Chapter 2
Hawaii Policy Background

Abstract This chapter presents a quantitative overview of Hawaii's energy sector. Major supply, demand, and cost characteristics are examined together with factors which are distinctive to Hawaii. Overlaid on these quantitative factors is a recent forecast on the potential impact that the HCEI strategy may have on petroleum consumption in the state. A concluding section describes policy and resource issues which will potentially influence the future directions of the HCEI.

2.1 Distinguishing Characteristics of Hawaii's Energy Sector

Hawaii's geographic isolation and communities on separate islands create economy and energy patterns that are distinctly different from the rest of the US. These differences affect energy supply, the demand for energy, and the options available to policy makers. Of equal importance, these distinguishing characteristics create constraints on the role and economics of renewable technologies. Finally, although the state is rich in renewable resources, development of alternative energy programs must overcome costly infrastructure and management challenges.

In this chapter, the broad outlines of Hawaii's energy sector will be presented. Wherever possible, comparative data from the US mainland will also be presented in an attempt to highlight the unique characteristics of state's energy sector. But before embarking on a quantitative comparison, a few general observations may be useful. Several distinguishing energy-related factors can be readily identified for Hawaii's energy sector. These factors include:

- A much larger transportation sector relative to the size of the economy: The transportation sector is dominated by demand from air and marine transportation which are relatively insignificant for most of the mainland US.
- Short traveling distances for ground transport: Although distances are short, commuting times and fuel consuming traffic congestion are among the highest in the country due to a highway system that reflects island topography.

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- A small industrial sector: The state is economically dependent on service industries supporting government, tourism, and the military.
- Historical dependence on foreign oil and petroleum products: Energy prices in Hawaii reflect Asian, rather than U.S. supply conditions.
- No electrical connections between islands: The major electrical demand center is on Oahu, but most renewable energy resources are on the neighbor islands. There is no interisland transfer of electricity.
- High renewable energy potential: Hawaii has excellent wind, good solar and substantial geothermal resources. A productive agriculture sector (for biofuels/biomass production) is limited by land and water availability and by high labor costs.
- Very high cost for electricity and petroleum products: Although energy prices are among the highest in the nation, household expenditures on energy are modest due to Hawaii's benign climate and short travel distances.

Energy officials in the state and federal governments have long maintained that the Hawaiian Islands are rich in the wind, solar, and geothermal resources on which a sustainable renewable energy sector might be built. Based on conventional metrics and comparisons, this is a reasonable judgment. But conventional metrics rely on implicit assumptions about the infrastructure and operating environment in which the resources must be developed and operated.

As we shall see in a later in chapter, assumptions about both the infrastructure and operating environment in Hawaii are necessarily quite different from assumptions based on mainland US conditions. Beyond the island of Oahu, energy markets in the state are small and independent of one another. Land, water, and labor for biomass and other renewable energy development are expensive, and grid management of small, widely distributed renewable resources is challenging. As a result, many of Hawaii's "rich" renewable resources are less economic to develop than might be suggested by the quality of the resources themselves.

2.2 Hawaii's Energy Economy

Figure 2.1 presents data on the supply/demand balance for the major sectors of Hawaii's economy. Energy supply in the state is dominated by petroleum imports while demand is heavily concentrated in the power generation and transportation sectors.

While the overall division of energy demand is generally consistent with other areas of the US, the nature of transportation demand is unique. Reflecting its isolation and economic dependency on tourism, air travel represents over 40 % of the total transportation sector demand.

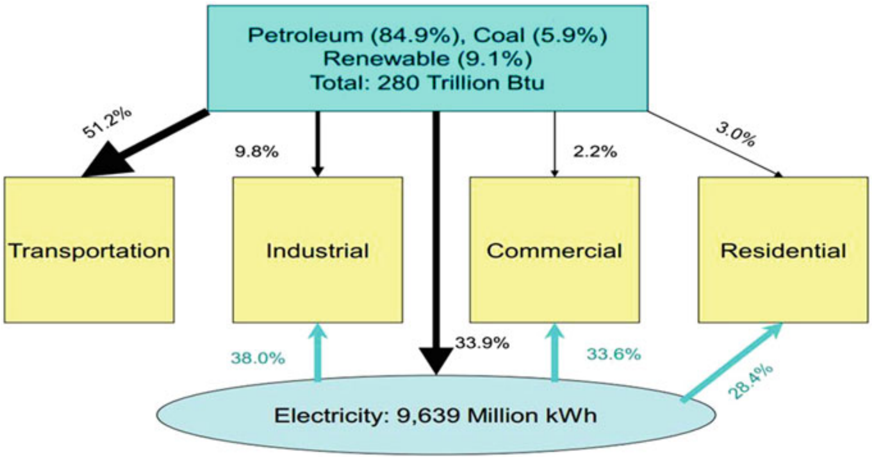

Fig. 2.1 Hawaii energy consumption by end use. Courtesy of State of Hawaii November (2008-2015)

2.3 Overview of Energy Costs and Prices

Any overview of Hawaii's energy sector must address the implications of the state's near total dependence on foreign petroleum. This dependence results in the highest retail electricity and gasoline prices in the US. To compound these problems, the revenue-starved state and county governments impose a staggering tax of $0.48 per gallon of gasoline. This is the third highest fuel tax rate in the nation.[1] Figure 2.2 presents a historical comparison of retail gasoline prices in Hawaii with average national gasoline prices.

To support its addiction to petroleum, the state annually spends over $6 billion on imported fuels. It is often argued that Hawaii's oil dependence increases its vulnerability to supply disruptions. These cost and vulnerability concerns form the core justifications for replacing imported petroleum with local renewable energy resources.

However, the cost and vulnerability arguments which underpin state energy policy are more complex and subtle than they appear on the surface. Even though energy prices are undeniably high in Hawaii, average household energy use and expenditures are modest, due to the temperate climate (e.g., little need for space heating and air conditioning) and the relatively short transportation distances on

[1]Ironically, the City and County of Honolulu which has the highest diesel consumption in the state, has the smallest tax incentive for biodiesel. Diesel fuel in Honolulu is taxed at $0.165/gallon while the tax on biodiesel is $0.123/gallon. In contrast, the other Hawaiian counties tax biodiesel at $0.04/gallon which is comparable to the tax rates imposed on ethanol.

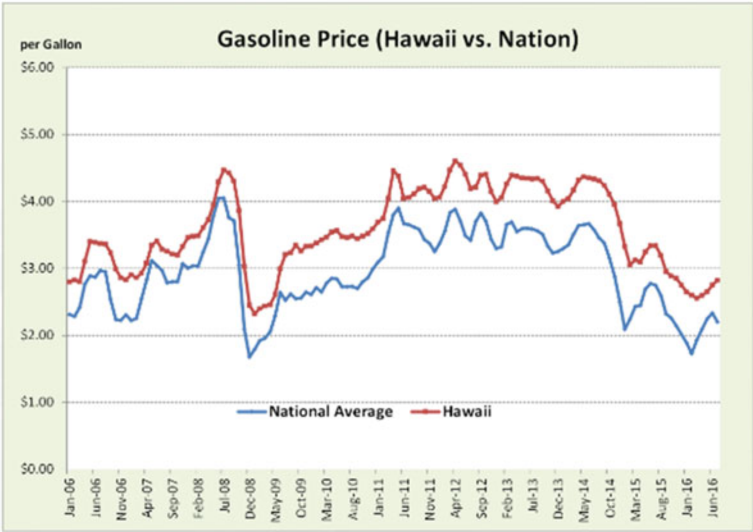

Fig. 2.2 Hawaii and national gasoline prices. Courtesy of Department of Business Economic Development and Tourism August (2016a, b)

Table 2.1 Per capita household consumption of electricity in Hawaii and US

Per capita consumption of electricity in Hawaii homes (kWh)	2126
U.S. Per capita consumption of Electricity in homes (kWh)	4566
State rank	49

Courtesy of Energy Information Administration (2014)

most islands.[2] According to Energy Information Administration (EIA) statistics, in 2014 Hawaii ranked 49th in per capita energy consumption and 46 in electricity consumption. Per capita household electricity consumption was less than 47 % of average US consumption. The DOE/EIA electricity estimates are presented in Table 2.1.

The widespread perception that energy costs are a major budgetary factor for Hawaiian consumers has colored political rhetoric and government policy making in the state for several decades. Clearly, low consumption partially offsets high energy prices. To the degree that Hawaiian consumers believe that they are already carrying a "relatively heavy" budgetary burden to meet their energy needs, the consequences of conversion from oil to clean energy tend to be exaggerated. Many alternative energy advocates have tried to counter this 'cost burden' concern by

[2]Land transportation patterns in Hawaii are characterized by to short commuting distances but lengthy commuting times. This pattern means that a great deal of ground transport energy is wasted in traffic congestion.

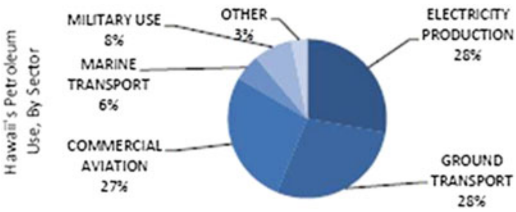

Fig. 2.3 Petroleum end use in Hawaii. Courtesy of Department of Business Economic Development and Tourism January (2013)

arguing that over the long term, oil prices will inevitably rise, and the cost difference between oil-based and renewable-based technologies will disappear.

2.4 Overview of Energy Demand

Figure 2.3 presents a simplified summary of the consumption of energy by the major sectors. The distinguishing characteristic of energy demand in Hawaii is the abnormally high demand for petroleum in the electricity and transportation sectors. Overall, oil's share of primary energy in Hawaii is about twice the national average. A large fraction of this demand can be directly attributed to the use of petroleum to generate electricity,[3] but petroleum demand in transportation is also abnormally high due to the importance of air travel to the tourist industry.

2.4.1 Air Travel

The percentage of petroleum used for air travel represents a unique policy dilemma for Hawaii since energy use by the airline industry is largely outside the regulatory control of the state. Fortunately for Hawaii, there is an inherent complementarity between the energy efficiency goals of the HCEI and the objectives of the aviation industry, since airline operations and new plane technology are heavily focused on minimizing energy consumption per passenger mile. The state government's general policy stance toward energy use by the airline industry recognizes this commonality of purpose, and energy policy analysis often specifically or tacitly excludes this sector from energy and environmental analysis.[4]

Inherent in the overall demand for petroleum is a large element linked to supporting the tourist industry. In addition to driving aviation fuel demand for middle distillate jet fuels, tourism also directly accounts for a sizable fraction of direct

[3]Fuel oil for electrical generation accounts for one-fourth to one-third of the total demand barrel.

[4]For example, state policy and analysis for regulation of GHG greenhouse gas emissions specifically excluded the air travel industry.

electricity sales and, indirectly, for the energy consumption of tourist-oriented support industries.[5] Both tourist linked electricity consumption and the substantial demand for fuel by tour buses and rental cars is derived from petroleum.

HCEI does not specifically target tourism, but clearly the transition from oil-powered electrical generation to renewable generation would reduce the tourist sector's energy profile. Historically, the state's attempts to encourage energy efficiency in tourism have been sporadic and only marginally effective, but several individual Hawaii hotels have embarked on successful energy reduction programs linked to cost-cutting or green marketing strategies. Likewise, state programs to promote the use of electric and hybrid vehicles may eventually impact the sizable tourist "rental car" market.

2.4.2 The Military

The military is the second largest economic sector in Hawaii. Each of the military services has its own fuel substitution and energy efficiency programs. These programs are mandated and funded directly from the Pentagon. Each military branch has embarked on various projects for promoting renewable energy sources. These projects compliment efforts being made by Hawaii's public utilities and other energy suppliers. In general, the most noteworthy military energy initiatives have been in residential and office building design and retrofits. The military services (including the Army Corp of Engineers) are significant players in addressing the energy issues associated with the "built environment" in Hawaii. Military research and development on renewable technologies is carefully coordinated with HCEI involvement. Even though the energy programs of the military branches are not formally planned or funded under HCEI, they count toward achievement of the HCEI oil substitution goals.

2.4.3 Household Electricity Demand

The typical household in Hawaii consumes about 600 kWh of electricity/month at a total cost of approximately $200–$250/month (depending on fuel cost adjustments). This electricity is used for a variety of standard household functions including air conditioning, water heating, lighting, appliances, etc. Since space heating and air conditioning needs are limited in the islands most policy attention focuses on water heating. Conversion from electrical to solar water heating reduces electrical

[5]Studies by the University of Hawaii suggest that of the 20 highest GHG emitting economic activities in the state, 35 % are linked to tourism.

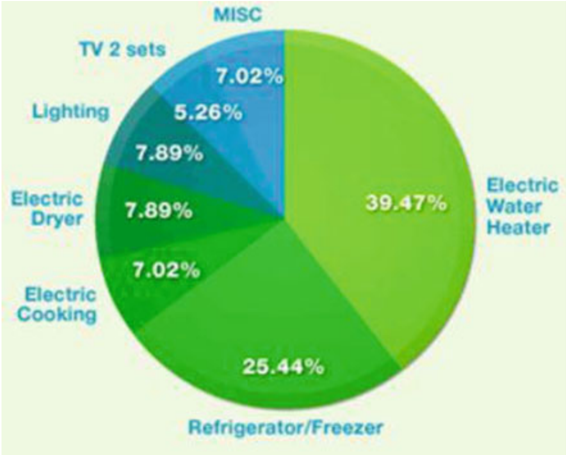

Fig. 2.4 Average home energy use. Courtesy of Department of Business Economic Development and Tourism (2016a)

consumption significantly and can result in savings of 35–40 %.[6] In addition, the state offers energy efficiency rebates to consumers who purchase Energy Star appliances (Fig. 2.4).

In recent years, the sales of rooftop photovoltaic (PV) systems for residential users has exploded as a result of state and federal tax credits and net energy metering policies which can subsidize up to 65 % of the PV system cost. Hawaii currently has one of the highest rates of rooftop solar units in the US.[7] In 2012 the payback period for a typical rooftop PV installation in the state was 5 to 6 years. The high penetration of solar water heaters and rooftop PV systems is widely viewed as a major contribution to the success of the HCEI energy policy.

2.5 Overview of Petroleum Supply Patterns

2.5.1 Importing and Processing Oil Products

Like other aspects of Hawaii's energy sector, petroleum supply patterns differ significantly from those on the US mainland. Hawaii historically has had two small oil refineries that process foreign crude oil into petroleum products for the local market. Eighty four percent (84 %) of Hawaii's crude oil supply comes from the Asia-Pacific region, versus less than two percent (2 %) of oil imports to the US

[6]The state offers a $500 instant rebate plus State and Federal tax credits for solar water heating installations.

[7]There were 40,000 rooftop PV units in 2014.

West Coast. No domestic US crude oil is imported to Hawaii although limited volumes of diesel and jet fuel are occasionally imported from the West Coast. The local oil refineries have no desulfurization capacity and must import expensive low-sulfur crude oil to meet federal environmental standards. Since there is no market on the US West Coast for the sizable quantities of low-sulfur fuel oil (LSFO) used in Hawaii's electricity generation, local LSFO prices are closely linked to prices in the Far East (particularly Japan, Korea, and Singapore).

2.5.2 Liquid Fuel Use

Hawaii's demand for petroleum products is summarized in Table 2.2. As noted earlier, commercial and military aviation is the largest single user of petroleum fuels. Additionally, electricity generation and road transport annually consume sizable quantities of fuel oil, middle distillates, and gasoline.

Both aviation use and the demand for fuel oil in electric generation distinguish Hawaii from typical petroleum patterns on the US mainland. To achieve its goals, the HCEI oil substitution strategy is targeting fuel oil use in electrical generation and gasoline use in the transportation sector.

Table 2.2 Hawaii's demand for petroleum products

Use	Fuel	Petroleum based fuels (MGY)	Biofuel	Goal
Electricity production	Fuel oil	390		
	Diesel	90	4	
	Naphtha	30		
Ground transportation	Gasoline	400	40	
	Diesel	50	1	
Commercial aviation	Jet fuel	450		
Marine transportation	Bunker fuel	70		
Military use	Diesel	130		25 % (32 mgy) renewable by 2018
	JP8 jet	80		
	JP5 jet	10		
	Diesel	40		
Other uses	Methane, Propane	60		
Total (rounded)		180 mgy (1.8 billion gallons/year)		

Courtesy of Department of Business Economic Development and Tourism November (2014)

2.5.3 Petroleum Use in Electrical Generation

Hawaii has historically been dependent on petroleum for electricity generation. The major petroleum products burned in the generation of power are fuel oil, diesel, and small quantities of naphtha. Overall the electric sector consumes over 28 % of the crude oil and petroleum products imported to Hawaii. The needs of the electric utilities are a primary factor in fuel storage and distribution infrastructure, and one of the principle determinants in the operation of the state's oil refineries. The pricing relationships between the oil refiners and the electric utilities are subject to review by the Public Utilities Commission but are sealed from public inspection.

A successful HCEI oil substitution program obviously has significant implications for Hawaii's refining sector, since the substitution of renewable resources for oil-based electrical generation is a primary objective. This substitution will reduce —but not eliminate—fuel demand by the state's electric utilities. The reduction of LSFO demand will significantly alter the balance of petroleum products produced by the refineries.[8] In addition, related energy developments such as the introduction of electric cars/mass transit, and more stringent Federal Corporate Average Fuel Economy (CAFE) standards to increase car/truck fuel efficiency will dampen future demand for high-profit-margin gasoline in road transportation. This deteriorating demand outlook is expected to complicate the ability of the existing refineries to technically and economically meet the demand for LSFO.[9]

2.5.4 Liquid Fuel Use in Ground Transportation

Trucks, buses, and cars consume roughly 20 % of Hawaii's energy. While ground transportation is dominated by gasoline sales to private cars, there is a small but stable market for diesel fuel in commercial vehicles. The major renewable substitution opportunity in road transport is liquid biofuels (ethanol for gasoline driven passenger vehicles; biodiesel for diesel driven commercial vehicles) and electric vehicles. Currently, neither electric passenger vehicles nor biodiesel-powered commercial vehicles are serious transportation alternatives to gasoline and diesel in the surface transportation market. However, a great deal of attention is being directed toward increasing the use of biofuels in this sector. Since the state has limited legal or regulatory control over transportation, most initiatives include some combination of subsidies or tax incentives.

Hawaii's ethanol program began in 2006 and was originally promoted as much for its agricultural and rural development potential as for its impact on ground transport energy demand. Since its inception, ethanol has been imported primarily

[8]It is important to note that even if HCEI meets all its objectives, there will still be a need for about 20,000 barrels/day of petroleum products for power generation.

[9]In early 2013, Tesoro announced the pending sale of its Hawaii refinery.

from Central American countries at world price levels prevailing outside the US. These prices have fluctuated considerably over the years. In recent years, ethanol has sold nationally at prices well below gasoline but ethanol in Hawaii sells at prices well above Los Angeles ethanol prices. Industry estimates provided to the 2012 Legislature place demand in the state at approximately 40 million gallons of ethanol per year, and suggest that by displacing gasoline, ethanol blending resulted in notional import savings of approximately $24 million annually.[10]

Although there is considerable scope for reducing fossil fuel consumption through vehicle efficiency measures, the state has limited influence over consumer vehicle choice or over vehicle-use patterns (which determine average vehicle miles traveled). The issues and the energy policy implications of fossil fuel use in ground transportation are very important to successful achievement of Hawaii's renewable energy strategy and are further examined in Chap. 6.

2.5.5 Domestic Use of Synthetic Natural Gas

Small amounts of synthetic natural gas are produced from naphtha at the Oahu refineries. Most of this gas is domestically consumed through a limited reticulation system in metropolitan Honolulu and as bottled gas in rural areas on the neighbor islands. To the extent that the HCEI strategy poses a threat to continued operation of the Oahu refineries, the future of the synthetic gas market will be directly affected. In response to this threat, the synthetic gas distributor HawaiiGas has proposed importing liquefied natural gas (LNG) into the state. In March 2014, the Hawaii PUC granted HawaiiGas approval to implement the first stage of its small scale LNG import proposal. HawaiiGas has been a leading advocate for the conversion of the HECO power plants to LNG. Clearly, substitution of LNG for LSFO in HECO's power plants would vastly increase the potential market for LNG imports. Both HECO and HawaiiGas agree on the attractiveness of LNG as a power plant fuel but major differences have recently emerged over import and logistics issues. These differences are explored further in Chaps. 5 and 8.

2.6 A Recent Forecast of HCEI's Impact on Petroleum Demand

In a recent study, an internationally recognized oil and gas consulting firm analyzed historical and projected demand for petroleum products in Hawaii on the assumption that HCEI's goals would not be achieved. The conclusions are summarized in Fig. 2.5.

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[10]Testimony of William Maloney of Pacific West Energy at hearings on Senate Bill 2339.

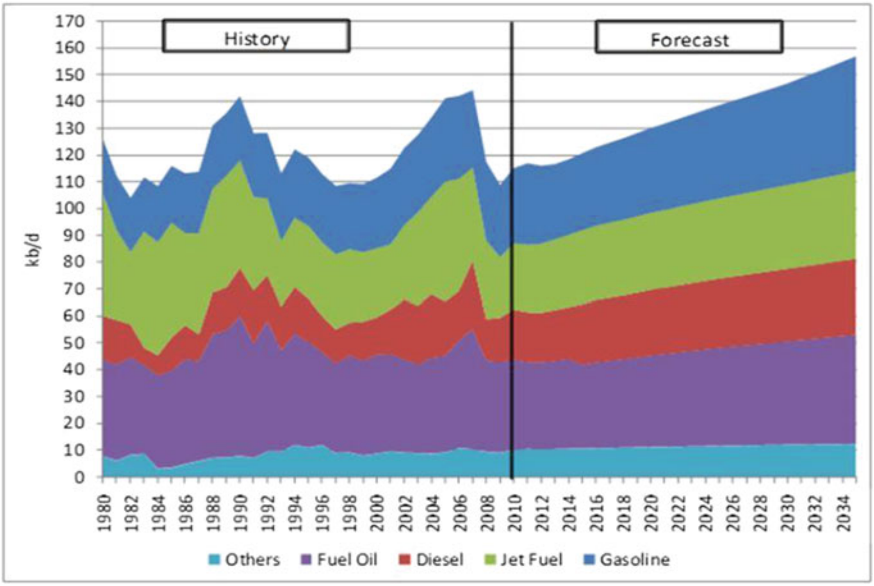

Fig. 2.5 Fuel demand: history and forecast. Courtesy of Hawaii Natural Energy Institute/FGE December (2012a, b)

The study noted that since a 2007 peak level of 145,000 barrels per day (kb/d), petroleum demand in Hawaii first declined (to ~110 kb/d) before rebounding in 2011–2012 levels of ~220 kb/d. FGE projected a baseline (business-as-usual) forecast through 2030 that factored in a modest demand growth and known national energy and environmental policy changes including new 2015 Federal environmental standards for fuel oil.

FGE then expanded their study to examine three different petroleum demand scenarios for (1) a baseline/business-as-usual scenario, (2) a diesel substitution scenario where EPA regulations on fuel oil are met by substituting diesel for fuel oil, and (3) a scenario where all HCEI objectives are also achieved. This projection compared the three demand scenarios for the years 2010, 2020, and 2030. The resulting comparisons are presented in Fig. 2.6.

In considering the expanded FGE analysis, a few things are evident regarding the impact of the HCEI renewable substitution strategy. First, the demand for residual fuel oil will decline dramatically since this fuel is entirely related to the generation of electricity and, consequently, is directly influenced by the PUC's Renewable Portfolio Standards. Second, gasoline sales are expected to remain nearly flat throughout much of the forecast period. This lack of growth in gasoline demand has significant implications for Hawaii's oil refineries, since gasoline has historically been the highest profit margin product produced by the refineries. Third,

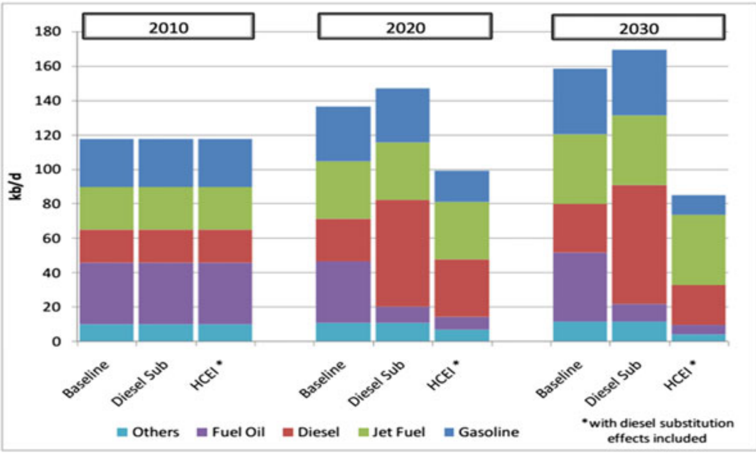

Fig. 2.6 Fuel demand projections under different scenarios. Courtesy of Hawaii Natural Energy Institute/FGE December (2012a, b)

in light of expected gains in aircraft engine efficiency, any growth in the jet fuel market implies that either increasing numbers of tourists will be visiting the islands, or that they will be traveling greater distances to vacation in the state.

2.7 Electricity Supply

2.7.1 Structure of Electricity Supply

Hawaii is served by four utilities whose service areas reflect the state's four counties. As noted in Chap. 1, three of these utilities are owned by Hawaiian Electric Industries (HEI) through its Hawaii Electric Company (HECO) subsidiaries. The parent Hawaiian Electric Company serves the City and County of Honolulu (HECO), Maui Electric Company serves Maui, Lanai, and Molokai islands in Maui County (MECO) and the Hawaii Electric Light Company (HELCO) serves Hawaii County. The fourth utility is a small electrical cooperative on the island of Kauai Island Utility Cooperative (KIUC). The HECO utilities provide over 95 % of the electricity consumed in the state and, as a result, this book focuses on the regulatory and policy relationships between the state PUC and the HECO companies. All four utilities provide conventional generation, transmission, and distribution services within their service areas and operate under a state monopoly franchise. Regulation of the utilities is through a PUC comprised of three members appointed by the governor, and confirmed by the Senate.

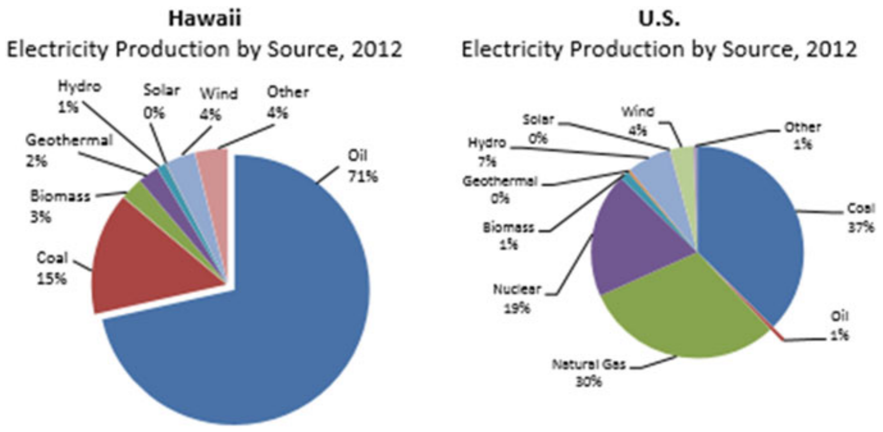

Fig. 2.7 Comparison of generation mix by primary energy resources. Courtesy of Department of Business Economic Development and Tourism November (2014)

For size, resource, ownership, and historical reasons the problems facing implementation of the HCEI strategy at KIUC are atypical for the rest of the state.[11] However, there is one potential area where the KIUC model might prove important to the future of Hawaii's HCEI strategy. Should proposed changes in HECO's ownership (see Chap. 8) fail to win government approval, it seems likely that some sort of public ownership option may be put forward. While the cooperative ownership structure of KIUC is unlikely to work for the much larger HECO Companies, the simple existence of a successful publicly owned utility in the state is likely to encourage debate of this option.

2.7.2 Generation, Comparative Cost and Management of Electricity

With no interisland transmission connection, electricity is generated independently on each island. With the exception of Oahu, generation is done in small power plants using either diesel or medium sulfur fuel oil (MSFO). Figure 2.7 contrasts Hawaii electrical generation by source with comparable data from the US mainland.

[11]KIUC is a non-profit consumer owned cooperative owned by the 15,000 members in its service area. Its Board of Directors is elected from its membership. For reasons associated with Kauai's sugar industry, much of its non-petroleum generation has historically come from hydroelectric sources. The company plans to meet the state's renewable energy mandate through a combination of biomass and utility scale solar generation. Neither resource has hitherto played a role in the planning of the HECO companies.

Table 2.3 Percent renewable generation 2012–15 (HECO companies only)

Year	Oahu (HECO)	Maui county (MECO)	Hawaii (HELCO) county	Consolidated
2012	7.6	20.8	46.7	13.9
2013	11.7	29.1	48.1	18.2
2014	15.2	33.7	47.4	21.3
2015	17.2	35.4	48.7	23.2

Courtesy of Public Utilities Commission

But to understand some of the less obvious factors influencing the competitiveness of renewable technologies, we need to understand a bit more about the structure of the Hawaii oil sector in general, and the electrify sector in particular. Petroleum fuels (e.g., fuel oil and diesel) are the largest source of primary energy for the company. Coal generation is limited but important and is restricted to the AES power plant on Oahu which provides power under contract to HECO.[12]

Over the past several years, the HCEI strategy has resulted in significant increases in electrical generation from renewable sources and, as a consequence, the electrical utilities have exceeded early RPS goals. This early success has been the result of a mix of wind, residential solar and geothermal development to supply local (island) needs. These increases have occurred across all islands and are summarized in Table 2.3.

However, this development pattern is not sustainable over the medium and longer term due to the disproportionate concentration of electrical demand on Oahu. Over the longer term, optimal development of the substantial renewable resources on the neighbor islands is likely to require a marine transmission link to the demand center on Oahu.

Despite having substantial geothermal potential and some of the best wind resources in the country, the lack of grid interconnection between the islands poses major challenges in meeting HCEI goals. These problems are compounded by the intermittent nature of wind and solar generation which results in technical grid management problems. And are likely to become more acute as Hawaii's renewable energy strategy progresses.

The HCEI renewable strategy is designed to address oil dependence by substituting capital-intensive renewable technologies for imported oil while simultaneously reducing overall demand for energy through increased energy efficiency. Only time will tell whether HCEI's ambitious goals are achievable but it is obvious that the relative economics for electricity consumers will depend heavily on future

[12]The AES coal plant is an important supplier of base load power to the Oahu grid and is essential to the reliability of the transmission system. Coal generation uses low cost Australian coal.

oil price trends. If oil prices remain stable at or near the \$60–\$80/barrel level, the average household will need to devote a higher fraction of its disposable income to renewable energy under HCEI than would otherwise have been the case under continued importation of foreign petroleum. Conversely, if oil prices significantly escalate above these levels, the HCEI renewable energy strategy may turn out to be a significant bargain for ratepayers.

2.8 Energy Conservation and Efficiency

In 2012, Hawaii ranked 20th in the American Council for Energy Efficient Economy's (ACEEE) ranking of state energy efficiency programs even though the state does not have measures to improve gas efficiency. Across the state, approximately \$15/capita is annually spent on energy efficiency programs. Energy efficiency and conservation have traditionally commanded significant attention in Hawaii. Both the state government and the electric utilities have had well-established consumer education programs that support direct efficiency/conservation measures such as comprehensive incentive and demand-side management programs. While HCEI saw a change in the primary responsibility for these direct programs from HECO to Hawaii Energy, most of the supporting consumer education programs continued at or near the same level. It is difficult to judge the effectiveness of consumer education programs but antidotal evidence suggests that the return on the energy efficiency investments has been reasonably high. Between 2005 and 2010, energy reductions across the state averaged slightly less that ∼1 %/year. Figure 2.8 presents estimates of energy improvements in the power industry proceeding and following formulation of the HCEI.

While efficiency improvements during the early HCEI implementation period were modest, a consultant report commissioned by the PUC in early 2014 was optimistic that the goals of the Energy Efficiency Portfolio Standards (see Chap. 3) could be met by 2030. Table 2.4 summarizes the findings of the PUC consultant report.

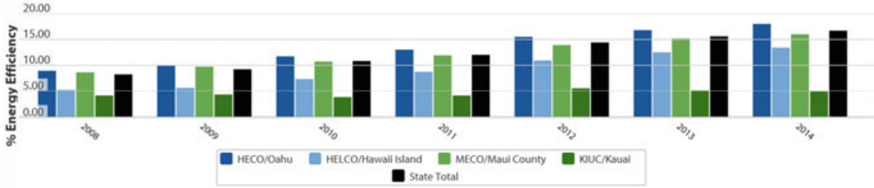

Fig. 2.8 Hawaii energy improvements 2008–2014. Courtesy Public Utilities Commission 2012–2015

Table 2.4 Potential energy efficiency savings relative to EEPS (GWh) goal

	2015	2020	2025	2030	Marginal contribution in 2030
EEPS GWh Goal	1375	2350	3325	4300	n/a
Cumulative savings (GWh)					
2009–2012 Program savings	591	377	182	64	64
Existing codes and standards	759	1110	1461	1540	1476
Economic potential	2519	4042	5275	6210	4670
Technical potential	2724	4493	5870	6848	638
Energy savings (% of EEPS standard)					
2009–2012 Program savings	43 %	16 %	5 %	1 %	1 %
Existing codes and standards	55 %	47 %	44 %	36 %	34 %
Economic potential	183 %	172 %	159 %	144 %	109 %
Technical potential	198 %	191 %	177 %	159 %	15 %

Courtesy of Public Utilities Commission (2014)

2.9 Special Problems for a Special Place

2.9.1 Risk Implications of Oil Dependence

Since petroleum products (particularly fuel oil) are the primary energy source for Hawaii's power sector, electricity prices closely follow oil prices in Asian markets. Depending on the level of crude oil prices, oil can represent up to three quarters of the costs of generating electricity in the state. Price fluctuations are automatically reflected in consumer bills through a monthly automatic price adjustment mechanism called the Energy Cost Adjustment Clause (ECAC). The consequence of the automatic price pass-through mechanism is to shift oil price risk directly to consumers and create volatile fluctuations in the ratepayer's bills. Although automatic cost adjustment clauses are not uncommon in the electric utility industry on the US mainland, they are accentuated in Hawaii by the very high dependence on oil.[13]

Utility risks are affected by ECAC for two reasons. First, although actual fuel costs are obviously a legitimate cost of utility operations, recovering these costs immediately from consumers has enormous cash flow advantages versus financing these fuel price costs and recovering them through a lengthy rate case submission at

[13]Critics sometimes point out that the automatic pass-through of fuel price changes minimizes the incentive for the electric utility to aggressively seek the lowest fuel prices from suppliers.

the PUC.[14] Second, since HECO burns oil products in its boilers, its exposure to price changes is much greater than with the natural gas or coal consumed under long-term contracts by utilities on the US mainland. During the HCEI negotiations, the state government threatened to change the ECAC fuel cost mechanism as a means of encouraging/inducing the electric utilities to support an accelerated transition to generation from alternative energy resources.

The implications of the ECAC pricing mechanism is an extremely important, but little acknowledged, policy factor in Hawaii. Without this automatic price adjustment, the utilities would be exposed to potential cash flow problems and lower credit ratings. These pressures might significantly change the risk perceptions by investors and rating agencies and conceivably could affect the financial structure and dividend policies of the state's electric utilities. On the other hand, the ECAC mechanism, combined with the state's heavy dependence on fuel oil for electrical generation, exposes consumers to greater price volatility than in mainland utilities. This exposure tends to accentuate consumer anxiety over household energy expenditures. In the underlying logic of HCEI, the substitution of capital (from implementation of renewable energy technology) for the volatile operating costs associated with imported oil should, over the long term, provide more price stability for utility rate payers, investors, and other stakeholders in the electrical sector.

2.9.2 Transparency of Prices

The regulatory history of the role of oil prices in electricity costs is interesting. Given the magnitude and contribution of fuel costs to overall electricity generating costs, the oil pricing arrangements between the utilities and their refinery suppliers would seem to be a primary regulatory concern. Yet, neither the PUC Public Utilities Commission, the Consumer Advocate (CA), nor the energy authorities at the state Department of Business, Economic Development, and Tourism (DBEDT) have ever mounted a public investigation of oil pricing arrangements between the oil refineries and the electric utilities.[15] Moreover, since oil products are supplied from only two sources, the actual prices paid by the utilities are not publicly available.[16] This is not to say that regulatory review of the oil price contracts does

[14]Since petroleum fuels amount to over two thirds of HECO's direct production costs, the impact on any rate case submission would be dominated by the fuel adjustment. This might make it politically more difficult for the PUC to grant rate case relief for other legitimate cost increases.

[15]In contrast to utility fuel prices, the profitability and prices of gasoline have periodically come under public review by government regulators, including the Attorney General.

[16]The premise in treating utility oil price costs is that public disclosure might provide information that could be used by the competitors to their advantage in contract negotiations.

not take place, but rather to suggest that the entire process is not transparent to the public. This lack of transparency makes it difficult to determine how aggressive the utilities are at pursuing the lowest contractual fuel prices for their ratepayers.

2.9.3 Intermittent Generation and Grid Management

With no imports or exports of electricity beyond small island transmission grids, the management of local transmission and distribution grids is problematic. This management problem is compounded as intermittent resources, like solar or wind, become an ever larger fraction of total generating capacity under HCEI. There are two significant policy aspects to this problem. First, and foremost, transmission grid management problems potentially threaten overall system safety and reliability. Second, the early implementation history of local distribution networks is associated primarily with the state's rooftop Photovoltaic program and occurs when solar generation approaches 100 % of the daytime load on a particular distribution circuit. At this point, fluctuations in solar generation resulting from environmental factors like cloud cover can destabilize the distribution system. Currently, this problem is most acute for residential rooftop PV systems in certain areas of Oahu.

Because of the unique nature of Hawaii's electricity system and the ambitious nature of the HCEI renewable goals, the problems of transmission grid management prompted the federal Department of Energy to mount a major technical study to examine the grid management question. This renewable wind integration study was undertaken under the basic support agreement between the state and DOE and is described in Chap. 5. The study was a pioneering evaluation of the technical limits and consequences of intermittent generation sources on transmission grid management.

Neither the grid management nor the distribution saturation problems are technically insurmountable over the medium or longer terms. The issues are well understood by utility engineers but remedial measures will require time and, in some cases, fundamental alteration of existing transmission and distribution infrastructure. To accomplish these changes in a manner which accommodates the solar and wind generation timetable of HCEI is a substantial challenge in unconnected grids and virtually unprecedented outside the state.

2.9.4 Impact of Environmental Regulations

New regulations by the Environmental Protection Agency (EPA) for controlling emissions from power plants will have a significant impact on the fuels burned by Hawaii's electric utilities. The new mercury (M) and air toxics (AT) regulations will affect the major oil- and coal-fired units on Oahu and potentially divert financial resources from renewable energy development. The impact of the MATS regulation will be explored in depth in the environmental chapter (Chap. 7).[17]

2.9.5 Public Acceptance

In Hawaii, public attitudes toward energy development represent formidable challenges. In addition to the "not-in-my-back-yard" concerns, opposition sometimes involves deeply held cultural beliefs. While cultural concerns are experienced elsewhere they are accentuated in Hawaii. An illustrative example of the interaction of market size and public opposition lies in the geothermal resources of the Big Island. Geothermal is the largest renewable energy resource in the islands. It has the potential to provide much of the electrical demand required by the state for several decades. The history of geothermal development—in Hawaii and elsewhere—suggests that the impacts of geothermal development on the physical environment are manageable. However, Hawaiian culture groups have historically objected to geothermal development on the basis that it violates traditional spiritual beliefs about volcanoes. These cultural objections led directly to an early decision to exclude the state's largest and lowest cost renewable energy resource from consideration in early HCEI planning.

For Hawaii's two premiere renewable resources—wind and geothermal—the transfer of large amounts of electricity from neighbor islands to Oahu will require a marine transmission cable. But this marine cable project has attracted its share of opposition from environmentalists[18] and from local groups on the neighbor islands who see large scale renewable energy development as a threat to their lifestyles. Without the cable project, development of Hawaii's wind and geothermal resources to meet local needs will remain at a scale that would be economically unattractive in many parts of the US mainland.

In summary, Hawaii is blessed with an abundance of renewable energy resources on which to base its clean energy strategy. To realize the full potential of this natural endowment, the state must overcome significant geographical and institutional barriers. These barriers include the lack of electrical transmission connections between the resource-rich neighbor islands and the demand center on Oahu. Even with an integrated transmission link, some sectors of the Hawaiian economy will continue to require imported oil products over the long term. Of particular importance are the needs of the transportation sector where surface and air transport will continue to require hydrocarbon fuels. Meaningful progress in these areas will

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[17]In the likelihood that climate change regulation re-emerges as a major national concern, major differences between GHG emission's in Hawaii and on the US mainland will need to be accommodated in HCEI. These differences involve the carbon intensity of the tourist industry and the composition of GHG emission. These issues will be explored in Chap. 7.

[18]The marine cable project is also opposed by some environmental groups since the proposed route would transit a national whale sanctuary.

rest on major improvements in energy efficiency and on new transportation technologies. The recognition that both substitution of renewable resources and improvement in energy efficiency are essential to transform the state energy sector formed the basis for the HCEI strategy which will be considered in the next chapter.

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