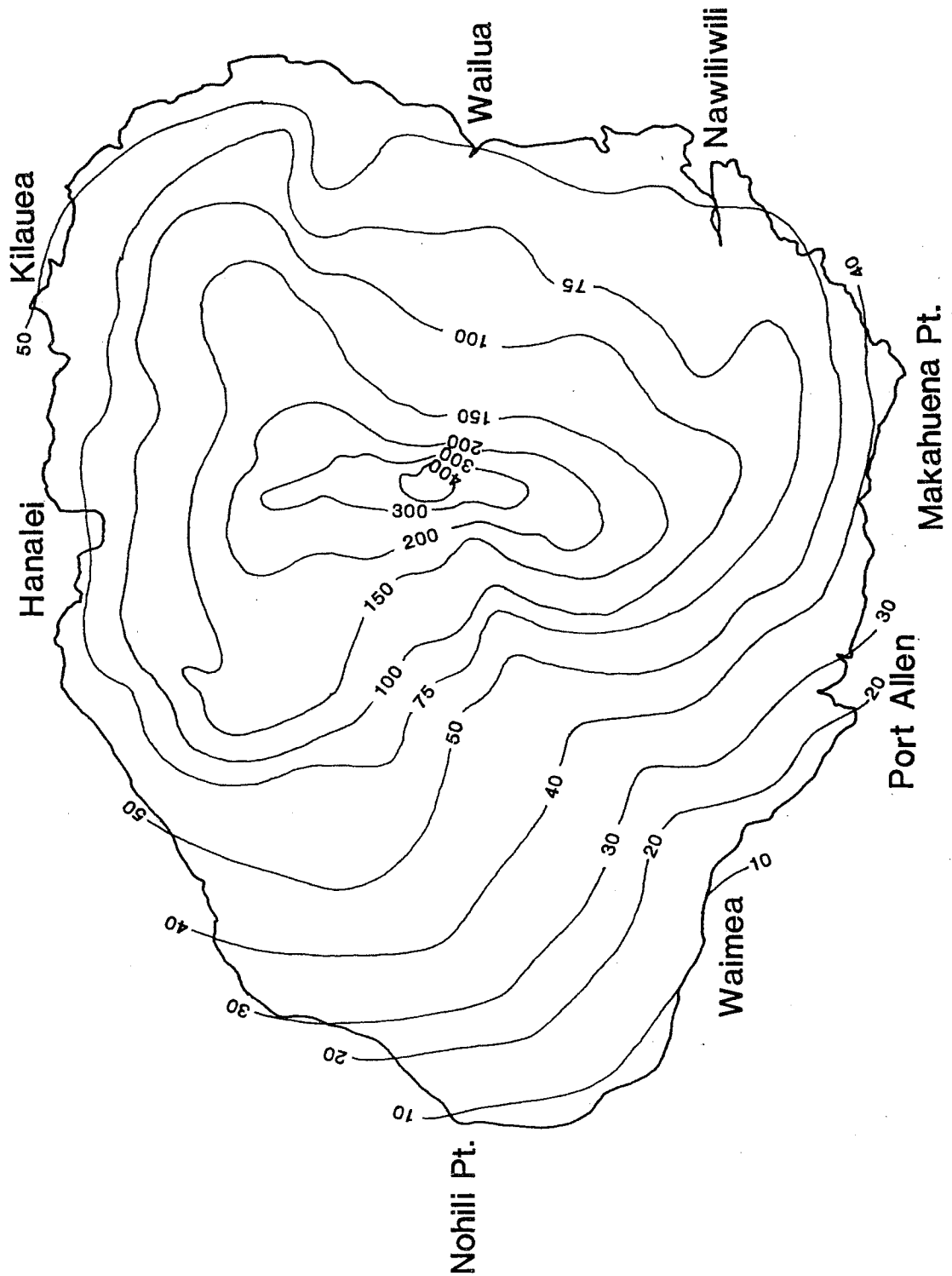


Figure 2. Median Annual Rainfall Isohyets for Kauai

Adapted from [1]

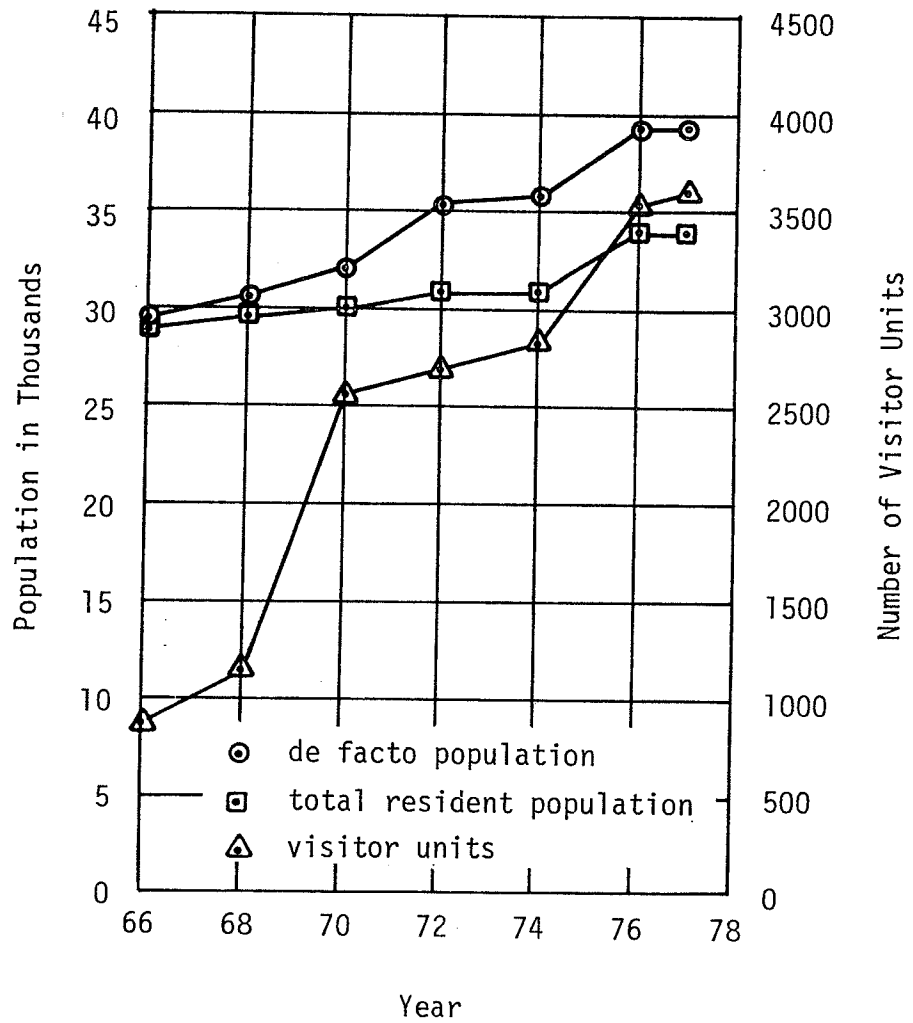


Figure 3. Kauai's Resident Population and Hotel Room Growth

Adapted from [3].

PRESENT ENERGY SITUATION

The present energy picture for the island of Kauai is analyzed in this section. Aviation fuel which will be included in the data analysis amounts to less than 2 percent of the total petroleum imported in the County. A technical glossary and standard conversion tables are provided in Appendix A. The data to be presented will form the basis from which an implementation plan will be designed.

The State and Counties of Hawaii receive their petroleum products from a number of worldwide origins. Table 4 lists these sources along with the amount and cost of petroleum imported. While this table only shows a snapshot of the situation in 1977, the present picture is different and is undergoing rapid changes daily. For instance, more Alaskan crude is coming into the State than usual -- this may increase or decrease depending on a multitude of factors beyond our control.

The Counties in the State generally follow a similar pattern: dependency on petroleum products, electrical generating facilities burning bagasse, and hydroelectric power. The differences lie in the amount of energy contributed by bagasse burning and hydroelectric power. As reported in the Maui County energy self-sufficiency report [6], less than 30 percent of the Maui sources of energy is generated from natural energy resources. For Kauai, this figure exceeds 49 percent. Table 5 presents the sources of energy for the County. The British Thermal Unit (BTU) values used represent gross or input values. In other words, the bagasse figure typifies the heat content before it reaches the boiler, while hydroelectric power has been converted to an input state by dividing by an estimated efficiency of 60 percent. In this manner, all the sources of energy are kept in an equivalent form for evaluation. However, one must remember that these values are gross heat or input values and as in any energy generating system there are losses due to inefficiencies. Table 6 lists the efficiencies of various energy convertors.

Also too, it should be noted that the 50% self-sufficiency figure for Kauai represents a downward trend. The energy derived from the natural alternatives has kept relatively constant throughout recent history, while petroleum consumption has been increasing. Unless major steps are taken immediately, Kauai will become more and more dependent on imported fuel.

Table 4. State Petroleum Imports, 1977 *

Source	Million Gallons	Million Dollars	% Gallons
Indonesia	864	260	47.0
Brunei	335	97	18.2
Oman	144	42	7.8
Saudi Arabia	109	31	5.8
Singapore	96	36	5.2
Nigeria	75	23	4.1
Bahamas	58	20	3.2
Malaysia	31	8	1.7
United Arab Emirates	31	7	1.7
Bahrain	21	9	1.2
Others **	76	26	4.1
TOTAL	1,840	559	100.0

* Insignificant share from Mainland United States.

** Includes: Liberia, Bermuda, Venezuela, Australia, Trust Territory of the Pacific Islands, Panama, Trinidad, Tobago, Taiwan, Gambia, Japan, Papua New Guinea, Iran, Yemen, Phillipines, Burundi, Ecuador, and Finland.

Source: [5]

Table 5. County of Kauai: Sources of Energy, 1977*

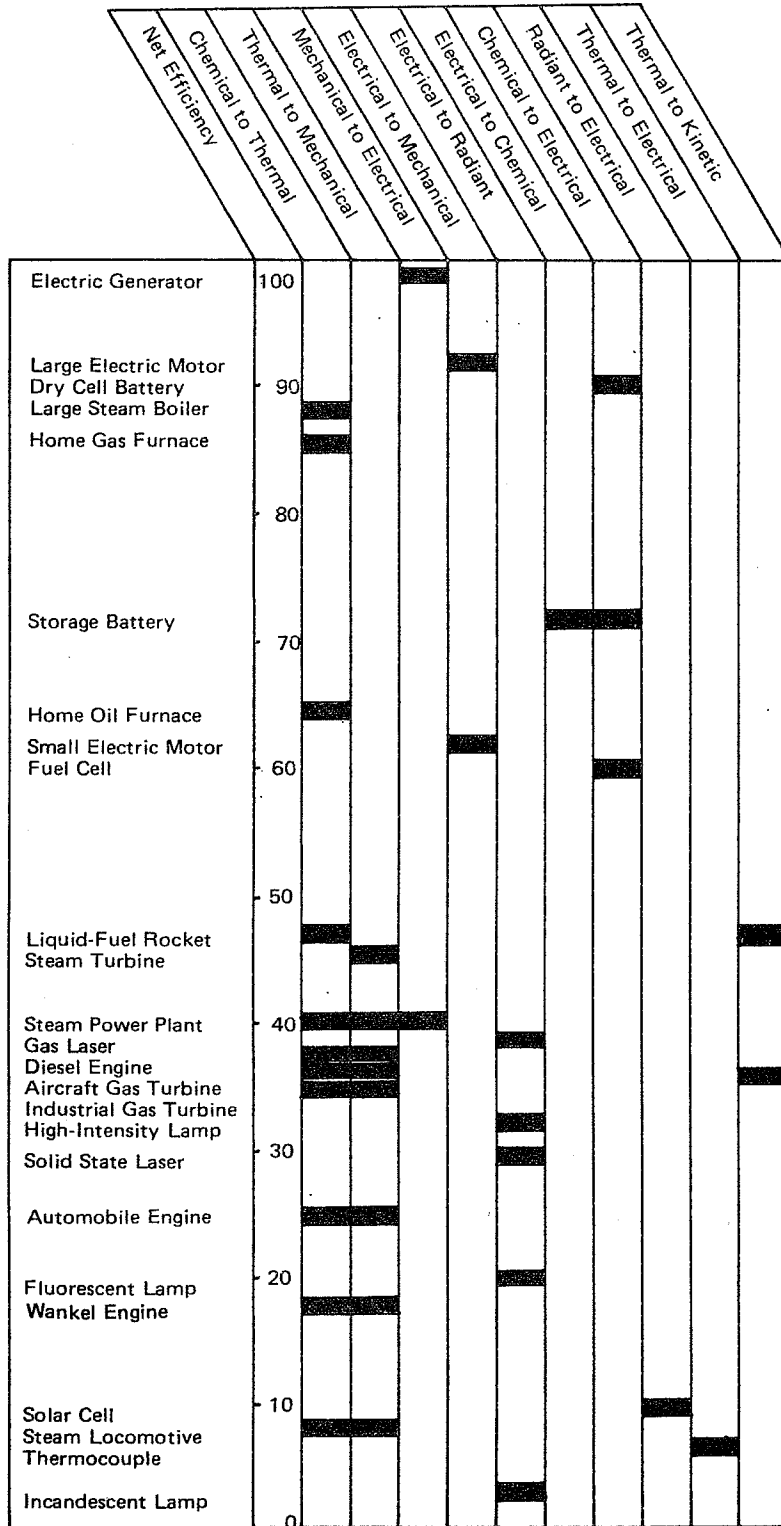
Sources	BTU $\times 10^9$	Percentage	Equivalent** Barrels
Petroleum	4,961	47.7	49,610
Biomass (Bagasse)	5,170	49.7	51,700
Hydro	267	2.6	2,670
TOTAL	10,398	100.0	103,980

* Includes aviation fuel.

** 100 Million BTU = 18 barrels petroleum.

Source: [7,8,9,10,11,12,13,14,15,16]

Table 6. Efficiencies of Various Energy Convertors



Source [17]

Kauai is the second largest bagasse producing county in the State trailing the Big Island and followed by Maui and Oahu, respectively. Each sugar mill uses petroleum as a supplement when the quantity of bagasse is low or the moisture content too high. The interesting point is that of the four counties, Kauai sugar mills consumed the least amount of boiler fuel oil [16].

Gasoline, diesel oil, and boiler fuel are the major petroleum products consumed on the island. Table 7 presents the County petroleum expenditure by fuel type, while Table 8 shows the usage by economic sector. The residential sector includes single and some multi-unit housing, while the industrial/commercial sector covers, power generation from Kauai Electric and the Sugar Companies, hotels, the remainder of multi-unit housing, retail trade, food outlets, and other services. Transportation consists of land, air, and water travel. The two main consumers are the industrial/commercial and transportation sectors. Electrical generation and ground transportation dominate each respective group.

A flow diagram of energy consumption is shown in Figure 4. The large consumption in the industrial and transportation sectors are again reflected. The high figures representing bagasse burning is somewhat misleading because most of the energy produced in the sugar mills is used in the factory as either steam or electricity, or within the plantation to run the irrigation pumps. However, a significant amount of the electricity produced is sold to the local utility company. The sugar companies also buy power on occasion from Kauai Electric when the mill's electrical demand cannot be met.

A typical daily Kauai Electric load profile is shown in Figure 5, while Figure 6 displays the typical daily load profiles obtained from limited surveys for three individual sectors: large load (100-kw or greater), commercial (100-kw or less), and residential (single family dwelling). Table 9 reflects the electrical consumption by user category. Residential and commercial-large power are the chief consumers, with 36.4 percent and 25.3 percent, respectively. The end use of residential electricity is shown in Figure 7. These percentages are based on a Hawaiian family of four. The major consumers are electric water heaters, frost-free refrigerators, and electric ranges, using approximately 40 percent, 20 percent, and 10 percent, respectively.

Table 7. Direct Petroleum Consumption by Fuel Type, 1977

Fuel Type	Gallon	BTU × 10 ⁹	BTU %
Gasoline	14,359,041	1,795	36.2
Gasoline (small planes)	119,994	15	0.3
Gasoline (small boats)	657	<0.1	<0.1
Subtotal	14,479,692	1,810	36.5
Diesel Oil (highway)	642,527	89	1.8
Diesel Oil (non-highway)	1,981,713	275	5.5
Diesel Oil (electrical generation)	8,778,006	1,218	24.6
Diesel Oil (small boats)	15,943	2	<0.1
Diesel Oil (military) *	432,020	60	1.2
Subtotal	11,850,209	1,644	33.1
Heating Oil	328,600	38	0.8
LPG (highway)	40,811	4	0.1
LPG (non-highway)	2,573,524	246	5.0
Subtotal	2,614,335	250	5.1
Aviation Fuel **	439,169	59	1.2
Boiler Fuel	7,751,730	1,160	23.3
TOTAL	37,463,735	4,961	100.0

*Military use includes highway, non-highway, and on-site electrical generation. (Bendix Corporation-NASA, 307,610 gal.; National Guard, 720 gal.; Barking Sands, 118,000 gal.; 202nd Air Traffic Control Flight Administration, 2,895 gal.; and 150th Aircraft Control and Warning Squadron, 2,795 gal.)

** Excludes fuel delivered from Pearl Harbor to Barking Sands.

Source: [7,8,9,10,11,13,14,15]

Table 8. Direct Petroleum Consumption by Economic Sector, 1977

Sector	Gallon	BTU × 10 ⁹	BTU Percentage
Residential (LPG)			
LPG	1,185,862	113	2.3
Industrial and Commercial			
Electrical Generation			
Diesel	8,778,006	1,218	24.6
Boiler Fuel	7,751,730	1,160	23.3
Non-highway			
Diesel	1,981,713	275	5.5
LPG	1,387,662	133	2.7
Heating Oil	328,600	38	0.8
Military			
Diesel	432,020	60	1.2
Subtotal	20,659,731	2,884	58.1
Transportation			
Ground			
Gasoline	14,359,041	1,795	36.2
Diesel	642,527	89	1.8
LPG	40,811	4	0.1
Air			
Gasoline	119,994	15	0.3
Aviation Fuel	439,169	59	1.2
Water			
Gasoline	657	<0.1	<0.1
Diesel	15,943	2	<0.1
Subtotal	15,618,142	1,964	39.6
TOTAL	37,463,735	4,961	100.0

Source: [7, 8, 9, 10, 11, 13, 14, 15]

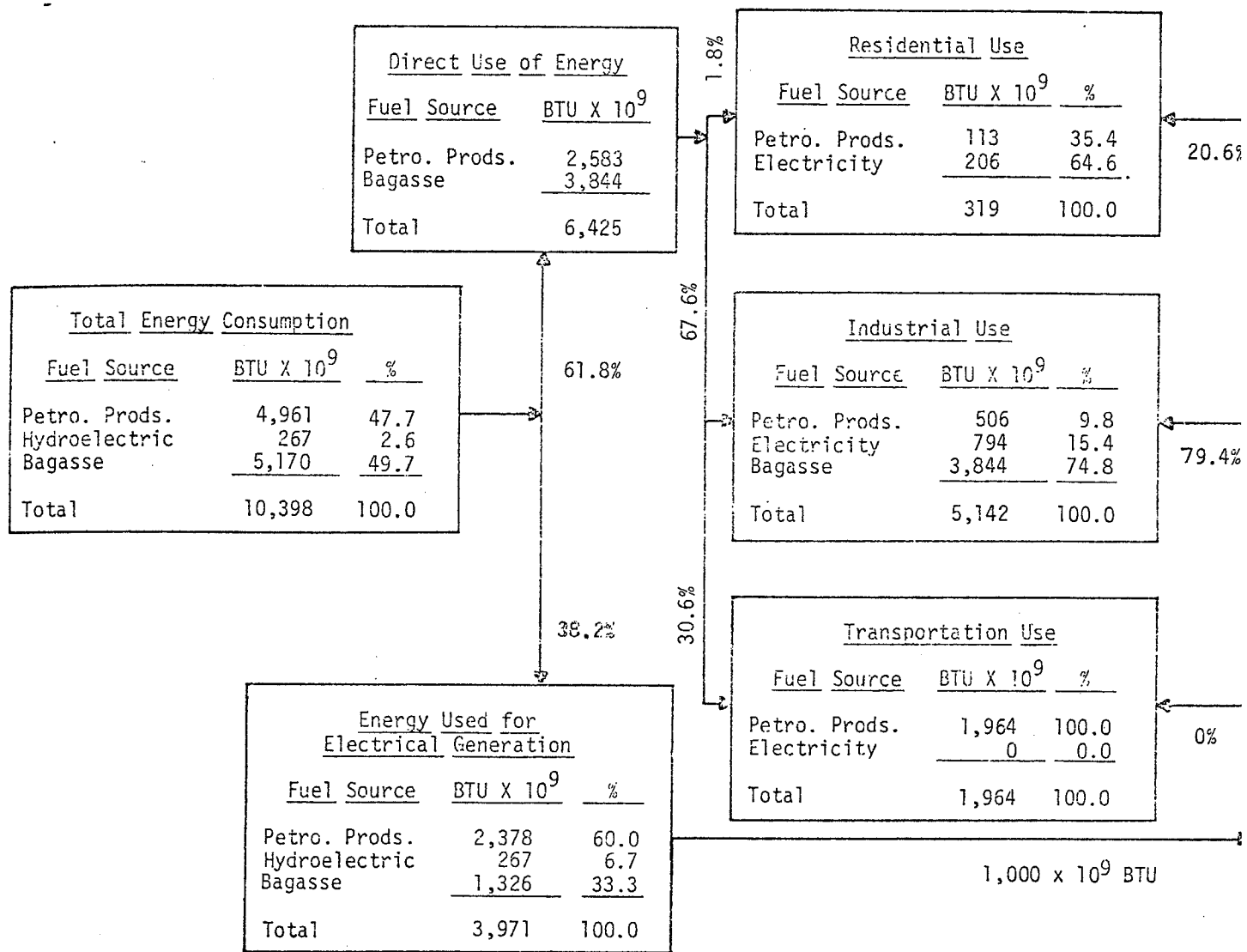


Figure 4. Kauai Flow Diagram of Energy Consumption, 1977*

Source: [7, 8, 9, 10, 11, 13, 14, 15, 16]

*includes aviation fuel
 bagasse efficiency ~ 20%
 hydroelectric efficiency ~ 60%

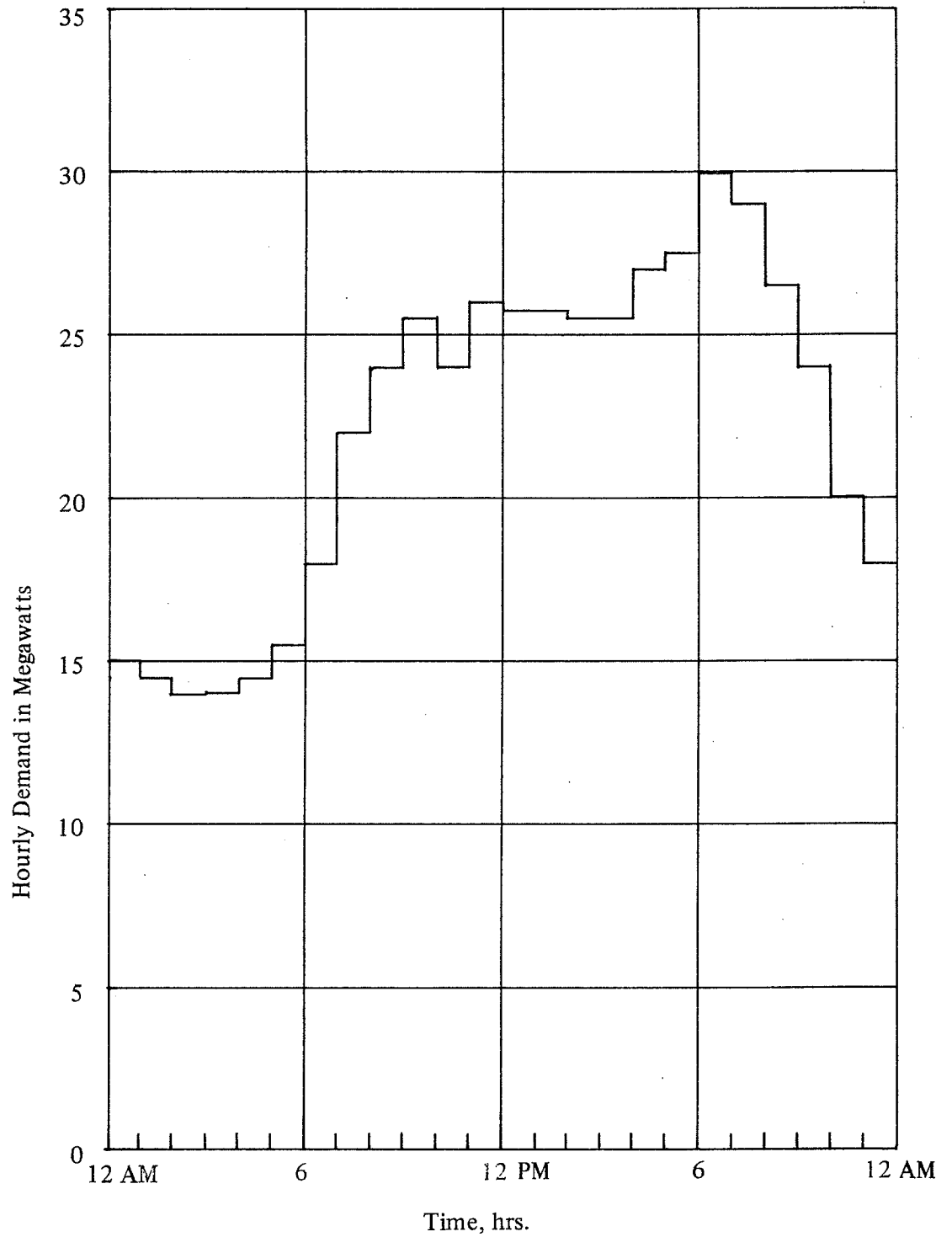


Figure 5. Typical Daily System Load Profile for Kauai Electric

Source: [7]

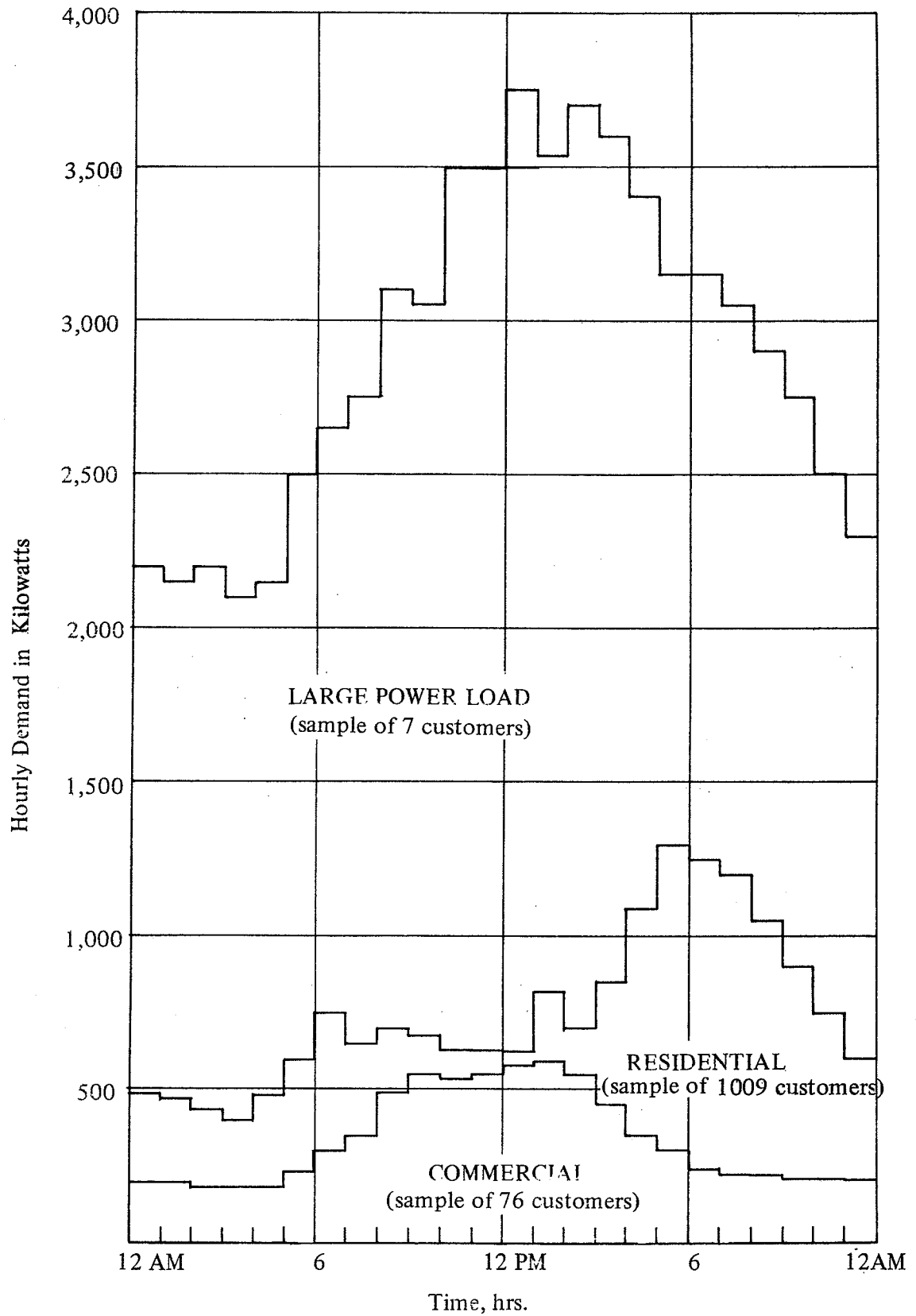


Figure 6. Typical Daily Large Power, Residential, and Commercial Load Profiles for Kauai Electric
Adapted from [7].

Table 9. Percentage of Electrical Energy
by Category of User on Kauai, 1976

User Category	%
Residential	36.4
Hotel	15.1
Military	5.7
Institutions*	4.5
Communications (Bureau of Standards)	4.3
Retail	3.1
Irrigation (and other agricultural included in 1976)	2.9
Street Lighting	1.5
Manufacturing	0.8
Food Processing	0.4
Commercial and Large Power**	25.3
TOTAL	100.0

*Institutional consumers include small schools, etc.

**Commercial consumers include offices, buildings, small restaurants, motels, theaters, etc.
Large power consumers include barges, hotels, hospitals, large super markets, etc.

Source: [7]

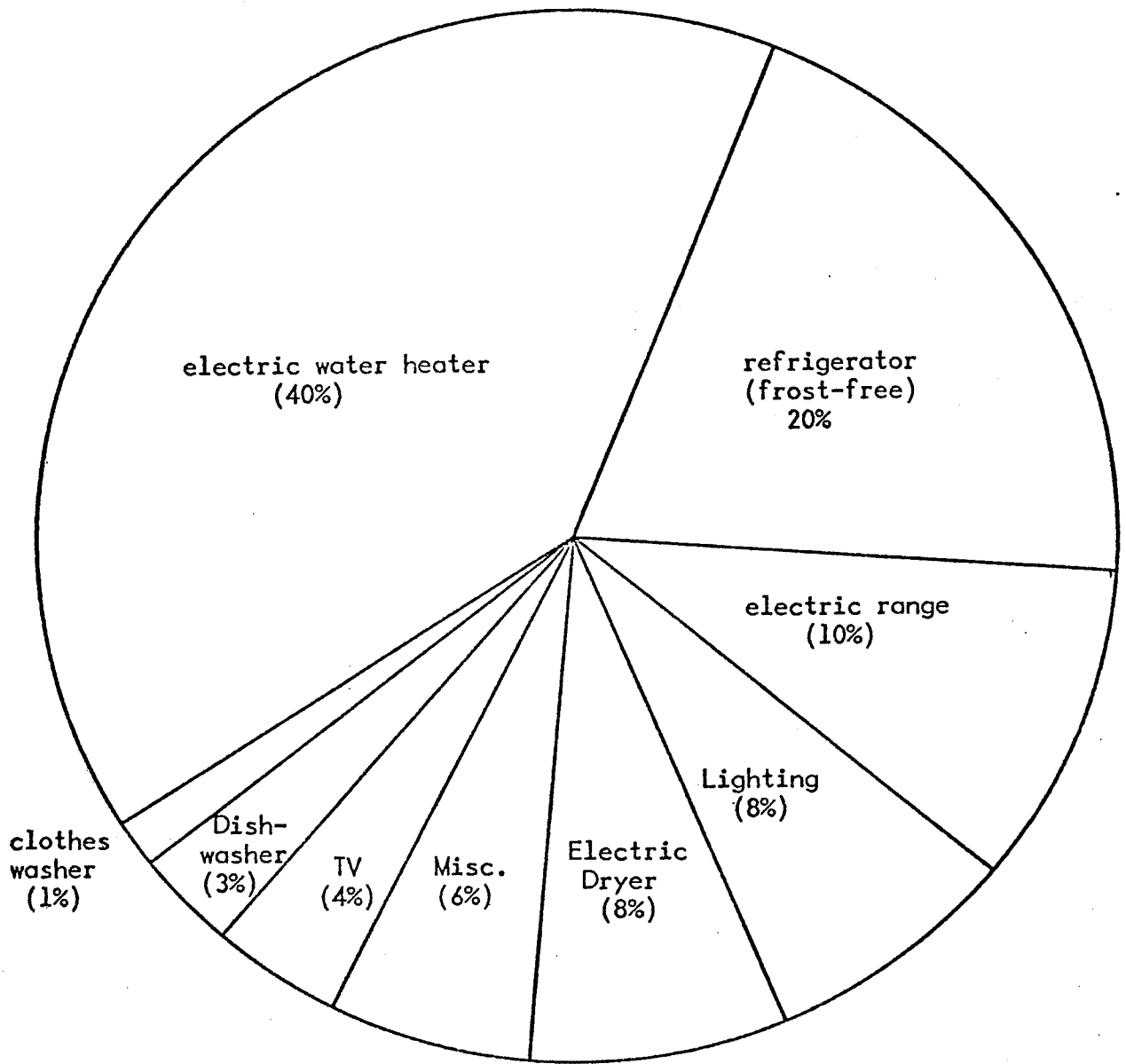


Figure 7. End Use of Residential Electricity in Hawaii, 1976

Adapted from [4]

The present status of all the electric generating units on the island show Kauai Electric Company having fairly new units — most of which should be in service for another 19 to 29 years if a thirty-year projected life is assumed. The sugar companies have predictably older units, with the exception of Olokele Sugar Mill. Most sugar units are well past their expected service life, yet are still in operation. Table 10 presents this information along with their generating capacities. Although there are a large number of operable units, closer examination reveals several units to have lower rated generating capacities. This is due to a number of reasons: small boiler capacity, water limitation, penstock limitation, and abandoned units. Figure 8 displays the location of the generating units and transmission lines on the island.

The growth patterns of energy data and related factors are presented in Table 11. The population of Kauai is expected to grow according to the State's forecast at an annual rate of 2.55 percent [19]. The County's energy growth rate is calculated to be 6.15 percent. This value is obtained by adding the difference of the State's predicted energy growth (5.00 percent) and population forecast (1.40 percent) to the County's population projections (2.55 percent).

Figure 9 displays the growth trend of various petroleum products and bagasse in the County. Gasoline, diesel oil, liquid petroleum gas (LPG), and aviation fuel indicate positive growth, while boiler fuel and bagasse for the most part have both shown a negative trend for the time period examined. Kauai Electric Company and the sugar mills are the prime consumers of boiler fuel in the County. This declining pattern may be attributed to the effective use of Kauai Electric's diesel and gas turbine units and the sugar mill's bagasse burning practices. Figure 10 reflects the Kauai petroleum consumption and forecast, and the cost predictions for the State. Figure 11 shows the growth of electrical consumption by rate classification, while Figure 12 shows the past and projected total electrical demand using an estimated growth rate of 7 percent.

The energy picture presented illustrates Kauai's rapid growth. Petroleum consumption is likely to increase even as the price of oil soars. The following section presents an alternative route through indigenous energy resources.

Table 10. Present Status of Electrical Generating Units for Kauai's Electric and Sugar Companies

Owner	Rated Capacity [kw]	Actual Capacity [kw]	Year Installed	Years Left in 30 Year Projected Life	Comments
Kauai Electric Company					
Steam	10,000	10,000	1968	19	
Co-generation	8,500	8,500	1980	32	
Diesel: No.1	2,000	2,000	1964	15	
No.2	2,000	2,000	1964	15	
No.3	2,750	2,750	1968	19	
No.4	2,750	2,750	1968	19	
No.5	2,750	2,750	1968	19	
Gas Turbine: No. 1	17,650	17,650	1973	24	
No. 2	22,180	22,180	1977	28	
Subtotal	70,580	70,580			
McBryde Sugar (Old Grove Farm)					
Steam: No. 1	7,750	7,750 ¹	1965	16	¹ can run only one at a time due to boiler capacity.
No. 2	7,750	0	1965	16	
Hydro: Kalaheo	1,000	800 ²	1928	—	² due to water limitation.
Wainiha No. 1	1,800	1,600	1928	—	
Wainiha No. 2	1,800	1,600	1928	—	
Malumalu	260	0 ³	1919	—	³ abandoned site
Subtotal	20,360	11,750			
McBryde Sugar (Old Location)					
Steam	2,500	0 ⁴	1952	3	⁴ not in use
Subtotal	2,500	0			

Table 10. Present Status of Electrical Generating Units for Kauai's
Electric and Sugar Companies (con't)

Owner	Rated Capacity [kw]	Actual Capacity [kw]	Year Installed	Years Left in 30 Year Projected Life	Comments
Kekaha Sugar					
Steam: No. 1	1,000	1,000	1930	—	
No. 2	2,500	2,500	1950	1	
No. 3	2,500	2,500	1929	—	
Hydro: Lower Waiawa	500	350 ⁵	1907	—	⁵ due to penstock limitation.
Mauka	1,000	750 ⁶	1954	5	⁶ due to water limitation.
Subtotal	7,500	7,100			
Lihue Plantation					
Steam: No. 1	2,000	1,750 ⁷	1949	—	⁷ due to age
No. 2	4,000	4,000	1957	8	
No. 3	4,000	4,000	1957	8	
Hydro: No. 1	800	800	1941	—	
No. 2	500	500	1930	—	
Subtotal	11,300	11,050			
Olokele Sugar					
Steam: No. 1	2,000	2,000	1965	16	
No. 2	750	0 ⁸	1941	—	⁸ can't run together because of boiler capacity - used as stand-by.
Diesel: No. 1	450	450 ⁹	1970	21	⁹ used for start-up and shutdown.
No. 2	450	450 ⁹	1970	21	
Hydro: Nonopahu	500	500	1930	—	
Subtotal	4,150	3,400			
TOTAL	109,640	103,880			

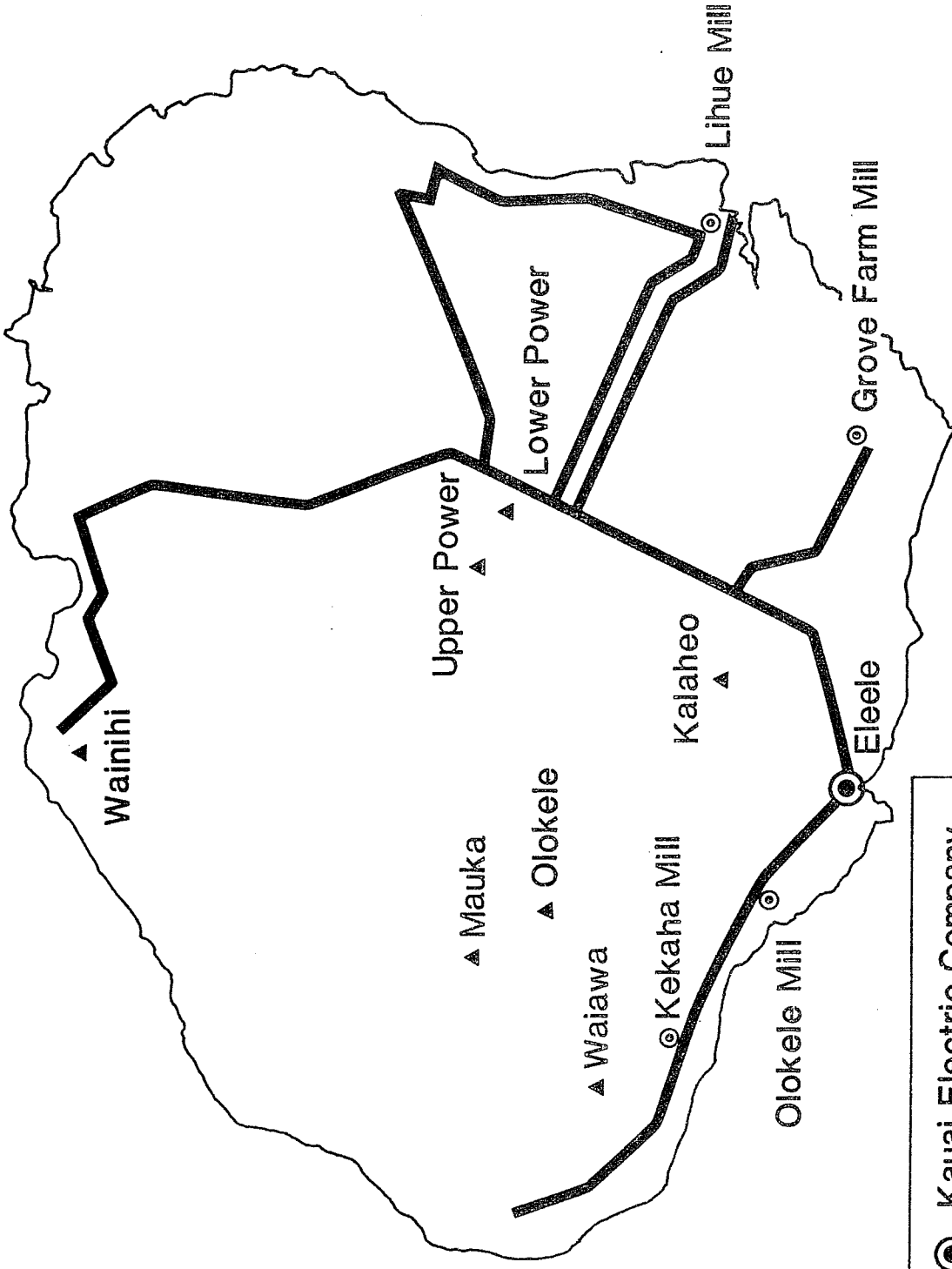


Figure 8. Location of Electrical Generating Units and Transmission Lines on Kauai
 Adapted from [1,7,8,9,10,11,12,18]

Table 11. Kauai County: Overview of Energy Data and Related Factors

	1970	1975	1977
Population			
Residential	30,000	32,700	33,800
de facto	32,500	37,400	39,600
Visitors (westbound)	426,030	632,821	740,017
Registered Vehicles	17,899	23,524	26,515
Liquid Fuel Tax: Gallon (BTU $\times 10^9$)			
Gasoline	10,398,239(1300)	12,684,385(1586)	14,479,692(1810)
Diesel	5,571,629 (773)	10,646,415(1477)	11,418,189(1584)
Aviation	289,531 (39)	386,346 (52)	439,169 (59)
LPG	38,242 (4)	77,571 (7)	75,618 (7)
Electricity Sold (KWH $\times 10^6$)	102.69	148.53	167.04
Gas Sold (therms $\times 10^3$)	1,373	2,203	2,421

Source: [7, 13, 15, 19, 20, 21, 22]

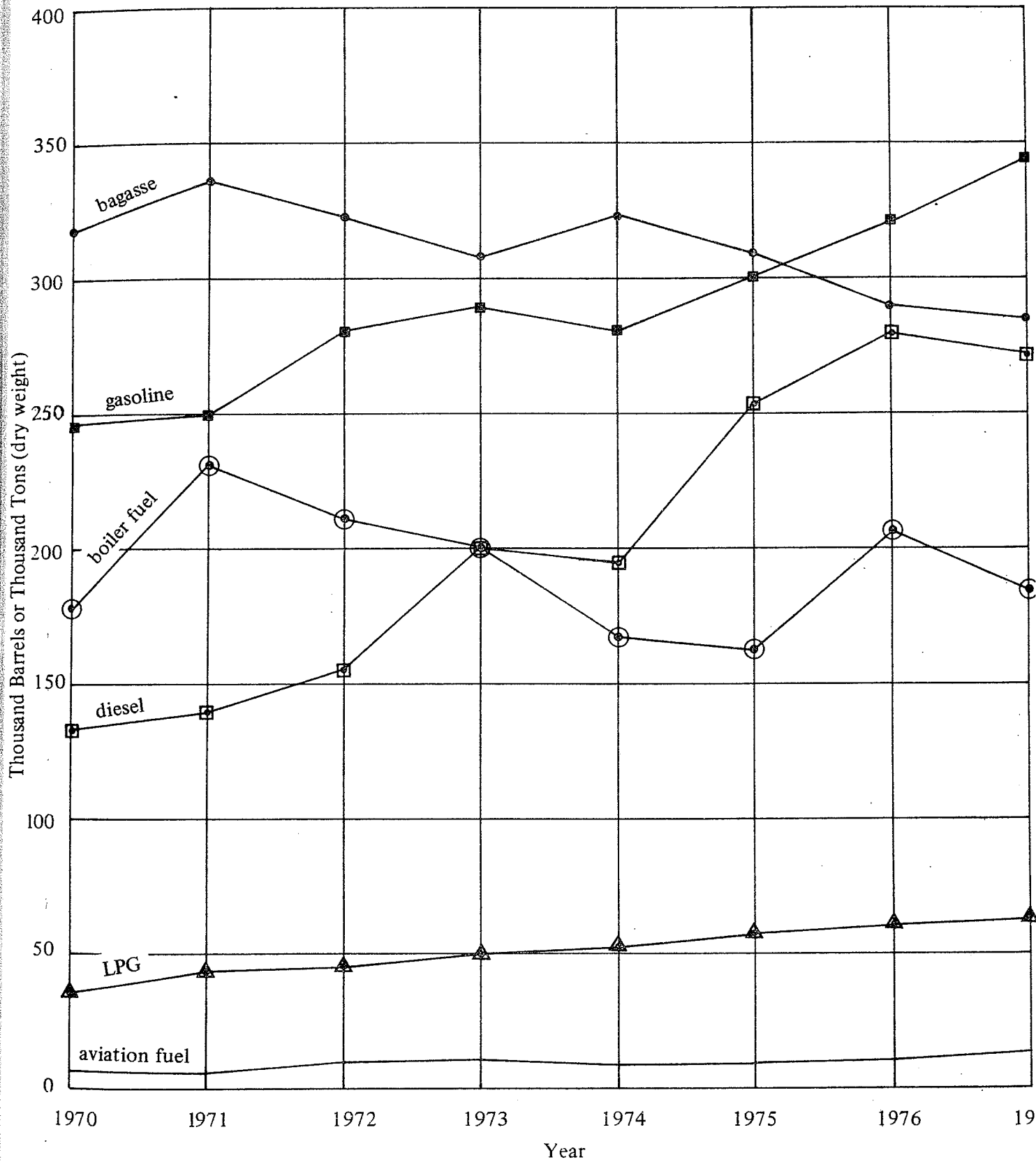


Figure 9. Growth Trends for Petroleum Products and Bagasse
Adapted from [7,8,9,10,11,13,14,15,23]

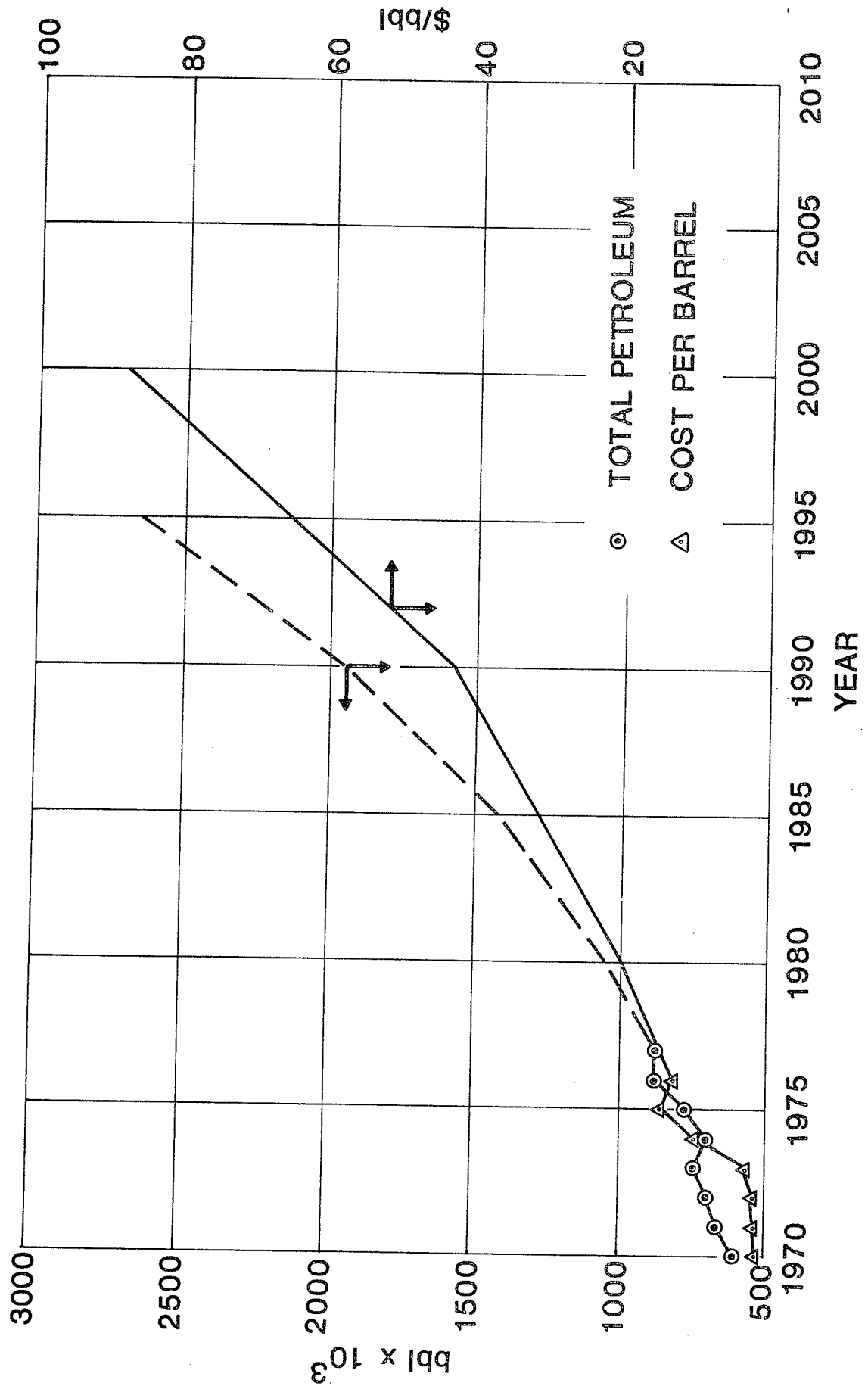


Figure 10. Kauai - Petroleum Consumption, Forecast, and Cost Projections
 Adapted from [4,7,8,9,10,11,12,13,14,15,16,24]

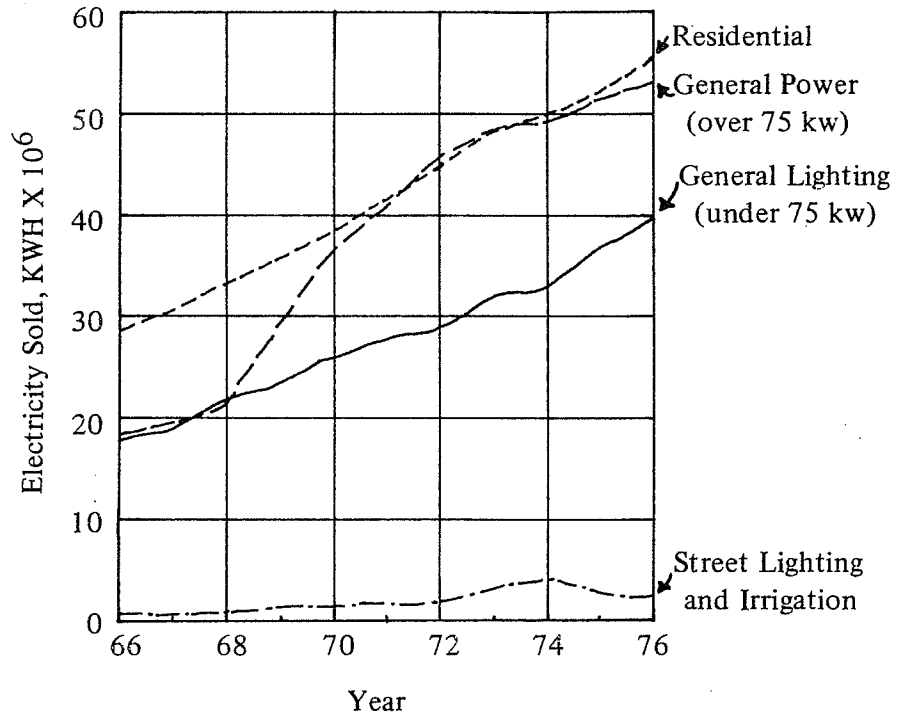


Figure 11. Kauai Electric Growth in Energy Sales by Rate Classification

Adapted from [3]

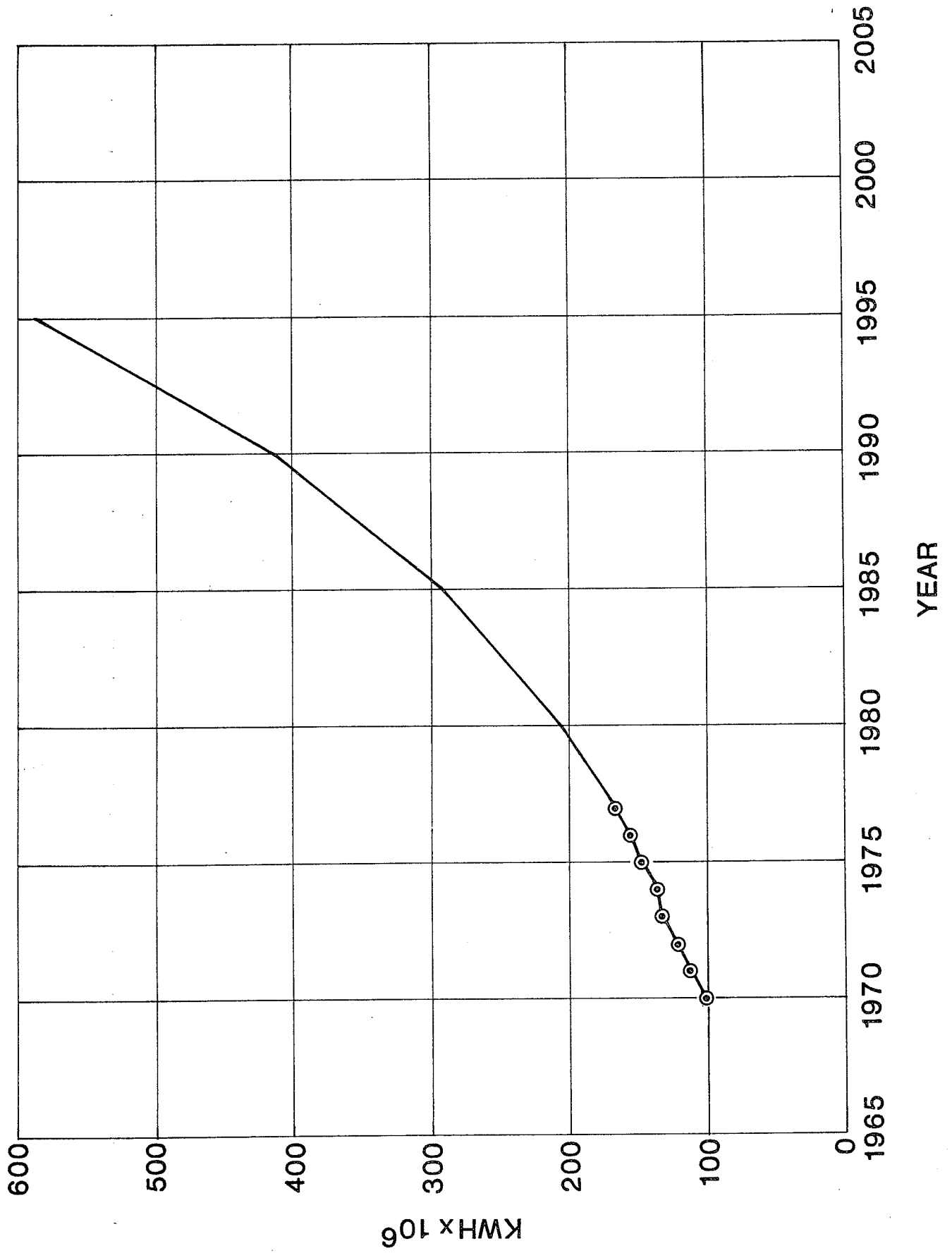


Figure 12. Electrical Consumption and Forecast for Kauai

POTENTIAL NATURAL ENERGY RESOURCES

Kauai County, like the other counties in the State, has a large reservoir of undeveloped natural energy resources. These areas are shown in Figure 13. Recent reviews of past geophysical data by the Hawaii Institute of Geophysics at the University of Hawaii have surprisingly uncovered warm water locations in the Mana and Wailua regions. This finding has been received with some amazement because Kauai is geologically regarded as being in the advanced stage of its volcanic life, therefore supposedly devoid of any residual subsurface heat [25].

Wind speed locales averaging 15 miles per hour or greater are shaded in Figure 13. The University of Hawaii's Meteorology Department conducted the wind speed surveys. Kilauea Point in the north and the strip along the southeast coast between Makuhena Point and Kawelikoia Point possess the necessary conditions for wind energy conversion systems (WECS). Fixed wind speed monitoring stations occupy the Kilauea Point, Lihue Airport, Makuhena Point, and Kapeku Cinder Pit regions. Data secured from these areas will help refine or modify the preliminary findings [26].

The Meteorology Department is also conducting insolation surveys. The solar information collected on Kauai along with the sugar industry's recorded values identify potential solar areas. The regions with an annual average insolation value of 400 g-cal/cm²/day or better include the coastal plains of: lower Waimea to lower Koloa, Lihue to Kapaa, Kapaa to northern Anahola, and Princeville [27].

Thus far most of the OTEC work has been directed towards the Keahole Point area on the Big Island of Hawaii. The essential factor for a nearshore OTEC facility is a zone with a minimum temperature difference of 38 degrees fahrenheit at sufficient depth (maximum of 1500 feet) near the coastline (assumed maximum of 3 miles). Presuming the required temperature conditions exist for all Hawaiian waters exposed to sunlight, then nearly three-fourths of the Kauai coastline exhibit OTEC potential [28]. Wave action potentials are shown in Figure 13. The areas are based on a five foot wave height average [29].

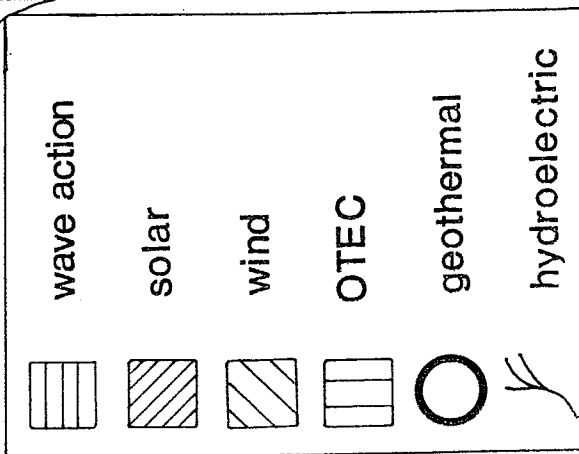
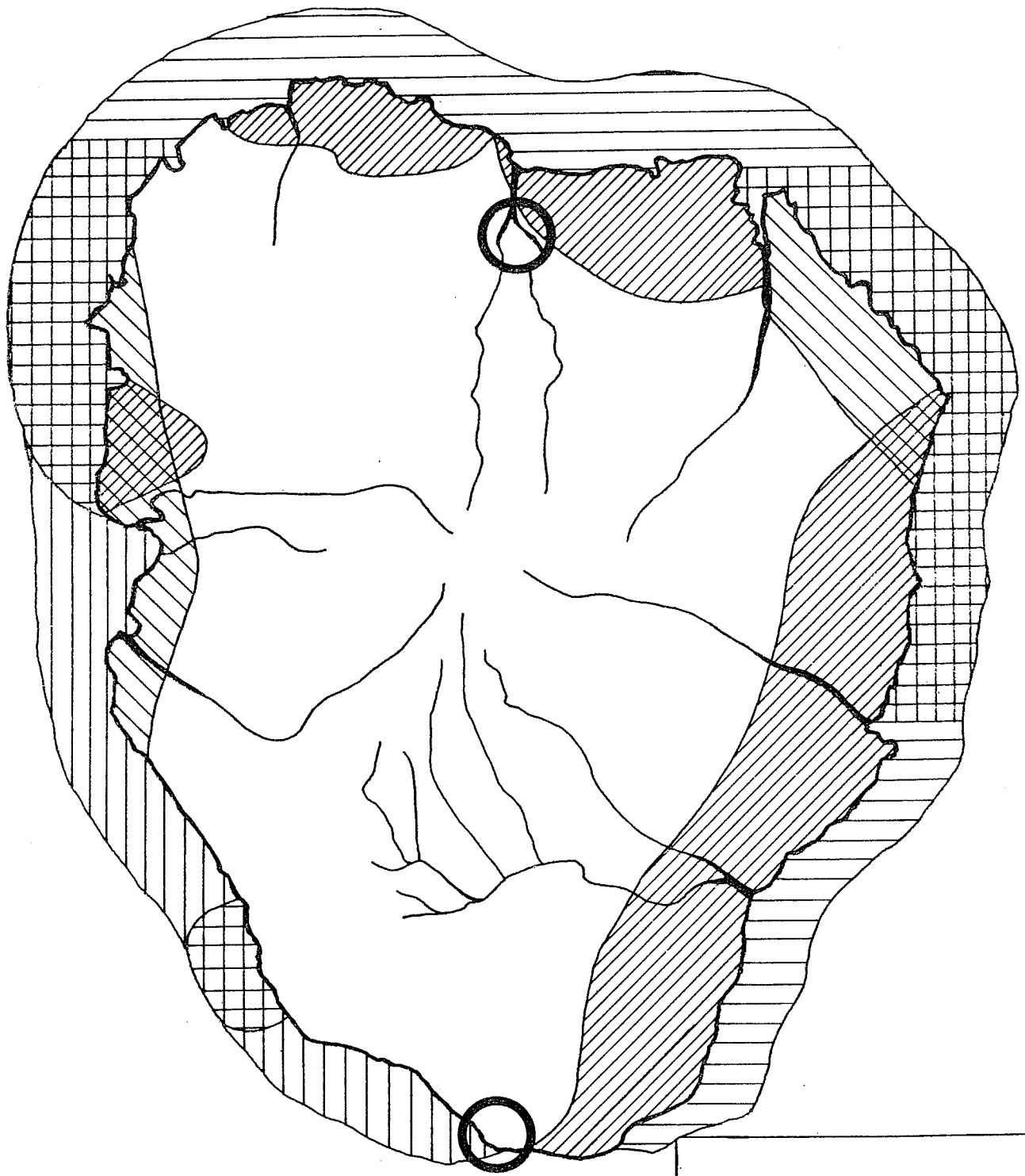


Figure 13. Kauai's Potential Natural Energy Resources

Adapted from [18, 25, 26, 27, 28, 29, 30]

The U. S. Army Corps of Engineers study indicated that Kauai possesses promising hydroelectric potential [30]. The rivers suggested for further analysis include: Hanalei, Kawaikoi (Kokee), Hanapepe, and South Fork Wailua.

Kauai has the necessary basic ingredients for a successful biomass operation - sunlight, water, and land. Figure 14 delineates the various biomass crops presently on Kauai. Sugar-cane dominates the low-lying areas near the coastline and the plateaus of the Waimea terrain. Shrub, ohia, and a few potential tree plantations span the wet mountainous zones.

CONCLUSION

Kauai County is heavily dependent on petroleum products, with electrical generation and ground transportation being the chief consumers of petroleum. Indigenous energy resources, however, account for more than 50 percent of all energy consumed in the County, bringing Kauai closer than any of the other Counties to the goal of energy self-sufficiency. With carefully planned, appropriate, and expeditious development of available natural energy resources, and with an effective energy conservation program, the goal of energy self-sufficiency should be well within the reach of Kauai County.

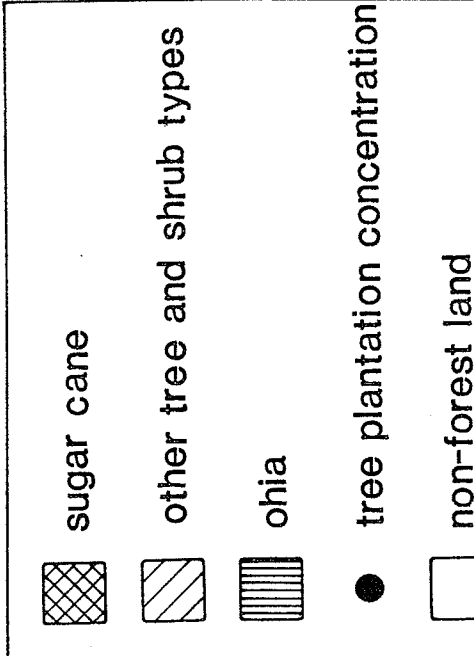
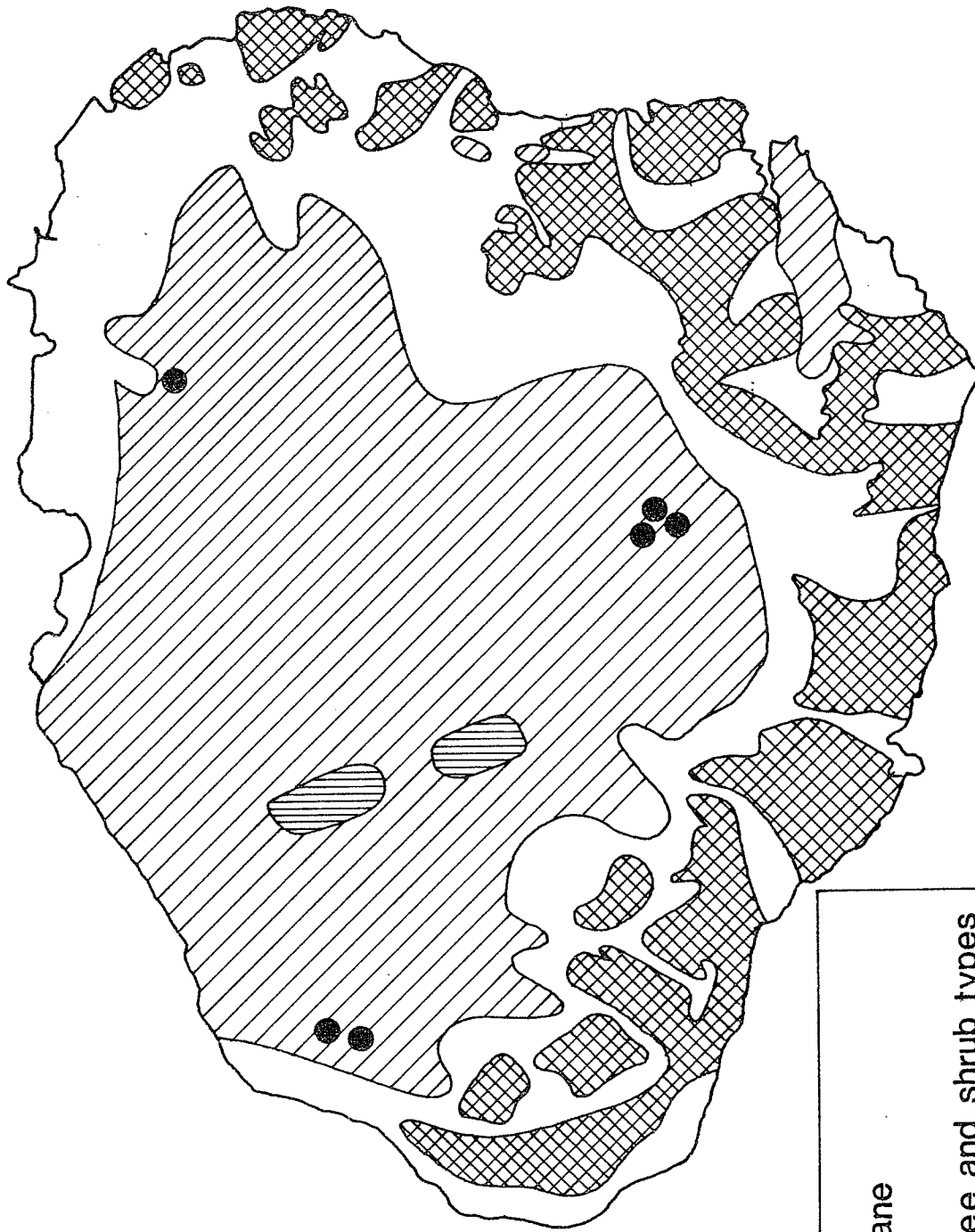


Figure 14. Kauai's Biomass Potential

Adapted from [1]

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APPENDIX A

Glossary and Standard Conversion Tables

GLOSSARY

Bagasse	The material that is left after the juice of the sugar cane has been extracted. Used by plantations for fuel (1 ton of bagasse is approximately equivalent to 1 bbl. of oil in heat produced).
British Thermal Unit (BTU)	The quantity of heat necessary to raise the temperature of 1 pound of water one degree Fahrenheit.
Barrel, (bbl)	Unit of bulk petroleum measure = 42 U. S. gallons.
Bunker C or Fuel Oil No. 6	Heavy, thick, dark grade of residual oil used as boiler fuel in power plants or in large commercial ships. Usually requires heating before use.
Crude Oil	Liquid hydro-carbon found in the earth and used as raw material for processing into refined petroleum products.
Diesel Fuel	Light thin oil used for diesel engines and most gas turbines. Also called No. 2 Fuel Oil or just Fuel Oil.
Diesel Oil	More refined distillate for use in internal combustion engines.
Distillates	Midrange of products from crude oil refining. Used in various forms for heating oil, and as engine fuels in trucks, boats, rail locomotives, power generating turbines, etc.
Gasoline:	
Motor (MoGas)	Liquid hydro-carbon fuel used in internal combustion engines, trucks and autos.
Aviation (AvGas)	Liquid hydro-carbon fuel used to power aircraft (usually reciprocating engine type).

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Generating Capability

The largest number of MW or kw that generator plant or system can produce. It is total "capability" of the machinery.

Installed Capacity

The nameplate rating (MW or kw) on power generators. This is the manufacturers rated capacity for the equipment. However, this may be several different values at different conditions. Usually a conservative figure.

Jet Fuels (Turbine Engines)

JP-1/RP-1 Kerosene Type

Normally used in commercial aircraft.

JP-5 Kerosene Type

Used in U. S. Navy aircraft. Meets specifications for safer storage and use on Navy aircraft carriers.

JP-4 Naptha or Gasoline Type

Normally used in U. S. Air Force aircraft.

Kerosene

A petroleum product used as household fuel and in the manufacturing of JP-5 and RP-1 aircraft turbine fuels.

Kilowatt, (kw)

A unit of electrical measurement equal to 1000 watts.

Kilowatt hour, (kwhr)

A unit of electrical energy equal to that done by 1-kw over a period of 1 hour.

Low Sulfur Fuel

A fuel oil that has a low sulfur content, normally less than 0.5 percent.

LPG, Propane, Butane

Heavier than air gas fuel processed from oil and coal and changed to a liquid state by compression.

Megawatt, (MW)

A unit of measurement equal to 1000 kilowatts.

Megawatt hour, (MWhr)

Equal to 100 kwhr.

Naptha	A petroleum product used in manufacture of gaso- lines, JP-4, SNG, and various solvents.
Peak Load (actual)	The estimated peak load on the entire system for one year. Measured in MW over a 15-minute or 1-hour period.
Peak Load (system)	The estimated peak load on the entire system for one year. It is not an actual peak.
Petroleum Products:	
Natural Gas or NG	A lighter than air hydro-carbon gas occuring in the earth in a natural state, used extensively in residen- tial, commercial, industrial and utility applications.
LNG	Natural gas in a liquid form.
SNG	Gas manufactured from petroleum products used as a substitute for natural gas.
Required Capacity	The capacity that a utility needs to enable it to meet the system's peak demand. Capacity over and above this amount becomes reserve capacity.
Reserve Capacity	The power that can be generated over and above what is necessary to meet the demand peak for the system.
Residual Oil	Heavy fuel oil used in boilers that is a product of re- finery distillation processes after the light ends are taken out. Close to Bunker C Fuel Oil in properties.

STANDARD CONVERSION FACTORS
(Energy Content Factors by Product Type and Limit)

	BTU/Gal.	BTU/ bbl.	OTHER
Gasoline Auto and Aviation	125,000	5,300,000	
Jet Fuel - Kerosene	135,000	5,670,000	
Jet Fuel - Naptha	127,000	5,355,000	
Diesel Oil and Medium Fuel Oil	138,700	5,825,000	
Heating Oil No. 2	115,000	4,830,000	
Residual Fuel Oil	149,700	6,287,000	
Liquid Propane Gas	95,500	4,011,000	
Liquified Gas (naptha, propane, refining gas)	81,238	3,412,000	
Ethanol	84,000	3,528,000	
Crude Oil	133,333	5,600,000	
Natural Gasoline	110,000	4,620,000	
BTU/kwhr			3,412 BTU
BTU/kwhr Delivered (average for State)			11,150 BTU
BTU/kwhr (hydropower)			10,389 BTU
BTU/Therm			100,000 BTU
BTU/Pound of Steam Produced			1,220 BTU
BTU Content of Bagasse (47% moisture)			4,100 BTU/lb. 8,200,000 BTU/ton
1 Ton of Bagasse (wet)			1 bbl. boiler fuel oil
BTU Content of Pineapple Plant Material (20% moisture)			12,600,000 BTU/ton
1 bbl.			42 gallons
1 HP HR (horsepower hour)			2,544 BTU

Adapted from [4].