Hawaii Renewable Energy

Team 2

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Current State of Energy

Hawaii Renewable Energy Generation by Resource

Source: Renewable Portfolio Standards Status Reports, 2009-2015 (Hawaii Public Utilities Commission)
Current State of Energy

Average Electricity Price, $/kWh

- Hawaii
- U.S.

Hawaii, $0.26
U.S., $0.10

Dollars per Gallon

Hawaii statewide regular gasoline prices, $/gallon
Crude oil (Brent) spot price, $/gallon
Hawaii electricity prices, statewide, all sectors $/kWh

Dollars per Kilowatt-hour
Goals

- **Achieve 100% renewable energy** by focusing on decentralized renewable power
- 70% clean energy by 2030
- 100% clean energy by 2045
Hawaii’s energy policy seeks to ensure:

- dependable, efficient, and economical energy
- increased energy self-sufficiency
- greater energy security
- reduction of greenhouse gas emissions
Regulations

- **Solar Roofs Act** requires most new homes in Hawaii to be equipped with solar water heaters.
  - Federal and State Law
  - National Environmental Policy Act
  - Hawaii Endangered Species Law
  - Migratory Bird Treaty Act
  - Magnuson-Stevens Fishery Conservation and Management Act
  - Hawaii Contaminated Properties Regulation
  - Protection of Hawaii Cultural Resources
Challenges

- Cost
- Government Policy
- Technique
- Environment and climate
- Culture
**Cost**

- Switching from an oil-based system to a renewable based system will take investment in renewable energy, storage, and a redesigned grid.
COST OF HAWAI'IAN ENERGY SOURCES

(Hawaii average retail electricity price, June 2015)

Cost per kilowatt-hour

- Liquefied natural gas: 20.7¢
- Fuel oil: 19¢
- Big Island: 20¢
- O'ahu: 24.7¢
- Maui: 15.2¢
- Geothermal: 17.7¢
- Onshore wind: 13.2¢
- Offshore wind: 10.2¢
- Pumped hydro storage: 14.5¢
- Distributed renewables: 15¢
- Energy efficiency: 2.2¢

DEMOCRATIC ENERGY INITIATIVE
Government Policy

- A new state law compels electric utilities to power 100 percent of their net electricity sales with renewable energy by 2045, up from 40 percent by 2030.

- But to reach 100% renewable energy, it may be too costly to support both a 20th century centralized and 21st century decentralized strategy.
Many renewable resources are variable, or intermittent.
Utilities typically have no way to measure the amount of electricity being put on power lines by solar panels, in real time. Nor can they control it.
On small, stand-alone grids like those in the Hawaiian Islands, fluctuations caused by wind must be offset by "firm" generators. One challenge is that the wind can change quicker than typical electric generators. Maintaining 60Hz frequency can strain generators.
Large-scale electric storage is being developed. But some technologies are in very early stages of development. At present, large batteries or other storage can be very expensive.
For ocean energy, the challenge is to convert this abundant source of energy into useable power for electricity and transportation.
Environment and Climate

- Bird migration patterns that have prohibited development of utility-scale wind on Kauai may also impact the potential to develop large-scale wind on O’ahu and other islands.
- There are concerns from locals over environmental damages and impact on tourism.
- Hawaii will be affected by the impacts of climate change; particularly in rising sea levels, ocean acidification.
Culture

- Some Hawaiians see the Island’s volcanoes as a sacred power that should never be commercialized.
- They believe that it would be sacrilege to drill into and extract energy from Mauna Loa, home of the volcano goddess Pele and one of the world’s most active volcanoes.
Demand Response

- Energy storage as a reserves asset:
  Operating reserves may be called upon to provide energy for 10 to 30 minutes, filling the gap until an additional generation resource can be started and ramped up to deliver energy (25 MW energy storage system). The battery can store 4.62 megawatt-hours of electricity.

- Higher contribution from non-spinning resources:
  Operating reserves are a combination of spinning and non-spinning reserves. Spinning reserves provide the first course of action to counteract sudden loss of generation, and then non-spinning resources maybe called upon if additional support is needed.
Recent studies show demand response potential of 160 MW on Oahu. The utility calls on demand responsive loads to reduce their consumption when there is a shortage of generation resources. This analysis assumed that 160 MW of demand responsive load is available for up to 2 hours of service during time of need.

Interconnecting the Oahu and Maui grids with a HVDC cable (grid-tie) or interconnecting Oahu to an off-island wind plant (gen-tie) offers several potential benefits.

- Increase operational flexibility
- Reduce reserve requirements
- Improve grid reliability
Comparison of Strategies to Procure Operating Reserves

- Curtailed W&S Energy
- Energy Storage
- Higher Non-spin Contribution
New Thermal Generator: 78 MW of new combustion turbines
Energy efficiency: 2020 target approved by PUC - 2350 GWh of potential for Hawaiian Islands
Demand Response: ASSESSMENT OF DEMAND RESPONSE POTENTIAL FOR HECO, HELCO, AND MECO - Global Energy Partners, LLC
Hawaii’s islands are already connected by several telecommunications cables.
RENEWABLE ENERGY POTENTIAL

Source: Hawaii State Energy Office

Renewable electricity potential and demand by island (gigawatt-hours)

- Kauai
- Oahu
- Molokai
- Lanai
- Maui
- Hawaii
- State

Legend:
- Geothermal
- Biomass
- Hydro
- Wind
- Solar
- Ocean
- Annual Use

Graph showing the comparison between renewable energy potential and demand within different islands, illustrating the energy potential as well as the annual use.
## Room for More Renewables

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<th>Existing renewable energy</th>
<th>Untapped rooftop solar potential</th>
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**Gigawatt-hours of 2030 annual electricity sales**

- **KIUC**: 165 GW-h
- **HECO**: 1621 GW-h
- **MECO**: 381 GW-h
- **HELCO**: 503 GW-h
References


Questions