ENERGY

3.1 INTRODUCTION AND ANALYSIS

For the foreseeable future, Hawaii will continue to be dependent on petroleum to meet its energy demands. Fortunately, Hawaii is endowed with a variety of natural energy resources that are renewable for low polluting sources of electricity. Hawaii's dependence on imported petroleum provides the incentive for the promotion of energy efficiency and the development of technologies to harness natural energy resources (solar, hydrologic, wind, and geothermal) and to convert solid waste into a fuel resource.

Petroleum provides up to 75 per cent of the Island's energy needs. All of the petroleum used in the State must be imported in one of several forms. Most of the petroleum consumed in the State is imported as crude oil, which is then processed at two local refineries, Chevron and Tesoro, both located at Barber's Point, Oahu in the Campbell Industrial Park. Both refineries receive crude oil from Indonesia, Alaska, Africa, Malaysia, and the Persian Gulf. Petroleum products, primarily jet fuel, fuel oil, and propane, are also imported from California, the Caribbean, Singapore, and other areas to meet the demand not met by the refineries. Propane, which is widely used on the Island of Hawaii, is also manufactured from petroleum on Oahu. Petroleum products are received at the Kawaihae and Hilo Harbors.

Under normal circumstances, an estimated 30-day aggregate supply of most petroleum products is stored at the oil terminals and tank farms. A major interruption of petroleum supply due to a lengthy maritime strike, a disaster at the source of crude oil supply, the sinking of a petroleum tanker or barge, or an aviation disaster at Campbell Industrial Park could seriously affect the County of Hawaii's petroleum supply. The island's economy is also vulnerable to interruptions in the supply of oil from the Middle East.

The County of Hawaii must decrease economic vulnerability and energy costs. To do so, the County must combine the efforts of energy efficiency and the development of natural renewable energy alternatives that reduce the dependence on imported fossil fuels and increase energy self-sufficiency.

Electricity

Electricity is a major form of energy utilized on the island of Hawaii. The Hawaii Electric Light Company, Inc., (HELCO) which is regulated by the State, owns and operates a number of power generation plants in the County. Most of these plants operate on steam or

combustion gases and burn imported fuel. Two plants in Hilo generate power through hydroelectric means and a South Kohala location produces wind energy. A few Independent Power Producers (IPPs) generate power using various fuels and resources, and sell energy to HELCO. The methods of power production include geothermal, hydropower, wind, coal, and oil plants. Most recently, the construction of a 60 megawatt (MW) co-generation power plant in the Hamakua district will provide a firm power source and the excess heat generated by the power plant will be used to further develop agriculture and product manufacturing in the district.

The average annual residential power used in 1990 was 6,794-kilowatt hours (kWh). In 1999, the average residential usage decreased to 6,563-kilowatt hours.

Table 3-1. Electric Utility for the County of Hawaii

Customers	Number of Customers & Percent of Total Number	Power Sold (1,000 kWh) & Percent of Total Sold	Ratio of Power Sold (1000 kWh) to Customer
Residential	52,277 = (84%)	343,085 = (37%)	6.563 to 1
General Loads	9,654 = (15%)	308,493 = (34%)	31.955 to 1
Commercial Cooking and Heating	396 = (Less than 1%)	25,964 = (3%)	65.566 to 1
Large Power Service	65 = (Less than 1%)	234,889 = (26%)	3,613.677 to 1
Street Lighting	86 = (less than 1%)	3,879 = (Less than 1%)	45.105 to 1
Total	62,478 = (100%)	916,310 (100%)	14.666 to 1

Hawaiian Electric Company, 1999
Estimate - Planning Department

Residential refers to single-metered residential customers and may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents classified as commercial customers. General Loads refer to general light and/or power loads supplied through a single meter. Commercial Cooking and Heating applies only to commercial heating (heat pump water heaters), air conditioning, and refrigeration service. Large Power service is applicable to large light and/or power service supplied and metered at a single voltage and delivery point.

The table presented on the previous page clearly indicates that of the 62,478 customers of electrical power, approximately 84 per cent are residential customers. However, of the 916,310 total kilowatt hours used, residential customers accounted for approximately 37 per cent. This yields a ratio of about 6,563 kilowatt hours per customer as opposed to Large Power Service customers that account for less than 1 per cent of the customer base but use 26 per cent of the total kilowatt hours. These customers yield a ratio of 3,613,677 kilowatt hours per customer.

Power rates on this island are among the highest in the nation. One factor that contributes to the high cost of power is the present method of power generation. Most of the electricity is obtained through the burning of imported oil. The cost of fuel, coupled with transportation costs, cause higher rates. Additionally, the size of the service area and length of transmission and distribution lines necessary to transfer the power to the load centers are significant factors. A good example is the fast growing loads in West Hawaii. The major generating plants are located in East Hawaii. This requires generating more in East Hawaii to compensate for losses in lines going over to West Hawaii. Other factors creating higher costs are the small market and the sparseness of population in a relatively large service area.

Except in a few instances, most of the power lines in the County are overhead lines. Although underground wiring has an aesthetic desirability, there are several problems in establishing such a standard. Underground power lines will probably last longer but cost more to install, especially in rocky areas. There is a problem of common sharing of trenches with other utilities. Another problem is repair and maintenance, for while broken lines will probably occur infrequently, they will be more difficult to locate. There has been, however, considerable progress in solving the technological problems concerning underground power lines.

As affluence of the population increases, the consumption of power tends to accelerate faster than population growth. Studies of sources of energy other than the burning of fuel are being conducted. On September 1, 1998, HELCO submitted its second Integrated Resource Plan (IRP) to the Public Utilities Commission with input from a public advisory group.

Electrical Energy Self-Sufficiency for the Big Island

The County of Hawaii must strive to attain energy self-sufficiency in order to minimize its dependence on imported fossil fuels. A commitment by both the government and the public must continue in research, planning, and development to attain the goal of energy self-sufficiency for the County of Hawaii.

As a result of the 1974 and 1978 oil crisis, there has been concern over Hawaii's dependence on imported petroleum. In 1974 and 1976, the State Legislature enacted several significant bills designed to promote the research and development of natural energy resources, and the conservation of energy in order to foster a greater independence from imported fossil fuels.

The State Legislature adopted Act 237 (Chapter 196, H.R.S.) in 1974, which created the position of a State Energy Resources Coordinator to review and formulate existing and proposed energy resource programs.

Also in 1974, the State Legislature established the Hawaii Natural Energy Institute (HNEI, Act 235) to foster development of local natural energy research at the University of Hawaii. The HNEI maintains cooperation and coordination between all levels of government and private organizations involved with energy related projects with potential for Federal funding, and serves as the central source of information on natural energy policies and programs.

Act 236, adopted by the State Legislature in 1974, established the Natural Energy Laboratory of Hawaii (NELH) at Keahole (North Kona, Hawaii) to provide essential support facilities for future electrical energy research programs. The legislature selected Keahole Point through the criteria for development of three of the proposed natural energy programs (OTEC, Biomass conversion, and direct solar energy utilization systems).

In 1976, the State Legislature adopted Act 189 which complemented the development half for energy self-sufficiency by the creation of tax incentives for the installation and use of "solar energy devices" and "alternate energy improvements" to promote energy conservation. These devices and improvements increase the level of efficiency, and decrease the utilization of electrical power that accounts for 42 per cent of the total energy demand in the County of Hawaii.

In January of 1980, a final report prepared for the County of Hawaii entitled "Energy Self-sufficiency for the Big Island of Hawaii" was released. The report recommended that the County government provide a favorable climate for energy savings and new energy production. It also recommended establishing an Office of Energy Coordinator. The Energy Coordinator:

- Coordinates and provides information regarding conservation and energy production;
- Organizes ride sharing and travel reduction programs;
- Assists business in obtaining information and financial support for energy-related development;
- Funds necessary information gathering programs;
- Monitors the progress of energy departments;
- Recommends changes in the county's energy program;
- Analyzes the impact of proposed developments on the energy balance of the Island.

In addition, the development of naturally occurring energy resources will become an increasingly important factor in determining future industrial activity on the Island of Hawaii.

Gas

Propane gas is widely available and is a major source of energy for the Island of Hawaii. The two primary methods used in delivering gas are via an underground pipeline or tank/cylinder refill. The Public Utilities Commission regulates the underground gas delivery system in Hilo and along Alii Drive in Kailua-Kona. Gas is delivered by tanks or cylinders for the remainder of the island.

The use of propane gas diversifies the island's energy supply and creates less pollution. Compared to electricity generation and diesel emissions, propane offers a cleaner, less polluting fuel. Alternatives like propane gas offer opportunities to lessen the island's dependence on electricity and minimize land use conflicts created by the siting of large-scale electric generation, transmission and distribution facilities.

Propane can be used for self-generation (e.g. cogeneration, micro turbines) for large customers, thereby delaying the need to site and construct large, centralized electric generation facilities.

Geothermal Energy

Geothermal Energy is natural heat energy from the earth that can be harnessed for direct thermal use and for electrical power generation. The four basic ways that this type of natural heat energy may be found are steam, hot water, magma, and hot dry rock.

Geothermal drilling on the Big Island started in the early 1960's. Initial wells were either found to be unsuccessful or once drilled, were not further developed.

In 1972, the Hawaii Geothermal Project (HGP) was organized to investigate the development of geothermal energy in Hawaii, as a cooperative project involving Federal, State, County, and private funds. In April 1976, a successful well was completed near Kapoho in the Puna District, and HGP installed a power plant to demonstrate that geothermal energy is an economically viable natural energy alternative for the Big Island. The plant commenced operations in 1982 and ceased in 1989.

In 1983 and with subsequent amendments, the Legislature amended the State Land Use Law, Chapter 205, Hawaii Revised Statutes, by authorizing the State's Board of Land and Natural Resources to conduct a county by county assessment of areas with geothermal potential for the purpose of designating geothermal resources subzones. Geothermal resource subzones may be designated within the urban, rural, agricultural and conservation land use districts. Only those areas designated as geothermal resource subzones may be utilized for the exploration, development or production of electrical energy from geothermal resources. Other amendments to the State Land Use law provide authority to regulate the direct use applications of geothermal resources.

In addition, the 1983 Legislature set criteria for designating geothermal resource subzones. Three geothermal resource subzones were established by this legislative method. The Board of Land and Natural Resources has subsequently designated the Kapoho, Kamaili, Kahaualea, and Kilauea Middle East Rift Geothermal Resource Subzones. The geothermal resource subzones are shown on the Land Use Pattern Allocation Guide (LUPAG) map.

In April 1993, Puna Geothermal Venture (PGV) completed its geothermal power plant on the Kapoho Subzone on the East Rift Zone. The geothermal power plant uses steam and steam separated from hot water or brine resources at depths of around 5,000 feet below the surface. The closed loop system injects the spent fluids into injection wells at depths of 7,000 feet to be recycled. Although PGV currently produces 30 megawatts of power to the HELCO grid, PGV has been permitted under Geothermal Resource Permit No. 2 to provide up to 60 megawatts of geothermal power. PGV has been supplying approximately 25 per cent of the electricity for the County of Hawaii. Geothermal power generation has displaced nearly 110 million gallons of fuel oil that would have been used for electricity production. The reduction in fuel oil use has resulted in a reduction in carbon dioxide and other emissions common to fossil fuel plants and contributed to a cleaner environment in Hawaii.

Hydroelectric Power

Hydroelectric power is one of the oldest generators of electrical energy. On the Big Island, hydroelectric power fulfills about 5 per cent of the County's electrical energy demand at any given time.

On the Big Island, the percent of total demand supplied by hydroelectricity will probably not increase due to the reliance on normal stream flows and the lack of impoundment required to store enough water for continuous or increased energy output. However, small-scale hydroelectric units have been constructed at Hawi, Onomea, Wailuku River in Hilo, and Waimea. The Wailuku River Hydroelectric facility has the capacity to supply 11 megawatts of power to the electric power grid.

Solar Energy

Solar energy is the basis of many natural energy alternatives in Hawaii. Solar energy generates the global winds; stores energy in biomass through photosynthetic activity; warms the oceans, produces electrical power directly via photovoltaic cells; and can be used directly for heating through solar heat collection devices.

There are two direct forms of solar energy applicable to households; solar heat collection and solar light energy to electrical power via photovoltaic cells.

Solar heat collection is adaptable to domestic water heating, which accounts for approximately 30-35 per cent of the electrical power demand for an all-electric household.

Photovoltaic technology uses solar cells that convert sunlight into electricity. Industrial, commercial, and residential applications of photovoltaic technology are still being researched. However, advances in photovoltaic technology are resulting in improved efficiencies, lower costs, and integration into building products and designs. In May of 1998, the Mauna Lani Bay Resort installed a 100-kilowatt photovoltaic system on the rooftop, covering 10,000 square feet. The energy production is expected at approximately 423 kilowatts per day and the measured roof temperature reduction has exceeded 60 degrees. This project is expected to save operation costs for the hotel by providing electricity to 20 per cent of the 350 hotel rooms and reducing air conditioning costs. The resultant success of the project led to the installation of photovoltaic systems for the resort's golf facilities. The photovoltaic system will also be used to recharge Mauna Lani's golf carts.

These solar energy devices and improvements can be considered energy conservation technologies since their domestic use will possibly decrease the total energy demand in Hawaii County.

Wind Energy

The process of generating energy from wind simply uses the force and speed of wind to rotate the blades on windmills. This wind energy can be used to generate electricity through windmill electrical generators or by pumping water into storage for use in hydroelectric power systems. Wind energy is a relatively clean form of energy, in that it produces no emissions or chemical waste. Unfortunately, wind energy is inconsistent and electrical grids cannot rely solely on wind and must provide a back up supply from another source. Such is the case with the wind energy generation farms at Kahua Ranch, Lalamilo Wind Farm, and Kamaoa Wind Farm.

Biomass Conversion

Biomass is defined as "the total mass or amount of living organisms in a particular area or volume." Solar energy is converted into plant biomass through photosynthesis. Plant biomass can be used by power plants to produce thermal energy, then steam to generate electrical power.

Historically, biomass has been the Big Island's largest renewable energy resource. As recently as 1994, almost 13 per cent of the Big Island's electricity production were still being provided by two sugar processing companies that burned a mixture of biomass, coal, and fuel oil. With the closure of sugar operations, the companies have ceased burning biomass completely. However, one company continues the production of

electricity using coal and fuel oil. Other uses of biomass are currently being reviewed by both the public and private sectors.

Biomass conversion is one of the proposed projects of the NELH program at Keahole point, and involves the cultivation and harvest of plant and animal life forms as a natural energy alternative.

Biomass can also be considered solid waste, since it is the basis for most of mankind's organic refuse, and can be processed into ethyl alcohol. Alcohol fuel is adaptable for use in hydrocarbon combustion systems that account for about 58 per cent of the total energy demand of Hawaii County. Through combustion, alcohol can generate electrical power (via heat and steam) which represents the remaining 42 per cent of the County's total energy demand.

Ocean Thermal Energy Conversion

The oceans are the earth's largest solar energy collector and storage system, covering approximately 70 per cent of the earth's surface. Ocean Thermal Energy Conversion or OTEC is a power production method by which energy is derived from the difference in temperatures between the warm surface and cold deep ocean waters. In 1974, the Natural Energy Laboratory of Hawaii (NELH) was founded. In establishing the NELH, the Hawaii State Legislature set aside 321 acres of land for research and development of alternative energy resources, primarily OTEC.

In 1984, The State Legislature set aside an additional 547 acres of land adjacent to NELH for the commercial expansion of successful NELH research projects. This area was called the Hawaii Ocean Science and Technology (HOST) Park. However, in 1990 the legislature combined NELH and HOST Park into the Natural Energy Laboratory of Hawaii Authority (NELHA). There are now 26 tenant companies that operate at NELHA.

OTEC research began in earnest in 1982 following the construction of the laboratory and administration buildings and deployment of the first 30 centimeter diameter, 600 meter intake deep sea water pipeline. Currently, NELHA continues to conduct experiments and is working with other organizations to plan the construction of a 1 megawatt OTEC experimental facility and additional ocean pipelines for sufficient water supply.

3.2 GOALS

(a) Strive towards energy self-sufficiency.

(b) Establish the Big Island as a demonstration community for the development and use of natural energy resources.

3.3 POLICIES

(a) Encourage the development of alternate energy resources.

(b) Encourage the development and use of agricultural products and by-products as sources of alternate fuel.

(c) Encourage the expansion of energy research industry.

(d) Strive to educate the public on new energy technologies and foster attitudes and activities conducive to energy conservation.

(e) Ensure a proper balance between the development of alternative energy resources and the preservation of environmental fitness and ecologically significant areas.

(f) Strive to assure a sufficient supply of energy to support present and future demands.

(g) Provide incentives that will encourage the use of new energy sources and promote energy conservation.

(h) Seek funding from both government and private sources for research and development of alternative energy resources.

(i) Coordinate energy research and development efforts of both the government and private sectors.

(j) Encourage the continuation of studies concerning the development of power that can be distributed at lower costs to consumers.

(k) Strive to diversify the energy supply and minimize the environmental impacts associated with energy usage.

(l) Continue to encourage the development of geothermal resources to meet the energy needs of the County of Hawaii.

(m) Encourage the use of solar water heating through the continuation of state tax credit programs, through the Building Code, and in County construction.

(n) Encourage energy-saving design in the construction of buildings.

(o) Support net-metering and other incentives for independent power producers.

3.4 STANDARDS

(a) New power plants shall incorporate devices that minimize pollution.

(b) Applicable standards and regulations of Title 11, Chapter 46, "Community Noise Control" of the Hawaii Administrative Rules.

(c) Applicable standards and regulations of Title 11, Chapter 59, "Ambient Air Quality Standards" of the Hawaii Administrative Rules.

(d) Applicable standards and regulations of Title 11, Chapter 60.1, "Air Pollution" of the Hawaii Administrative Rules.