Advancing Renewables: Lessons Learned in Hawaii (So Far)

Presented by:
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Hawaii Public Utilities Commission
Where we are...
Hawaii Electric Systems – 4 Electric Utilities; 6 Separate Grids; % Renewable

**Kaua’i Island Utility Cooperative**
System Peak: 78 MW
52.6 MW PV / 7 MW Biomass / 9 MW Hydro
(+6.6 MW PV Under Review)
Installed PV: 67% of System Peak

**Hawaiian Electric**
System Peak: 1,206 MW
329 MW PV / 99 MW Wind 69 MW WTE
(+138.5 MW PV & Wind Approved to Install / +88.5 MW PV Under Review)
Installed PV & Wind: 35% of System Peak

**Maui Electric**
Maui System Peak: 202 MW
74 MW PV / 72 MW Wind
(+40 MW PV Approved or Under Review)
Installed PV & Wind: 72% of Sys. Peak
Lana’i System Peak: 5.1 MW
2.53 MW PV (50% of Sys. Peak)
Moloka’i System Peak: 5.6 MW
2 MW PV (36% of Sys. Peak)

**Hawai’i Electric Light**
System Peak: 192 MW
75 MW PV / 30 MW Wind / 38 MW Geothermal / 16 MW Hydro
(+31 MW PV Approved or Under Review)
Installed PV & Wind: 55% of System Peak
Hawaii Retail Electric Rates
2015 – 2016 ¢/kWh

<table>
<thead>
<tr>
<th>Sector</th>
<th>March 2015</th>
<th>March 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>$0.3087</td>
<td>$0.2735</td>
</tr>
<tr>
<td>Commercial</td>
<td>$0.2797</td>
<td>$0.2399</td>
</tr>
<tr>
<td>Industrial</td>
<td>$0.2379</td>
<td>$0.1986</td>
</tr>
<tr>
<td>All Sectors</td>
<td>$0.2712</td>
<td>$0.2324</td>
</tr>
</tbody>
</table>
Hawaii Is A Leader In Renewable Integration - 1

- In 2015, statewide renewable generation equaled 2198.8 GWh:
  - Wind – 27.9%
  - Distributed PV – 31.0%
  - Biomass – 19.2%
  - Geothermal – 10.5%
  - Hydro – 4.9%
  - Commercial Solar – 4.2%
  - Biofuels – 2.4%

- At end of 2015, 22% of total GWh, still 70% imported oil fired generation
Hawaii Is A Leader In Renewable Integration - 2

- Hawaii leads the nation in the penetration of residential rooftop solar PV systems:
  - Over 77,000 residential customers (17%) have rooftop solar PV systems installed or approved
- By necessity, Hawaii is at the forefront of integration issues associated with these high – and growing – penetration levels
Hawaii Renewable Portfolio Standards

2020 – 30%
2030 – 40%
2040 – 70%
2045 – 100%

70%/100% - Unless unable to acquire sufficient RE resources compared to economics of fossil fuel resources
60 RENEWABLE PROJECTS

Surrounded by ocean with year-round tropical sunlight, steady trade winds, and a volcano, the Hawaiian Archipelago is blessed with rich natural energy resources that make it ideal for achieving energy independence. These projects have the capacity to generate an estimated 180,637,333 kWh per month, which is enough to power approximately 200,000 Hawaii homes a year for the next 10 to 20 years.

- High percentage of daytime load (> 50%) is frequently provided by wind and solar on some islands
- Demand for rooftop solar remains high
- Individual circuits at or approaching 250% of minimum daytime load
How we got here...
Many Pieces To The Renewable Puzzle
Selected Pieces – Statutes:

- 1996 – First NEM Statute
- 2006 – Public Benefits Fund established
  - Used to support clean energy technology, energy use reduction, and demand side management
- 2009 - Energy Efficiency Portfolio Standards,
- 2011 – On Bill Financing - payment or renewable energy system or energy efficient device through assessment on customers bill
- 2012 – Reliability Standards & Interconnection Protocols
  - PUC may set standards
- 2013 – Grid Modernization
  - Commission shall consider the value of improving electrical generation, transmission, and distribution systems and infrastructure within the state using advance grid modernization technology
April 2014 – Four orders plus “Inclinations”:

- Rejection of IRPs, issuance of “Inclinations on the Future of Hawaii’s Electric Utilities”
  - Articulates the vision, business strategies and regulatory policy changes required to align the utilities’ business model with customers' changing expectations and state energy policy
  - Utilities need to move with urgency to modernize the generation system on each island grid, “delays are lost savings opportunities
  - New transmission projects must consider whether there are non-transmission alternatives (“NTAs”)
  - Distribution system must have the capability to act both as (1) a delivery service and (2) an aggregator of customer-sited distributed energy resources that benefit the customer and the grid.
Many Pieces To The Renewable Puzzle
Selected Pieces – Commission Orders - 2:

First Power Supply Improvement Plan - purpose of the PSIP is to
determine a reasonable power supply plan for each utility that can serve as
a strategic basis and provide context to inform important pending and
future resource acquisition and system operation decisions, so as to:

- Lower and stabilize customer bills;
- Integrate a diverse portfolio of cost-effective renewable energy projects;
- Operate each island grid reliably and cost-effectively with substantial
  quantities of variable renewable energy resources.

Demand Response Policy Statement – policy guidelines for continued
operation and expansion of DR
Net Energy Metering In Hawaii

Summary

- 1996 – 0.1% of peak demand
- 2001 – 0.5% of peak demand
- 2008 – 1.0% of peak demand
- 2011 – NEM caps eliminated:
  - 15% per distribution circuit threshold adopted

NEM participation increased by over 60 times the cap originally established by the Legislature.

NEM Capacity is now:
- 30% of HECO System Peak
- 42% of HELCO System Peak
- 53% of MECO System Peak

NEM program customers account for almost 20% of all customers on HECO and MECO systems.

NEM Cap Increases

- 1996 – 0.1% of peak demand
- 2001 – 0.5% of peak demand
- 2008 – 1.0% of peak demand
- 2011 – NEM caps eliminated:
  - 15% per distribution circuit threshold adopted
Net Energy Metering In Hawaii - 1

- **1996** – total rated generated capacity limited to 0.1% of peak demand
- **2001** – Limit raised to 0.5% of peak demand
  - Credits – **full retail rate** – The net energy metering calculation shall be made by measuring the difference between the electricity supplied to the ECG and the electricity generated by NEM systems in a given month, with carry over unused credits annually
- **2005** – Statute amended – PUC **may increase**:
  - total rated generating capacity produced by ECGs to an “amount above” 0.5% of peak demand
  - maximum generating capacity that ECGs may have to an amount greater than 50kW
- **2006** - PUC initiates investigation to determine whether to permit these increases

<table>
<thead>
<tr>
<th>Year</th>
<th>NEM MW (All Islands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.2 MW</td>
</tr>
<tr>
<td>2005</td>
<td>0.37 MW</td>
</tr>
<tr>
<td>2006</td>
<td>1 MW</td>
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</tbody>
</table>
2008 – by statute, PUC may modify:

- The total rated generating capacity produced by ECGs provided that a percentage reserved for residential and small commercial customers
- Maximum capacity for residential and small commercial ECGs

Senate Committee Report states:

- “Further study is necessary to prevent detrimental customer subsidization and system safety impacts”
- “the PUC requires the flexibility to evaluate and set the thresholds for the total rated generating capacity… applicable to NEM”

Cumulative NEM MW (All Islands)

<table>
<thead>
<tr>
<th>Year</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2.41</td>
</tr>
<tr>
<td>2008</td>
<td>7</td>
</tr>
</tbody>
</table>
2008 – PUC approves stipulations that increased:

- maximum generating capacity from 0.5% to 1.0% of peak demand
- maximum size of ECGs to 100 kW for HECO Companies, but kept at 50 kW for KIUC
- PUC found that stipulation should allow for growth in NEM for a reasonable period
- Utilities directed to evaluate and report the effects of further increases
2011 – PUC approves stipulations:

- For the HECO Companies:
  Eliminates NEM total rated generating capacity caps in favor of a 15% per distribution circuit threshold for distributed generation (“DG”) penetration

- For KIUC:
  Limits NEM rate to a fixed $0.20 per kWh and adjusting caps so as to allow up to 2 MW in aggregate for facilities from 50 kW kW up to 200 kW, and 1 MW for facilities smaller than 50 kW

- NEM program closed June 3, 2014, three years after tariff approved; approximately 0.8 MW of total subscribed capacity

Cumulative NEM MW (All Islands)

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<tr>
<th>Year</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>15</td>
</tr>
<tr>
<td>2010</td>
<td>27</td>
</tr>
<tr>
<td>2011</td>
<td>58</td>
</tr>
</tbody>
</table>
Circuits with installed PV up to and greater than 250% of daytime minimum load (DML) as of June 20, 2016
Closes NEM Program to new customers –
“simply not designed for DER deployment at the scale experienced today”

PUC allowed expansion far beyond original cap in conjunction with increased knowledge and mitigation of some technical challenges

NEM now represents between 30% and 53% of each of the HECO Companies’ peak load
Decision and Order No. 33258
Filed October 12, 2015 - 2

- Challenge facing the State is to ensure that DER continues to grow in such a way that it benefits all customers as transition to 100% renewable
- NEM program has fulfilled core objective of “jumpstarting” adoption of renewable energy
- Existing NEM customers and those in queue are grandfathered – existing agreements shall be honored, but no additional capacity may be added to existing systems
- Next step in this ongoing process is the creation of two new programs – self supply and grid supply options

Cumulative NEM MW (All Islands)

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<tr>
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<tbody>
<tr>
<td>2001</td>
<td>0.2 MW</td>
</tr>
<tr>
<td>2012</td>
<td>132 MW</td>
</tr>
<tr>
<td>2013</td>
<td>240 MW</td>
</tr>
<tr>
<td>2014</td>
<td>313 MW</td>
</tr>
<tr>
<td>2015</td>
<td>383 MW</td>
</tr>
</tbody>
</table>
Installed NEM Capacity (MW) – HECO Companies
2015 Installed NEM Capacity (MW) - KIUC
Where are we headed...
Ongoing Efforts
To Complete The Puzzle

- Ongoing dockets concerning:
  - Power Supply Improvement Plans
  - Distributed Energy Resources – technical and policy issues
  - Demand response
  - Time Of Use rates
  - Smart meters
  - Grid improvements
  - Implementation of Community Based Renewable Program
  - Interim NEM replacements: Grid Supply and Self Supply Options
Grid Supply Option - 1

- Customers have option to export excess energy to the grid in exchange for energy credit against bill
- Functionally similar to NEM, but rate not tied to retail electricity price
- Price = 12 month average on peak avoided cost as of June 2015
  - Commission finds this is a reasonable approximation of the relative value of energy supplied to the grid
- Interim measure to enable continued beneficial deployment of DER in Hawaii

<table>
<thead>
<tr>
<th>Location</th>
<th>Grid Supply Credit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oahu</td>
<td>15.07¢</td>
</tr>
<tr>
<td>Hawaii</td>
<td>15.14¢</td>
</tr>
<tr>
<td>Maui</td>
<td>17.16¢</td>
</tr>
<tr>
<td>Lanai</td>
<td>27.88¢</td>
</tr>
<tr>
<td>Molokai</td>
<td>24.07¢</td>
</tr>
</tbody>
</table>
Grid Supply Option - 2

- Prudent to establish an initial cap on the availability of the grid supply option – unconstrained growth is not in the public interest given the finite capacity of each island’s grid to accommodate uncontrolled export of energy during mid-day hours

- Caps: $25 \text{ MW}_{\text{ac}}$ for HECO,
  
  $5 \text{ MW}_{\text{ac}}$ each for MECO & HELCO

- Despite comments that grid supply would not be popular:
  - Maui cap has been reached
  - May 16, 2016 – coalition of PV suppliers and others files motion to increase the caps – action pending
Self Supply Option

- A non-export solution for PV customers allowing them to use PV to meet their energy needs and a limited amount of inadvertent export to the grid.
- Systems under this option to be approved on a fast track basis.
- Allows utility and customer to agree in writing for customers to deliver power.
- Utilities must document need for any additional equipment or modifications to existing equipment.
- Essentially invites a combination of PV and battery storage.
Lessons Learned In Hawaii - 1

- Transformation to renewables involves many interests and parties: legislators, regulators, utility operators, third parties
- Ultimately, market forces (customer choice), new technologies, and declining costs will drive the scope and scale of the transformation
- It is important to embrace new technologies, but “everything new becomes old again,” so expect set backs
- Diversified portfolios are (still) necessary to ensure affordable rates – renewable & fossil fuels, distributed energy & utility scale renewables
Lessons Learned In Hawaii - 2

Hawaii experienced:

- Exponential growth in PV installations which, for a variety of reasons, exceeded ability to manage interconnections and costs
- Created a boom/bust cycle for installers – interconnection approvals slowed due to safety, reliability, and operational concerns

Some major issues (many more now and to come):

- How to provide utility customers with choices and enable utilities to serve non-DER customers at reasonable costs
- How to migrate from “dumb” to “smart” DER
- How to effectively establish and manage a flexible generation, transmission, and distribution system
Mahalo to Dr. James (Jay) Griffin & David Parsons for their assistance

For additional information, please contact
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Additional Material
1996 – Hawaii Revised Statute ("HRS") 269-16.21
- Limit - total rated generated capacity under NEM limited to 0.1% of peak demand

2001 – Recodified as HRS 269-101 to 269-111
- Limit – 0.5% of peak demand
- Credits – full retail rate – The net energy metering calculation shall be made by measuring the difference between the electricity supplied to the ECG and the electricity generated by the EGC in a given month, with carry over unused credits annually

2004 – Statute amended to include “governmental entities” as eligible customer-generators (“ECGs”)
- Increased metered capacity for residential and commercial ECGs from 10 kW to 50 kW
2005 – Statute amended – PUC may increase:
  - total rated generating capacity produced by ECGs to an “amount above” 0.5% of peak demand
  - maximum generating capacity that ECGs may have to an amount greater than 50kW

2006 – PUC initiates investigation to determine whether to increase:
  - total rated generating capacity produced by ECGs to above 0.5% of peak demand
  - Maximum generating capacity above 50 kW
2008 – Statute amended - PUC may modify:
- total rated generating capacity produced by ECGs provided that a percentage reserved for residential and small commercial customers
- maximum capacity for residential and small commercial ECGs

2008 – Senate Committee Reports:
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