Interconnection of Distributed Energy Resources in Hawaii

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Hawaii’s Clean Energy Policies

- Hawaii has some of the most aggressive clean energy policies in the country
  - 100% Renewable Portfolio Standard by 2045
  - 4,300 GWh Energy Efficiency Portfolio Standard by 2030
- Each of the islands is rapidly advancing towards these overarching policy objectives
- Success will represent a dramatic transformation of the electricity sector in Hawaii
HECO Companies Historical Renewable Growth and Projected Future Achievement

Source: Hawaii PUC 2018 RPS Report
Kauai Island Coop Historical Renewable Growth and Projected Future Achievement

Source: Hawaii PUC 2018 RPS Report
Recent Projects Suggest High Levels of RE May Be Possible Sooner

- PUC approved 6 new solar + storage projects for Hawaiian Electric Cos.
  - Totaling nearly 250 MW of generation and 1 GWh of storage
  - Across Oahu, Maui, and Hawaii islands
- KIUC recently announced it has passed 50% renewable generation with it’s latest solar + storage project
  - Anticipate achieving more than 70% renewable by as early as 2020
Demand Side Resources Critical for Cost-effective Renewable Achievement

- Demand side of the equation is a critical part of achieving broader policy objectives, especially as we progress closer towards 100% renewable
  - Includes energy efficiency, distributed storage, flexible/controllable demand, electric vehicles, etc.
- Increasingly, Hawaii will rely on “supply” from demand-side resources, which limits the usefulness of the distinction going forward

<table>
<thead>
<tr>
<th>December 2016 PSIP Projections</th>
<th>2017-2021</th>
<th>2022-2045</th>
</tr>
</thead>
<tbody>
<tr>
<td>New DG-PV</td>
<td>326 MW</td>
<td>2,086 MW</td>
</tr>
<tr>
<td>New Customer Self Supply (CSS) Energy Storage</td>
<td>89 MW-hr.</td>
<td>1,057 MW-hr.</td>
</tr>
<tr>
<td>New Demand Response Capacity</td>
<td>115 MW</td>
<td>442 MW</td>
</tr>
<tr>
<td>New Demand Response Energy Storage</td>
<td>104 MW-hr.</td>
<td>1,608 MW-hr.</td>
</tr>
</tbody>
</table>

- In addition to about 3,000 MW of new utility-scale renewable generation, HECO’s plans by 2045 include more than:
  - 2,400 MW of distributed solar PV
  - 550 MW and 2.8 GWh of distributed energy storage

Source: Hawaiian Electric Grid Modernization Strategy
Distributed Energy Integration Challenges

<table>
<thead>
<tr>
<th>System-level</th>
<th>Examples of Technical Integration Challenges</th>
<th>Contingency Events</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over-generation and increasing variability in generation resulting in:</td>
<td>Behavior of aggregate DER fleet may exacerbate grid instability during emergencies:</td>
</tr>
<tr>
<td></td>
<td>- Curtailment of other renewable generation</td>
<td>- Need grid-supportive frequency and voltage trip and ride through settings</td>
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<tr>
<td></td>
<td>- Frequency regulation and ramping challenges for central generation</td>
<td></td>
</tr>
<tr>
<td>Circuit-level</td>
<td>Over-generation resulting in:</td>
<td>Behavior of DER systems during circuit-level contingencies may result in:</td>
</tr>
<tr>
<td></td>
<td>- Approaching or exceeding distribution system equipment capacity limitations</td>
<td>- Unintentional islanding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Temporary load rejection overvoltage</td>
</tr>
</tbody>
</table>

Source: Table 2, Staff Report and Proposal, Docket No. 2014-0192, March 31, 2015
## DER Policy Dockets in Hawaii

<table>
<thead>
<tr>
<th>Docket Title</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Distributed Energy Resources (2014-0192)**     | • Interconnection requirements for DER, including advanced inverter functions  
• New tariff options (e.g., Smart Export) for customers to deliver energy and other services to the grid, alongside dynamic rate designs (e.g., time-of-use)                                                                 |                                                                                                                                                                                                                                                                                   |
| **Demand Response Portfolio (2015-0412)**        | • Market-based procurement of grid services from DER, including aggregated loads, distributed generation, and storage  
• Enables customers to provide ancillary services (e.g., frequency response, regulation) more cost-effectively than conventional solutions |                                                                                                                                                                                                                                                                                   |
| **Grid Modernization (2018-0141)**               | • Advanced grid technologies and software systems to enable DER integration and utilization  
• Includes operational dispatch of customer loads, distribution system sensing, communications, automation, control, and metering infrastructure                                                                                                                                       |                                                                                                                                                                                                                                                                                   |
| **Integrated Grid Planning (2018-0165)**         | • Integrated planning process across generation, transmission, and distribution  
• Competitive sourcing mechanisms for grid infrastructure and services, including non-wires solutions                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                   |
DER Tariffs and Interconnection Standards

**DER Program Options**
- Self-Supply (non-export)
- CGS+ (utility control when needed)
- Smart Export (time-varying export prices)

**Rule 14H (DER Interconnection)**
- Frequency and Voltage Ride Through
- Volt-var and Volt-Watt
- Frequency-Watt
Hosting Capacity Analysis

Source: HECO Companies
## Interconnection Queue

<table>
<thead>
<tr>
<th>Queue Position</th>
<th>Agreement ID</th>
<th>Procurement</th>
<th>Project Developer ID</th>
<th>System Size</th>
<th>Circuit</th>
<th>Review Status</th>
<th>Date Interconnection Application Received</th>
<th>Date Determined Complete and Valid</th>
<th>IRS Start</th>
<th>IRS Complete</th>
<th>Date Project Must Be Complete</th>
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Grid Modernization Essential to Integrating Additional Renewables

- PUC Approved HECO Companies Phase 1 Grid Modernization Project in March 2019

- $86 M investment in advanced grid technologies to enable DER integration and utilization

- Includes distribution system sensing, communications, automation, control, and metering infrastructure
Mahalo!

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Daily Load Profiles in 2020 and 2045

Energy Profile for 6/14/2020

Energy Profile for 3/19/2045

Source: Hawaiian Electric 2016 PSIP Update