Energy Storage and Hawaii Projects

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Sandia National Laboratories

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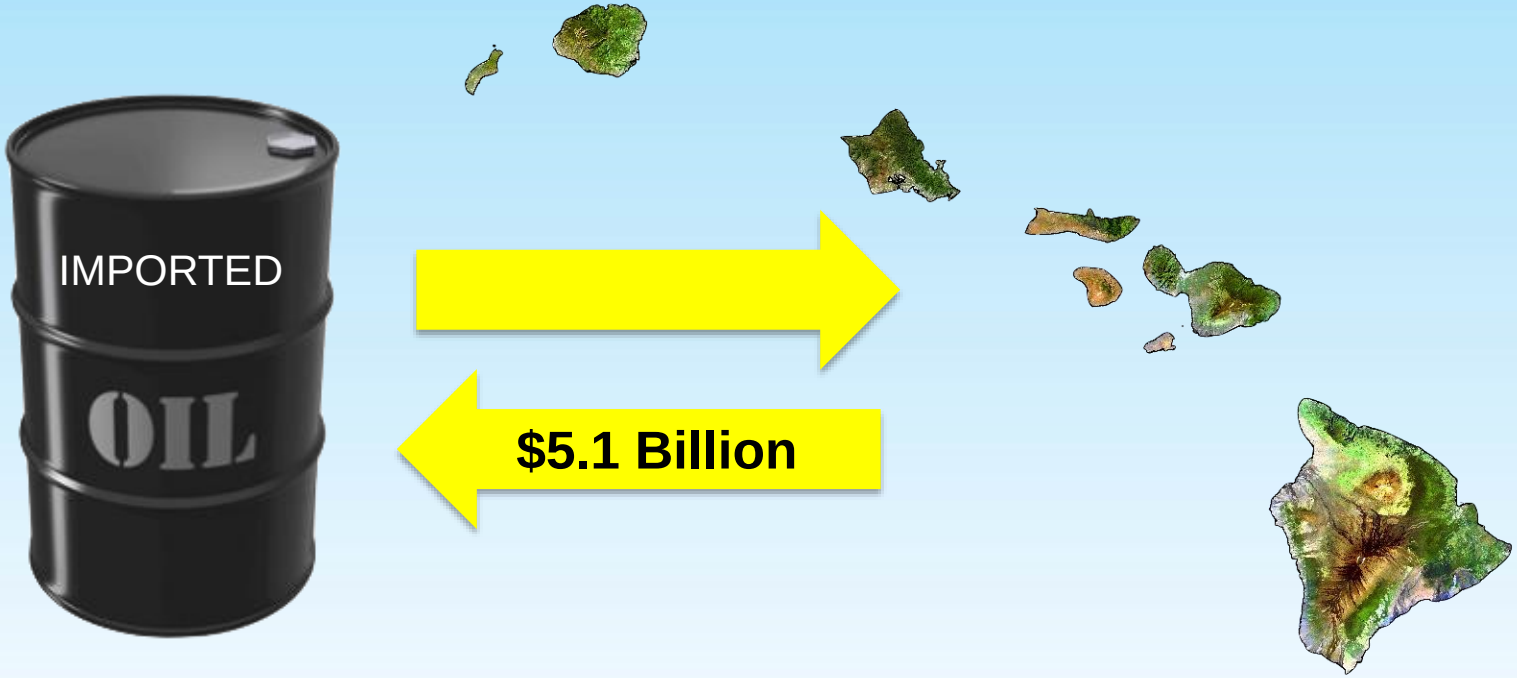
Breaking Our Addiction to Oil

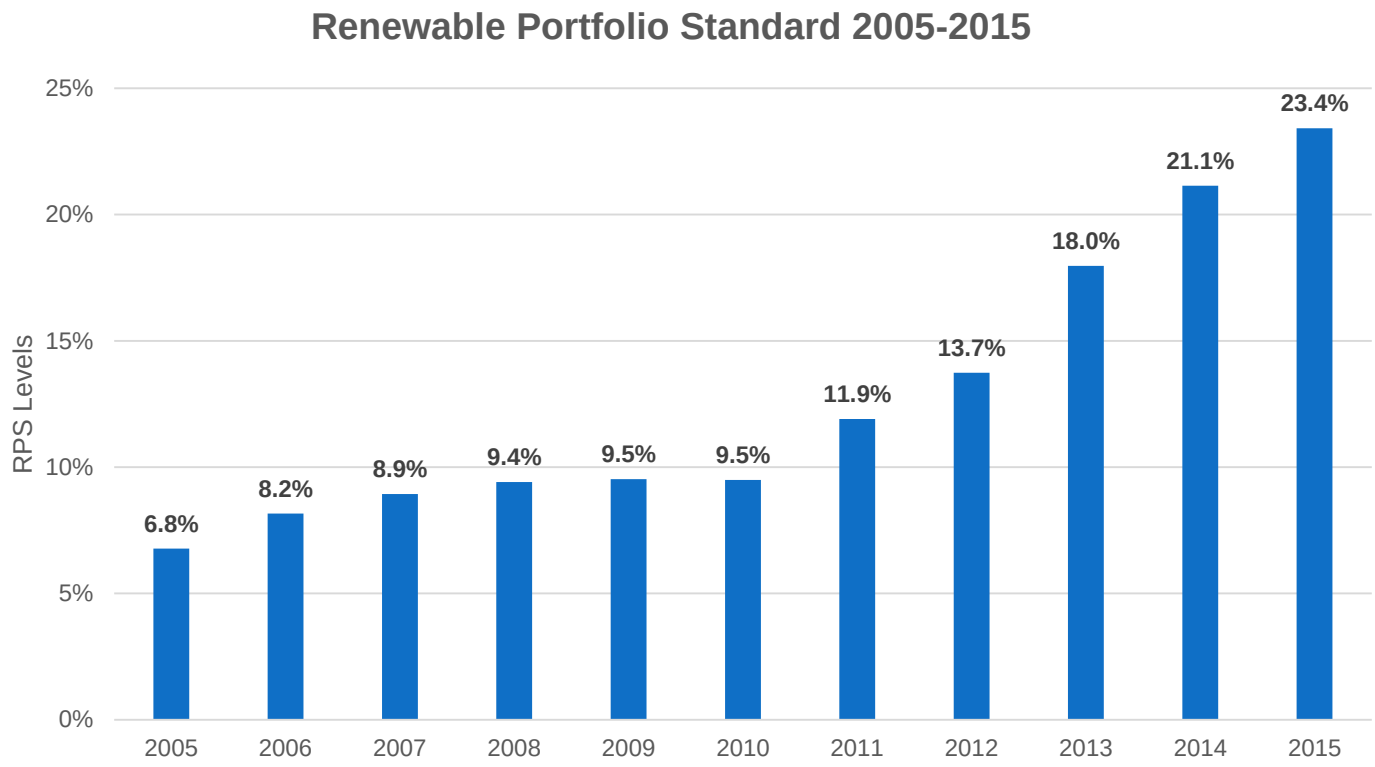
- Most oil dependent state in the U.S. – imported 93% of our energy in 2014
- Pays the highest electricity rates in the U.S.



100% RPS by 2045

- Under Act 97 Hawaii is the first state to set a 100% RPS.
- Establishes confidence in the market & drives investment decisions.
- RPS goals:
  - 15% by 2015 → Achieved early (2013)
  - 30% by 2020
  - 40% by 2030
  - 70% by 2040
  - 100% by 2045

Renewable Portfolio Standard Status



Source: *Renewable Portfolio Standards Status Reports,* 2005-2015 (Hawaii Public Utilities Commission)

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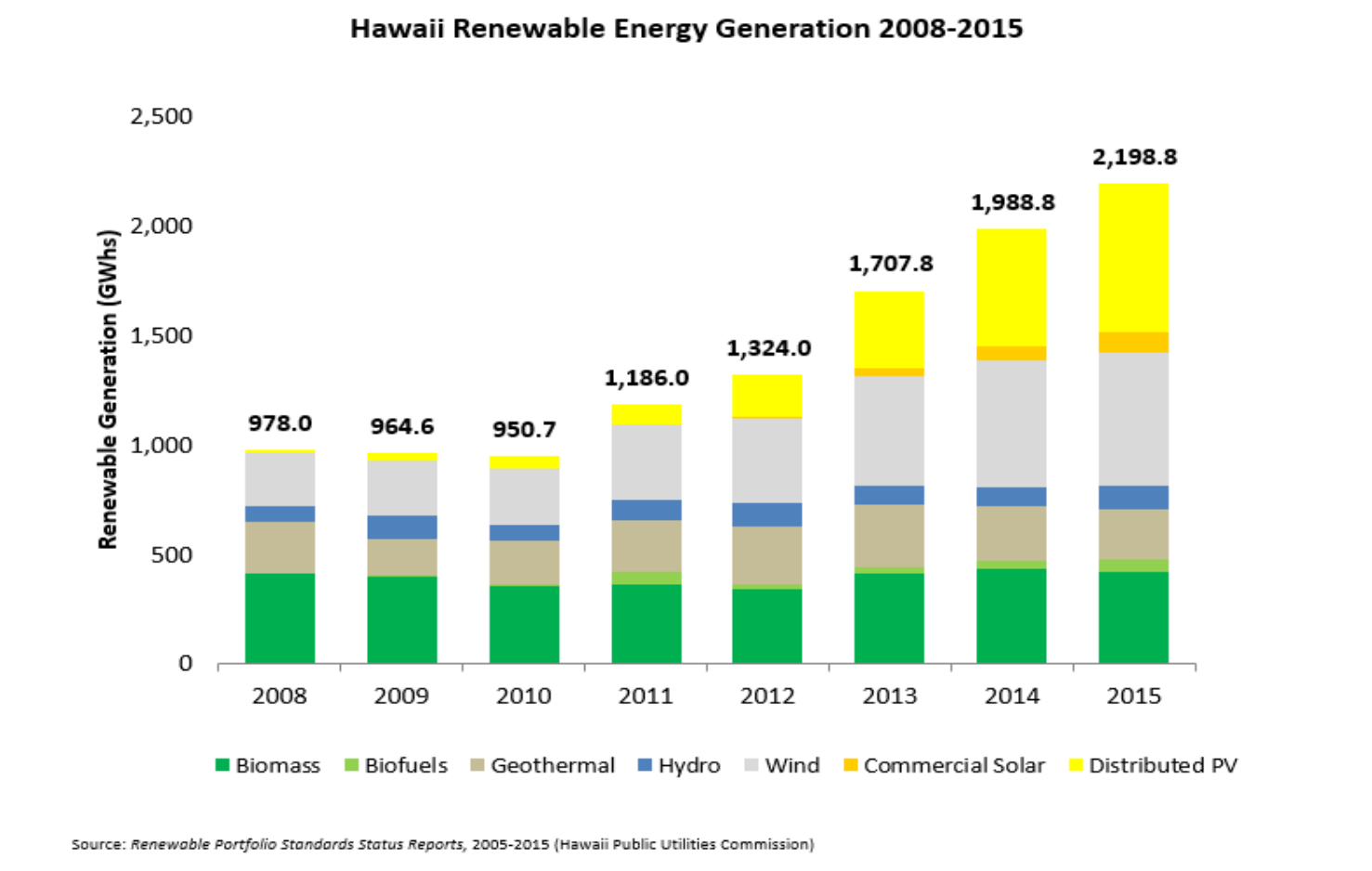
Striving for a Diversified Portfolio of Renewables



Source: *Renewable Portfolio Standards Status Reports*, 2005-2015 (Hawaii Public Utilities Commission)

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PSIP – Inclusion of Storage in System Wide Utility Planning Toward 100% RPS

- Power Supply Improvement Plans (PSIP) Update Report filled with Hawaii PUC on April 1, 2016
  - Considered battery storage and pumped storage hydro (although hydro does not actually appear in plans) at utility-scale and customer level
  - Potential benefits and capabilities
    - Load Shifting
    - Ancillary services, including fast frequency reserves, primary frequency reserves, regulation reserves, and replacement reserves.
    - "**Using storage to provide these functions provides an alternative to obtaining these services from online generation and can increase the ability of the system to accept more renewable energy**." (PSIP, I-9)

Reference: Docket No. 2014-0183

PSIP – Storage Options Being Pursued

- Plans considered battery storage and pumped storage hydro (although hydro does not actually appear in plans)
- 90 MW utility-scale battery storage in Oahu
  - To provide contingency reserve power to help maintain reliability in emergency situation, ensure energy resiliency under low inertia operating conditions, and help meet fluctuating energy needs due to variable wind and solar resources.
  - Storage will also be installed in Maui and Hawaii Island for same purpose.
- Energy storage pilot and research projects
- Evaluation of other storage options and their procurement

Reference: Docket No. 2014-0183

PSIP – Determining Value of Storage

- Update, define and determine the amount of technology-neutral ancillary services required to meet reliability criteria, rather than relying on must-run generating units, so any qualified resource can meet them.
- Objective: to identify the lowest reasonable cost combination that ensures system security for a given resource plan and in subsequent iterations, let the market and specific resource applications determine available resources.
- This analysis will be done in the future and in conjunction with ongoing demand response proceeding.

Reference: Docket No. 2014-0183

DER – Advancement of Distributed Energy Resources Interconnection

- Distributed Energy Resources Docket
  - Stemmed from RSWP, IRP, DGIP
  - Phase I PUC Decision & Order
    - Stipulated revisions of RSWG PV Subgroup
    - NEM closure
    - Establishment of Customer Grid-Supply and Customer Self-Supply Tariffs
      - Includes rules for interconnection of distributed scale storage
    - Modified TOU tariff
    - Approval of advanced inverter functions

Advancement of Distributed Energy Resources Interconnection - Continued

- Phase II is underway; topics of discussion include:
  - **Opportunities to integrate and aggregate various forms of Distributed Energy Resources** (PV, Storage, Demand Response, etc.)
  - Ongoing assessment of technical integration challenges and ensuring safe and reliable integration of DER
    - Evaluate impact of legacy inverters
    - Collaboration with inverter manufacturers and Parties to proceeding on self-certification process and test-plan for advanced inverter functions approved for inclusion in Rule 14H
    - Distribution-level and system-level hosting capacity – **will likely include further storage grid-impact characterization**
  - Developing proposals for establishing an appropriate DER market structure

Storage Status – As of March 31, 2016

- Grid-Sided Energy Storage (owned by utility or IPP)

Energy Storage Type and Technology at Hawaiian Electric Companies in kW				
Storage Type	Storage Technology	O'ahu	Hawai'i	Maui, Molokai, Lana'i
Chemical	Lithium Ion	6	1,100	11,000
	Advanced lead Acid	0	0	11,200
Thermal	Ice Storage	0	0	0
	Hot water	N/A	N/A	N/A
Mechanical	Pumped Storage	0	0	0
	Compressed Air Storage	0	0	0
	Flywheel	0	0	0

- Customer-Sided Battery Energy Storage (NEM, SIA, FIT, CSS, CGS)

Cumulative No. and Size of PV Systems with Battery Energy Storage						
Program (As of March 31, 2016)	O'ahu		Hawai'i		Maui / Lana'i /Moloka'i	
	No.	Size (kW)	No.	Size (kW)	No.	Size (kW)
NEM	103[2]	901	55[3]	233	21	188
SIA	5	162	1	7	1[4]	227
FIT[5]	0	0	0	0	0	0
CSS	0	0	0	0	0	0
CGS	0	0	0	0	0	0
Other	0	0	0	0	0	0

Sample Project:
KIUC PPA with Solar City

- 17 MWdc PV + 13 MWac/52 MWH battery energy storage system (BESS)
- SolarCity will build, own, operate, maintain and repair
- Key facility benefits:
  - BESS will enable the Facility to be "firm-like“
  - KIUC intends to use approximately 80% - 85% of the output from the PV System to charge the BESS, such that KIUC will be able to dispatch the stored energy to:
    - Help with ramping towards KIUC's afternoon/evening peak, avoiding or reducing the need for KIUC to ramp up its conventional oil-fueled units
    - Shave the evening peak, avoiding or reducing the need to dispatch KIUC's most inefficient conventional oil-fueled unit(s)).
- Facility is anticipated to reach full-scale commercial operation in the fourth quarter of 2016

Reference: Docket No. 2015-0331

Sample Project:
Stem's Fast Acting Grid Resource

- 1 MW pilot project across 30 customer sites to be fully deployed in 2016
- Aimed at demonstrating how distributed storage can help the utility affordably integrate more renewable energy onto the system
- Providing insight on potential structuring of future DR programs
- Customers leverage storage and software for savings e.g. manage and reduce peak demand charges
- Load control by grid operators
  - Aggregator role provides opportunity for utility access to excess capacity and customer's demand peak shaving
- Grid resources (ancillary resources) will be based on response time and availability to serve grid instead of customer's load

SHINES: Advancing innovation & growth in PV + storage

- Sustainable and Holistic Integration of Energy Storage and Solar PV
- Multi-million research project funded by US DOE
- Working with multiple partners, HECO will develop an energy management platform to give it greater visibility and control of the stored solar energy-generated electricity
  - Design and demonstrate energy management logics to view, evaluate and manage distribution-system level, customer-sited resources without compromising grid reliability

Mahalo

Thank you!

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