State of Hawaii
ENERGY SECTOR RISK PROFILE

This State Energy Risk Profile examines the relative magnitude of the risks that the State of Hawaii’s energy infrastructure routinely encounters in comparison with the probable impacts. Natural and man-made hazards with the potential to cause disruption of the energy infrastructure are identified.

The Risk Profile highlights risk considerations relating to the electric, petroleum and natural gas infrastructures to become more aware of risks to these energy systems and assets.

HAWAII STATE FACTS

State Overview
Population: 1.40 million (<1% total U.S.)
Housing Units: 0.53 million (<1% total U.S.)
Business Establishments: 0.03 million (<1% total U.S.)

Annual Energy Consumption
Electric Power: 9.6 TWh (<1% total U.S.)
Coal: 800 MSTN (<1% total U.S.)
Natural Gas: 3 Bcf (<1% total U.S.)
Motor Gasoline: 10,400 Mbarrels (<1% total U.S.)
Distillate Fuel: 5,200 Mbarrels (<1% total U.S.)

Annual Energy Production
Electric Power Generation: 10.5 TWh (<1% total U.S.)
Coal: 1.5 TWh, 15% [0.2 GW total capacity]
Petroleum: 7.5 TWh, 71% [2.2 GW total capacity]
Natural Gas: 0 TWh, 0% [0 GW total capacity]
Nuclear: 0 TWh, 0% [0 GW total capacity]
Hydro: 0.1 TWh, 1% [0 GW total capacity]
Other Renewable: 0.4 TWh, 4% [0.2 GW total capacity]
Coal: 0 MSTN (0% total U.S.)
Natural Gas: 0 Bcf (0% total U.S.)
Crude Oil: 0 Mbarrels (0% total U.S.)
Ethanol: 0 Mbarrels (0% total U.S.)

NATURAL HAZARDS OVERVIEW

Annual Frequency of Occurrence of Natural Hazards in Hawaii (1996–2014)

- According to NOAA, the most common natural hazard in Hawaii is Flood, which occurs once every 6.7 days on the average.
- The second-most common natural hazard in Hawaii is Other, which occurs once every 10.1 days on the average.

Annualized Property Loss due to Natural Hazards in Hawaii (1996–2014)

- As reported by NOAA, the natural hazard in Hawaii that caused the greatest overall property loss during 1996 to 2014 is Flood at $6.8 million per year.
- The natural hazard with the second-highest property loss in Hawaii is Earthquake at $2.9 million per year.
### ELECTRIC

**Electric Power Plants:** 39 (<1% total U.S.)
- Coal-fired: 1 (<1% total U.S.)
- Petroleum-fired: 20 (1% total U.S.)
- Natural Gas-fired: 0 (0% total U.S.)
- Nuclear: 0 (0% total U.S.)
- Hydro-electric: 8 (<1% total U.S.)
- Other Renewable: 10 (<1% total U.S.)

**Transmission Lines:**
- High-Voltage (>230 kV): 177 Miles
- Low-Voltage (<230 kV): 731 Miles

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#### Power Plants

<table>
<thead>
<tr>
<th>Nameplate Capacity (MW)</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Oil</th>
<th>Uranium</th>
<th>Water</th>
<th>Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 - 250</td>
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<tr>
<td>251 - 750</td>
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<td>751 - 1,500</td>
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<td>1,501 - 3,000</td>
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<tr>
<td>3,501 - 6,500+</td>
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</tbody>
</table>

#### Transmission Lines

- 220kV - 315kV
- 345kV - 450kV
- 500kV - 525kV
- 735kV - 765kV
- 1,000kV (DC)

*Utility Company* *Shaded by Company*

Data Sources:
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in Hawaii is **Natural Disaster - Earthquake**.
- Hawaii experienced 1 electric transmission outages from 1992 to 2009, affecting a total of 291 electric customers.
- **Natural Disaster - Earthquake** affected the largest number of electric customers as a result of electric transmission outages.


<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Outages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Disaster - Earthquake</td>
<td>291</td>
</tr>
<tr>
<td>All Other</td>
<td>0</td>
</tr>
</tbody>
</table>

Data Source: NERC

Electric Distribution

- Between 2008 and 2013, the greatest number of electric outages in Hawaii has occurred during the month of **December**.
- The leading cause of electric outages in Hawaii during 2008 to 2013 was **Unknown**.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Hawaii was **217,217**.
- The average duration of electric outages in Hawaii during 2008 to 2013 was **1,205 minutes or 20.1 hours a year**.


- **Animal**
- **Faulty Equipment / Human Error**
- **Overdemand**
- **Planned**
- **Theft / Vandalism**
- **Unknown**
- **Vehicle Accident**
- **Weather / Falling Trees**

![Electric Utility Outage Data Chart](chart.png)

Data Source: Eaton

- NOTE: # of Incidents – The number within each pie slice is the number of event incidents attributable to each cause.
PETROLEUM

Petroleum Infrastructure Overview
- Refineries: 2 (1% total U.S.)
- Terminals: 21 (1% total U.S.)
- Crude Pipelines: 0 Miles (0% total U.S.)
- Product Pipelines: 2,700 Miles (<1% total U.S.)
- Bio-Refineries (Ethanol): 0 (0% total U.S.)
Petroleum Transport

Top Events Affecting Petroleum Transport by Truck and Rail (1986–2014)

The leading event type affecting the transport of petroleum product by truck in Hawaii during 1986 to 2014 was Incorrect Operation, with an average 0.7 incidents per year (or one incident every 1.4 years). Petroleum product does not appear to be transported by rail in the State of Hawaii.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in Hawaii from 2003 to 2014 was Equipment Failure or Damage. Hawaii’s petroleum refineries experienced 28 major incidents from 2003 to 2014. The average production impact from disruptions of Hawaii’s refineries from 2003 to 2014 is 22.6 thousand barrels per day.
ENERGY SECTOR RISK PROFILE

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NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 0 (0% total U.S.)
Processing Plants: 0 (0% total U.S.)
Storage Fields: 0 (0% total U.S.)
Interstate Pipelines: 540 Miles (<1% total U.S.)
Local Distribution Companies: 1 (<1% total U.S.)

Data Sources: ANL 2013; EIA 2014; ESRI 2012; Platts 2014; NPMS 2011.
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in Hawaii during 1986 to 2014 was Outside Force for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 0.03 and 0.06 incidents per year (or one incident every 31 and 15.5 years), respectively.

Top Events Affecting Natural Gas Transmission and Distribution in Hawaii (1986–2014)

Data Source: DOT PHMSA
**Overview Information**
- Census Bureau (2012) State and County QuickFacts [http://quickfacts.census.gov/qfd/download_data.html]

**Production Numbers**

**Consumption Numbers**

**Electricity**
- Platts (2014 Q2) Transmission Lines (Miles by Voltage Level)
- Platts (2014 Q2) Power Plants (Production and Capacity by Type)

**Petroleum**
- Argonne National Laboratory (2012) Petroleum Terminal Database
- Argonne National Laboratory (2014) Ethanol Plants
- NPMS (2011) Petroleum Product Pipeline (Miles of Interstate Pipeline)
- NPMS (2011) Crude Pipeline (Miles of Interstate Pipeline)

**Natural Gas**
- EIA (2013) Number of Producing Gas Wells [http://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm]
- NPMS (2011) Natural Gas Pipeline (Miles of Interstate Pipeline)
- Platts (2014 Q2) Local Distribution Companies (LDCs)

**Event Related**

*The NERC disturbance reports are not published after 2009.

**Notes**
- Natural Hazard, Other, includes extreme weather events such as astronomical low tide, dense smoke, frost/freeze, and rip currents.
- Each incident type is an assembly of similar causes reported in the data source. Explanations for the indescribable incident types are below.
  - Outside Force refers to pipeline failures due to vehicular accident, sabotage, or vandalism.
  - Natural Forces refers to damage that occurs as a result of naturally occurring events (e.g., earth movements, flooding, high winds, etc.)
  - Miscellaneous/Unknown includes releases or failures resulting from any other cause not listed or of an unknowable nature.
  - Overdemand refers to outages that occur when the demand for electricity is greater than the supply, causing forced curtailment.
  - Number (#) of Incidents – The number within each pie chart piece is the number of outages attributable to each cause.

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