Morgan Lewis

RENEWABLE ENERGY AND STORAGE

Ken Kulak
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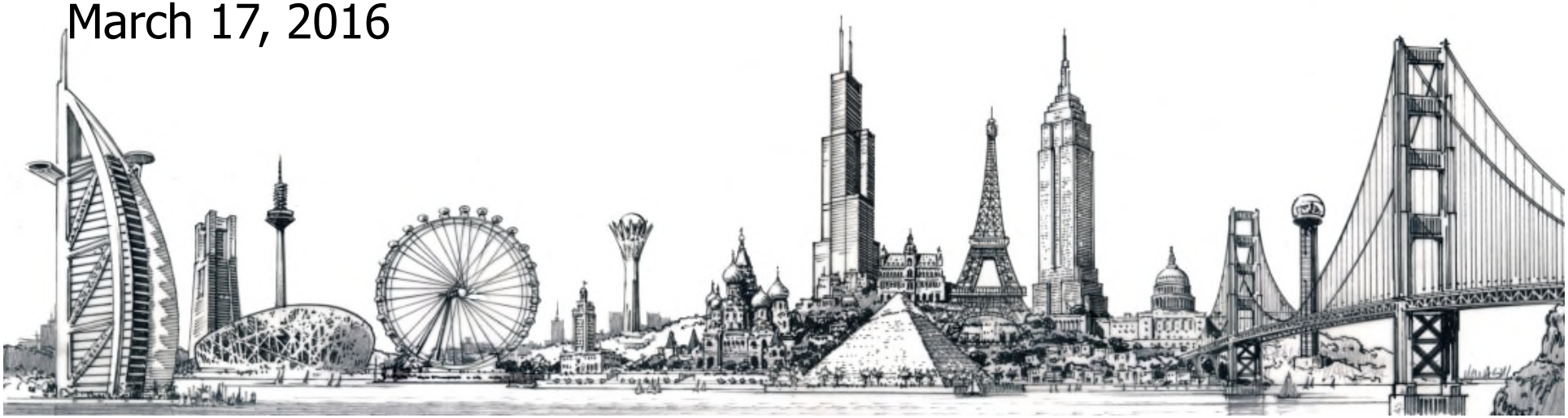
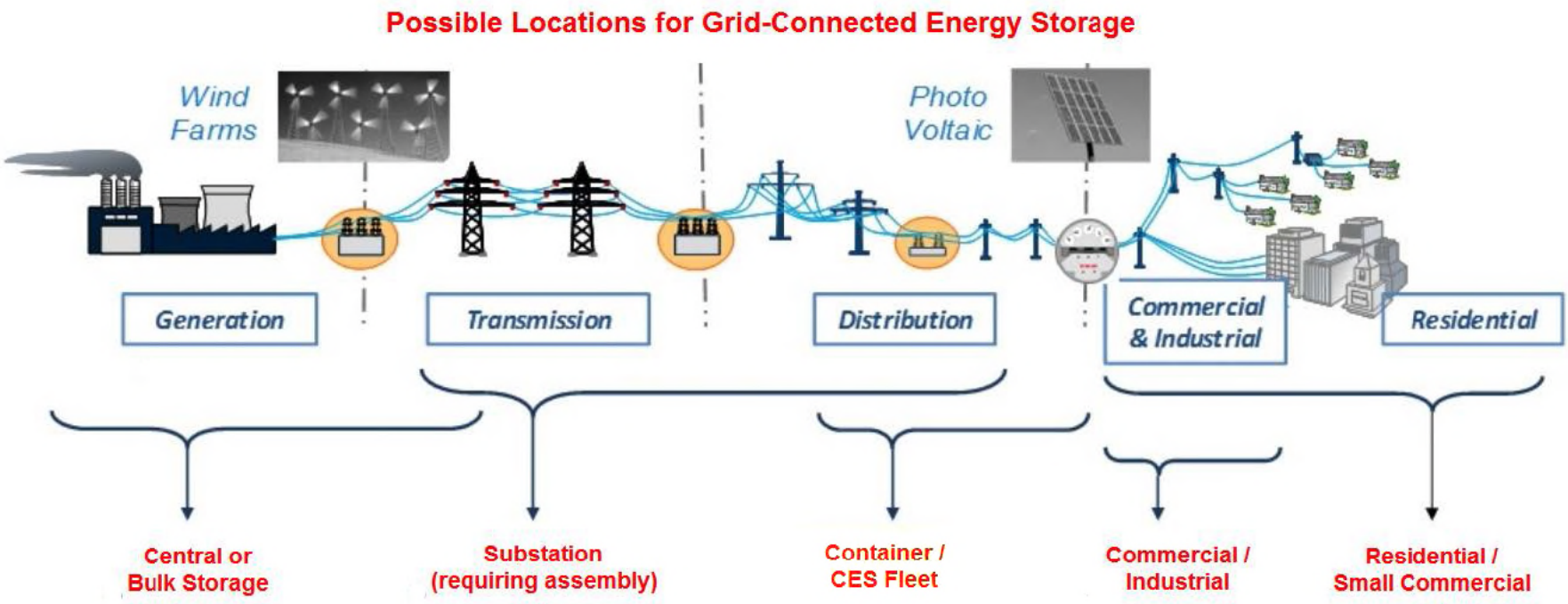
March 17, 2016



The Emerging Storage Landscape

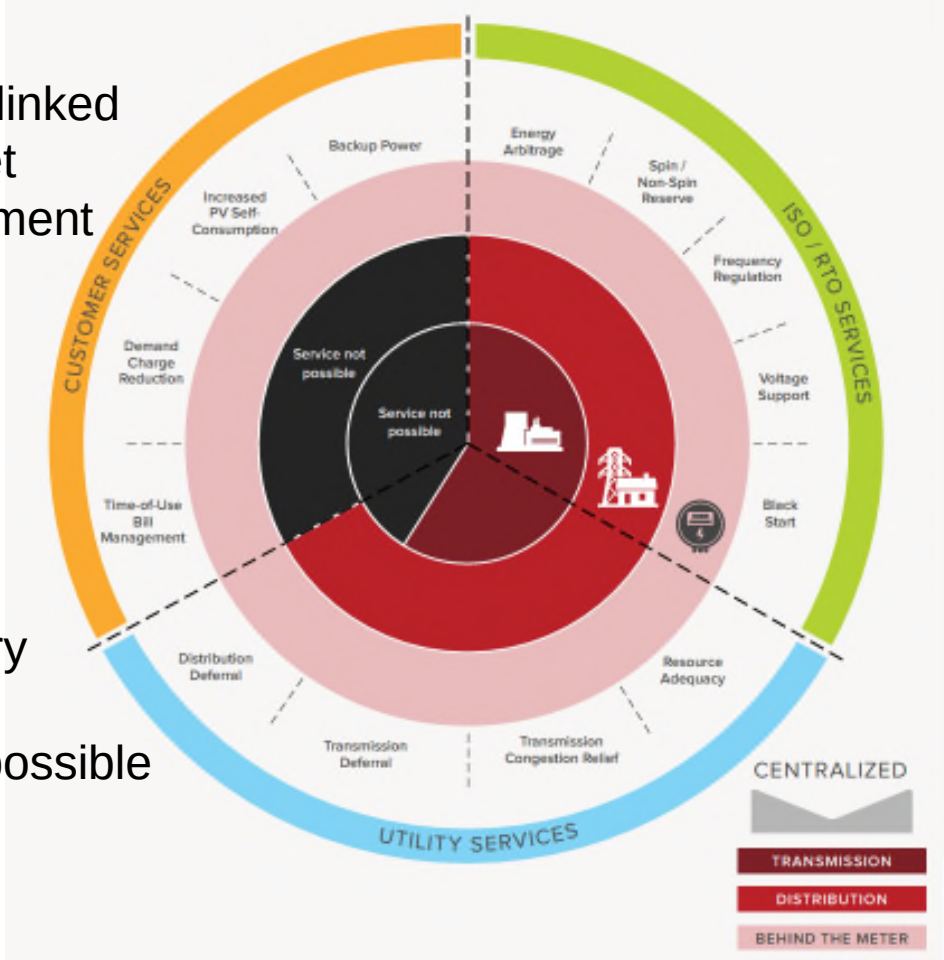


Source: Sandia National Labs / DNV KEMA

Storage Landscape: A Deeper Dive

- Value of storage linked to particular market and customer segment

- Multiple regulatory drivers for value propositions with possible change over time



- Key question: Can these value/ revenue streams be “stacked” to support growth and mitigate risk?

Source: RMI, The Economics of Battery Storage

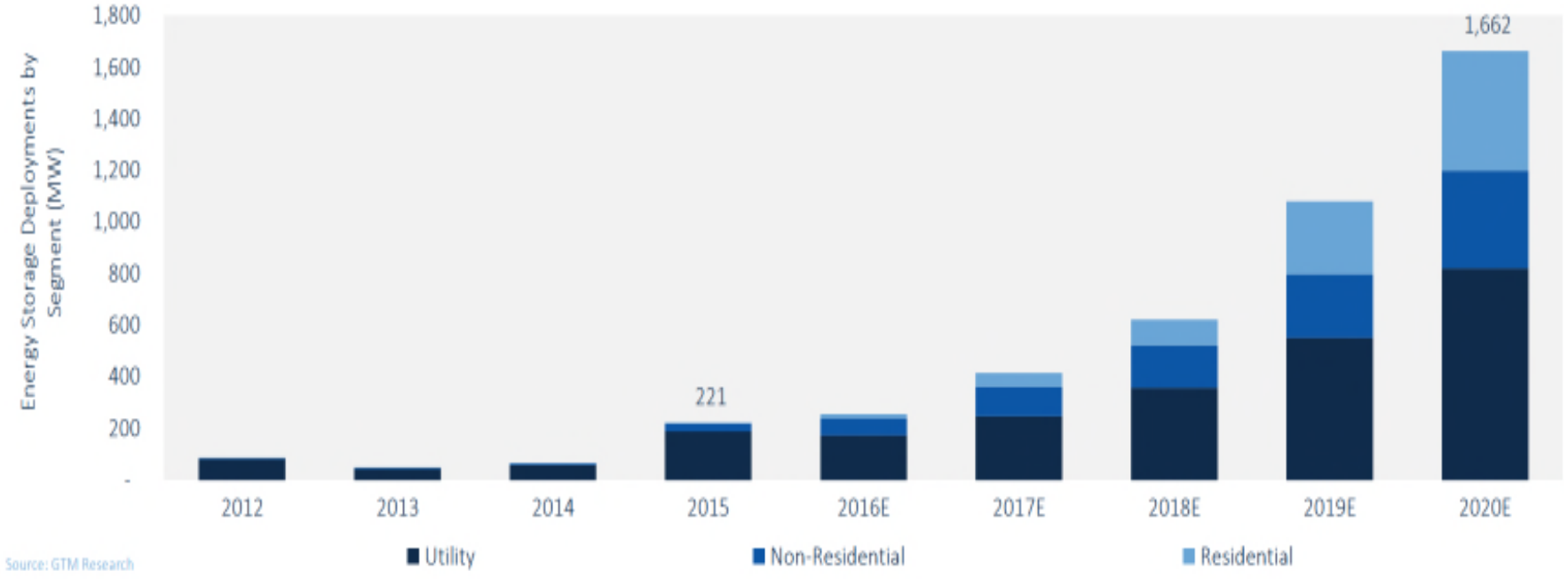
So Why The Excitement?

- Significant growth rates, but deployments are starting from a very low level
- Policy drivers at federal/state levels and large number of interconnection requests

	2015	2014	Change
Total Deployments (MW)	221	65	Up 243%
Total Deployments (MWh)	161	86	Up 88%
Front-of-Meter Deployments (MW)	187	58	Up 223%
Behind-the-Meter Deployments (MW)	35	6.9	Up 405%
Utility-Scale System Price ($/kWh)	$700-$1,200	$800-$1,300	Down 8% to 13%
Utility-Scale Pipeline (MW)	6,638	3,630	Up 83%
Number of Markets With Policy Developments	20 State Markets, 4 Regional Markets, and Federal	10 State Markets, 1 Regional Market, and Federal	13 Additional Markets
Cumulative Five-Year Forecast (MW)	4,030 (2016-2020)	2,294 (2015-2019)	Up 76%

Source: GTM Research/ESA U.S. Energy Storage Monitor: 2015 Year in Review

Rapid Growth Expected To Continue



- Projections show annual market of 1,662 MW valued at $2.5 billion
- But compare: 2015 installed solar at 25 GW

Range of Interest Is Linked to Underlying Policy Goals Of Diverse Stakeholders

- **Is Storage the "Holy Grail" That Will Fundamentally Change Electric Market Economics?**
  - Can the deployment of storage avoid – or reduce – peak demand and associated construction of new generation (central and distributed) and additional transmission/distribution infrastructure?

- **Is Storage Required To Facilitate "High Growth" Renewables?**
  - Can storage "solve" intermittency issues associated with solar and wind generation?

- **Should Storage Be Designed To Facilitate Customers Becoming Independent Of The Grid?**
  - Will this be an outcome of storage economics or should policy be designed to facilitate self-supply?

Agenda

- **California: Building a Storage Market in a 50% Renewables World** – Bill Kissinger
- **Renewable Energy and Storage Developments in Hawaii** – Monica Schwebs
- **FERC: New Incentives** – Pam Tsang
- **Emerging Issues in Storage Project Finance** – Neeraj Arora
- **Questions**

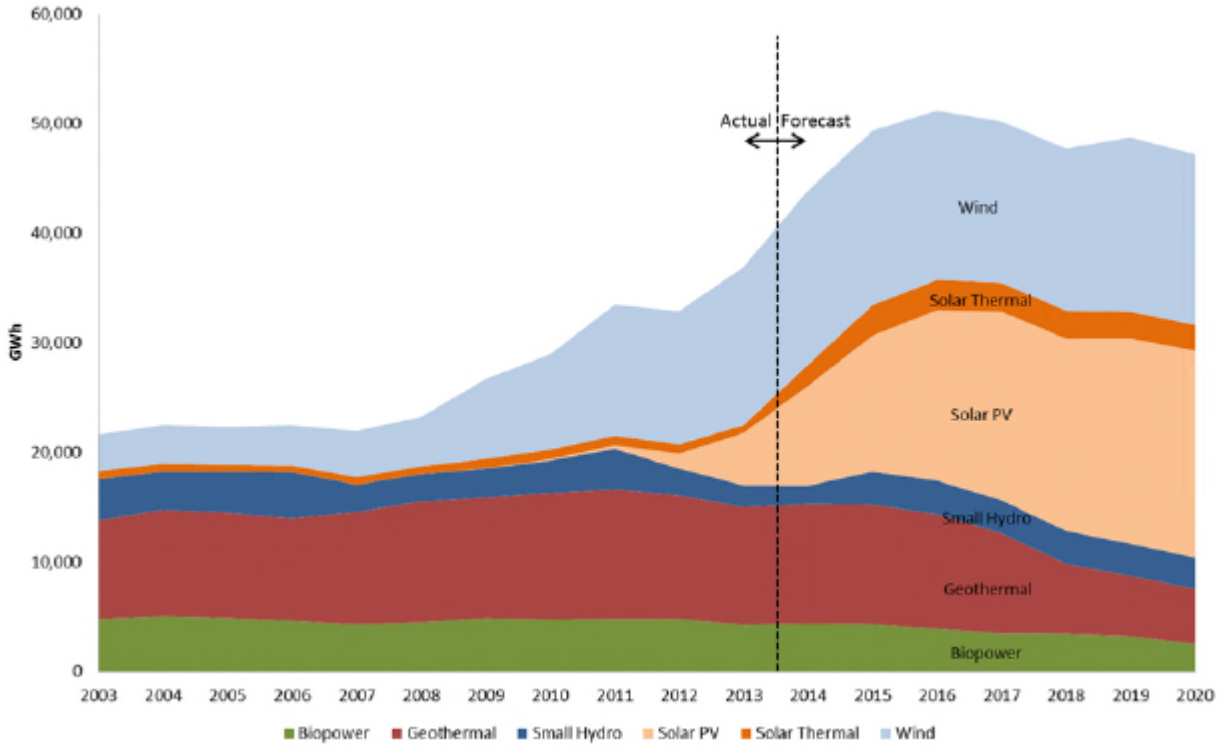
CALIFORNIA: BUILDING A STORAGE MARKET IN A 50% RENEWABLES WORLD

BILL KISSINGER

California – RPS Requirement

- CA RPS requirement apply to both investor-owned utilities regulated by the California Public Utilities Commission and municipal utilities
- Until 2015, CA's RPS target was for 33% of retail electricity sales to be from eligible renewable resources by 2020
- In 2015, the CA legislature passed SB 350 which increased the RPS requirement by imposing goals designed to reach a goal of 50% by 2030
- The current goals are
  - 33 percent by the end of 2020
  - 40 percent by the end of 2024
  - 45 percent by the end of 2027
  - 50 percent by the end of 2030
  - No less than 50 percent in each multiyear compliance period thereafter
- Solar from net-metered homes and large hydro are not considered eligible renewable resources for the RPS, so the state is headed for more than 50% renewables

California RPS Mix

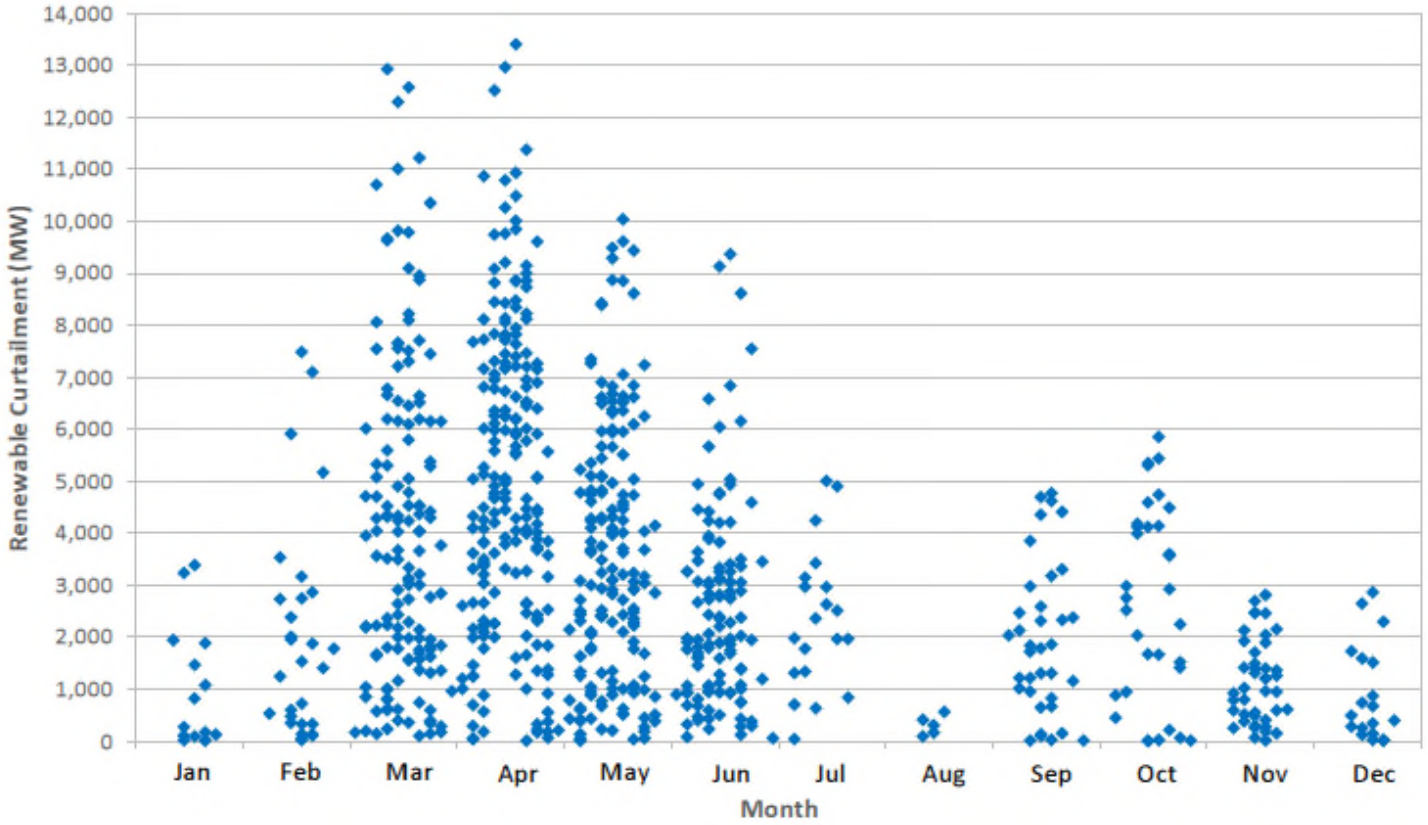


Renewable Resource Mix, Actual and Forecasted by Year

Source: CPUC, RPS Quarterly Report, 1st Quarter 2015

California and Curtailment

Figure 3.5-1: Curtailment of Renewable Generation in the 2014 LTPP 40% RPS Scenario



Source: CAISO, Draft 2015-16 Transmission Plan

Initial CA Efforts to Promote Energy Storage

- CA Energy Storage Bill
  - AB 2514 (2010) requires CPUC to consider requiring procurement of energy storage systems
  - In 2013 CPUC issued D. 13-10-040 setting ambitious procurement targets for storage systems by end-use (i.e. transmission, distribution, customer-side) for a total of **1325 MW by 2020**
  - Storage systems could include such things as batteries, fly-wheels, compressed air systems, pumped hydro under 50 MW, and concentrating solar plants with molten salt storage
  - Utilities given credit for some energy storage PPAs they already had
  - Utilities are to submit biennial storage procurement plans starting in 2014
- CA Energy Storage Roadmap
  - In 2014 the affected state agencies and the CAISO sought public input to develop a CA Energy Storage Roadmap which outlines the regulatory actions needed to facilitate development of energy storage

CPUC – Procurements through Storage Procurement Process

- CPUC approved initial storage procurement plans in 2014 and 2016 procurement plans were just filed
- 2014 Plans:
  - **SCE** entered into 16.3 MW of resource adequacy storage projects
  - **PG&E**
    - Issued an RFO for 50 megawatts of transmission grid-connected storage projects, and another 24 megawatts for the distribution grid
      - Entered into contracts for 75 MW of capacity from 7 projects including fly wheel, zinc-air batteries, and lithium ion batteries
  - **SDG&E**
    - Issued an RFO for a distribution level 4MW/12MWh utility owned Energy Storage System ("ESS")
    - Currently negotiating 40 MW of transmission level energy storage projects

CA Long-Term Procurement Proceeding

- CA also has a long-term procurement process in which SCE and SDG&E recently obtained significant procurement authority due to retirements
- SCE
  - In 2013 the CPUC authorized significant new procurement for West LA: 1900-2500 MW, including a minimum of 50 MW of energy storage
  - In 2014 SCE conducted an all-source RFO for West LA
    - Received over 1000 responses and over 500 for energy storage
    - CPUC approved 23 PPAs for a wide variety of energy storage technologies, on both sides of the meter, for a total of **264 MW of storage** capacity
- SDG&E
  - In 2013 also received procurement authorization for 800 MW, at least 25 MW of energy storage
  - In 2014 RFO indicated that it is seeking to procure between 25 MW and 80 MW of energy storage
    - SDG&E has not yet released information regarding energy storage PPAs but pledged to file an application seeing Commission approval for the 40 MW of transmission level storage currently under negotiation

Changes to CPUC Storage Program Currently Being Considered by the CPUC

- The CPUC has begun Phase II of its latest storage proceeding and is in the process of considering a number of important issues.
- These issues include whether to increase Energy Storage Procurement ("ESP") targets and to include electric vehicles and previously excluded bulk storage technologies such as pumped hydro storage, which had been deemed ineligible out of concern that their scale would crowd out opportunities for new, as yet uneconomic, chemical battery and other storage technologies.
- Phase II proceeding unlikely to result in a formal order imposing a specific mandate on the IOUs given its "quasi-legislative" categorization, but will likely result in increased ESP target that will find its way into the newly commenced Long Term Procurement Proceeding ("LTPP") and/or Integrated Resource Planning Proceeding ("IRP").
- Phase II proceeding also address the extent to which behind the meter energy storage can be counted and integrated into planning assumptions.

Other CPUC Efforts Relating to Storage

- Interconnection rules: CPUC developed rules for interconnection of energy storage projects on lines subject to CPUC jurisdiction in 2014
- Resource Adequacy: CPUC and CAISO developed rules for counting storage toward resource adequacy objectives
- Distributed Energy Resources Plans ("DERPs")
  - In 2013 AB 327 required the utilities to submit biennial Distributed Energy Resource Plans, including plans for storage
  - In 2015, the CPUC provided guidance to the utilities regarding preparation of these plans
  - First DERPs filed in July 2015
- Electric Vehicles: CPUC has developed rules to facilitate electric vehicle charging and use of vehicle batteries for grid storage

Overview of CAISO Efforts to Promote Storage

- Interconnection
- Transmission Planning
- Market reforms
  - CAISO Pay for Performance
  - CAISO Non-Generator Resource and Proxy Demand Response: Ancillary Services: Spin, Non Spin, Regulation (although PDR cannot provide Regulation)

CAISO Interconnection and Transmission Planning

- New rules for interconnection of storage
  - After CPUC established energy storage procurement targets in 2014, large number of interconnection requests were made
    - Queue cluster 7 (2014): 780 MW of energy storage (13 projects)
    - Queue cluster 8 (2015): 7,300 MW of energy storage (66 projects)
  - Rules are similar to those applicable to generators
- Transmission planning
  - CAISO can approve transmission lines needed for storage facilities for reliability, economic, or policy issues
  - Open issue is whether the CAISO can use its transmission process to approve storage projects that are transmission assets which are turned over to the control of the CAISO and paid for through the transmission access charge
  - The Draft 2015-16 Transmission Plan contains special study on impact of bulk storage

CAISO Bulk Storage Study Results

- Studied impact of two 250 MW pumped storage facility with 40% RPS
- Shows significant system benefits

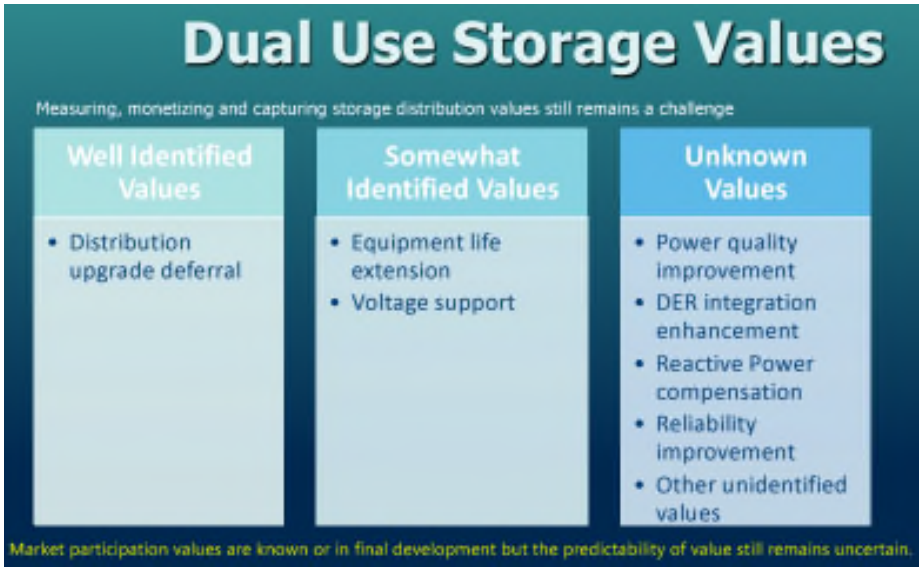
	Without Pumped Storage			With Pumped Storage		
Case	A	C	D	B	E	F
Renewable Curtailment (GWh)*	2,825	4,249	3,157	2,417	3,457	2,649
CA CO2 Emission (Million Ton)**	62.74	61.82	61.68	62.41	61.66	61.54
CA CO2 Emission ($ mil)***	1,460	1,438	1,435	1,452	1,435	1,432
Production Cost ($ mil)****						
WECC	14,167	14,109	14,068	14,111	14,070	14,037
CA	3,866	3,826	3,795	3,803	3,779	3,751
Renewable Overbuild and Pumped Storage Capacity (MW)						
Solar		1,918			1,569	
Wind			1,129			950
Pumped Storage				500	500	500
Levelized Annual Revenue Requirement of Renewable Overbuild and Pumped Storage ($ mil)						
Solar		703			575	
Wind			340			286
Pumped Storage				183	183	183
Pumped Storage Net Market Revenue ($ mil) *****				160	194	170

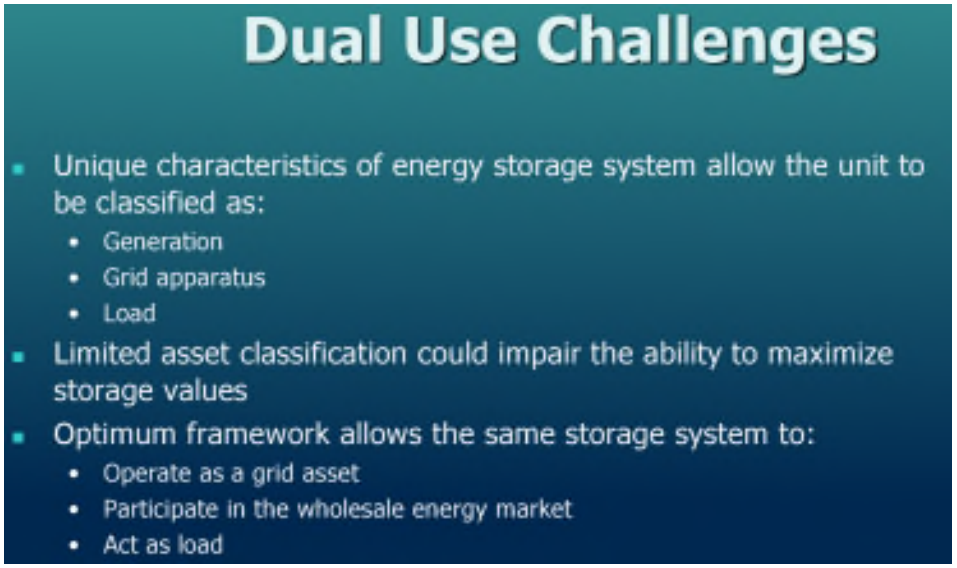
* Renewable generation is curtailed at -$300/MWh market clearing price (MCP)
** Includes the CO2 emission from net import.
*** Calculated using $23.27/m-ton price.
**** Includes start-up, fuel and VOM cost, not CO2 cost.
***** Net revenue is revenue of energy, reserves and load following minus cost of energy and operation.

Source: CAISO, Presentation on Draft 2015-16 Transmission Plan, Feb. 18, 2016

Difficulties of Developing CAISO Market Rules

- In accordance with FERC Order 755, CAISO had adopted pay for performance rules, but it is not clear this is enough to provide appropriate compensation for storage
- CAISO and SCE appeared before a FERC business meeting on November 17, 2015, to discuss the difficulties of designing a market for storage
- SCE discussed the difficulties associated with valuing a dual use facility





Source: Slides from Presentation of SCE before FERC, November 19, 2015

CAISO Market Reform Efforts

- The CAISO representative who appeared before FERC noted: "Revenue opportunities that value all storage capabilities are not yet well defined"
- Explained the Energy Storage and Distributed Energy Resources ("ESDER") stakeholder proceeding, Phase I (est. filing Q1 2016)
  - Beginning of efforts to change the CAISO market rules in Grid-level storage can interconnect as a generator with positive/negative output
    - Charges/discharges at wholesale LMP
  - Provide energy, reserves, regulation under non-generator resource (NGR) model
    - Applicable at both grid & distribution levels
  - Provide demand response (energy, reserves) under proxy demand resource (PDR) model
- ESDER Phase 2 – (est. filing Q1-2017)
  - Enhance PDR for 2-way dispatch & regulation
  - Expand options for multiple-use configurations

RENEWABLE ENERGY AND STORAGE DEVELOPMENTS IN HAWAII

MONICA SCHWEBS

Why Hawaii?

Top Energy Storage Markets, 2015

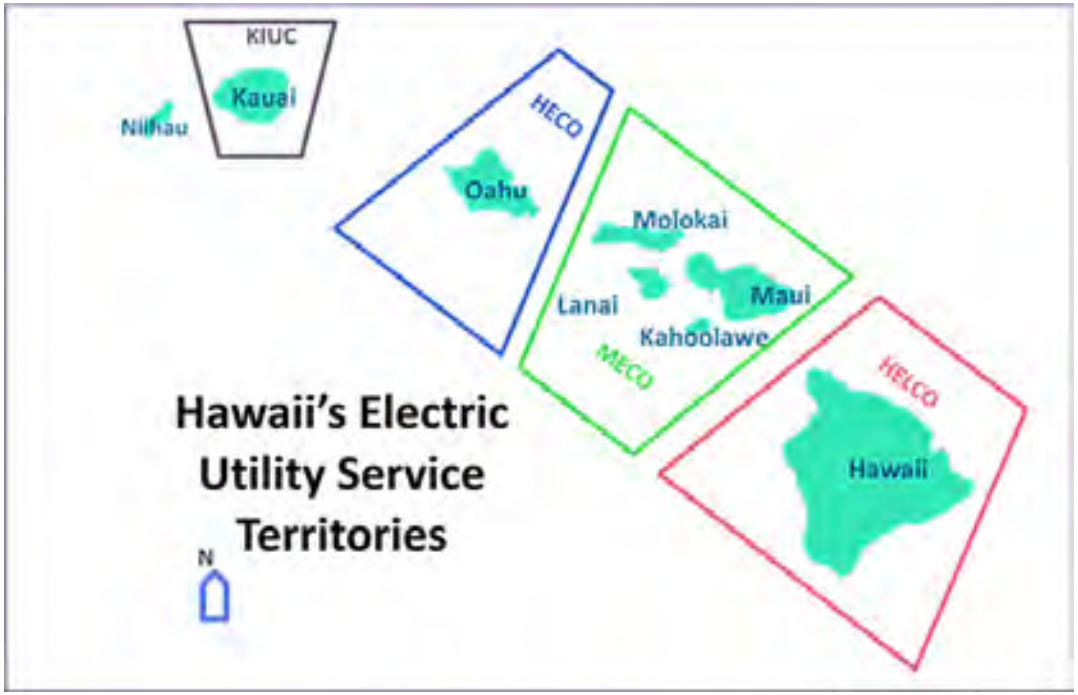
Rank	Residential	Non-Residential	Utility
1	Hawaii	California	PJM (excl. NJ)
2	All Others*	All Others*	All Others*
3	California	New York	Hawaii

Source: U.S. Energy Storage Monitor, 2015 Executive Summary, produced for Energy Storage Association by GTM Research

- Hawaii already has more residential storage than other states and a significant amount of utility storage
- Hawaii's leadership with respect to storage is expected to continue since it has an RPS law which requires 100% renewables by 2045

Background

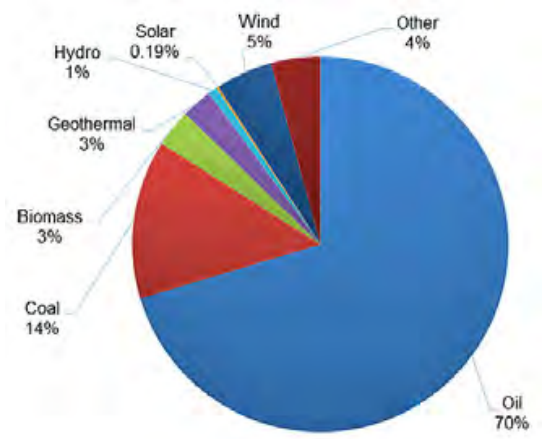
- The Hawaiian Electric Industries through its subsidiaries, HECO, MECO and HELCO (collectively "HECO Companies"), serve most of the islands and 95% of the population
- The island of Kauai is served by the Kauai Independent Utility Cooperative ("KIUC")
- The grids for the islands are not physically connected
- All of the utilities are regulated by the Hawaii Public Utilities Commission



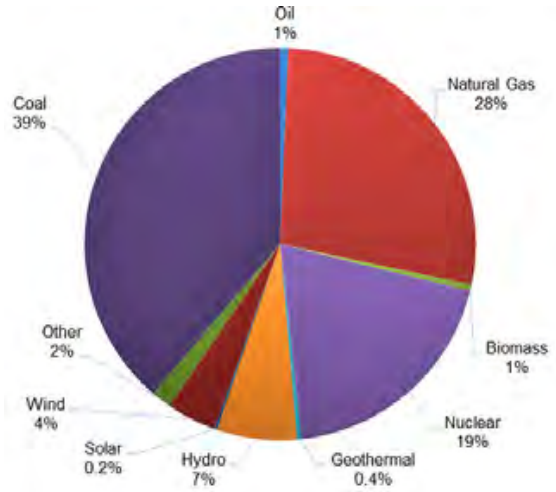
Source: Hawaii State Energy Office

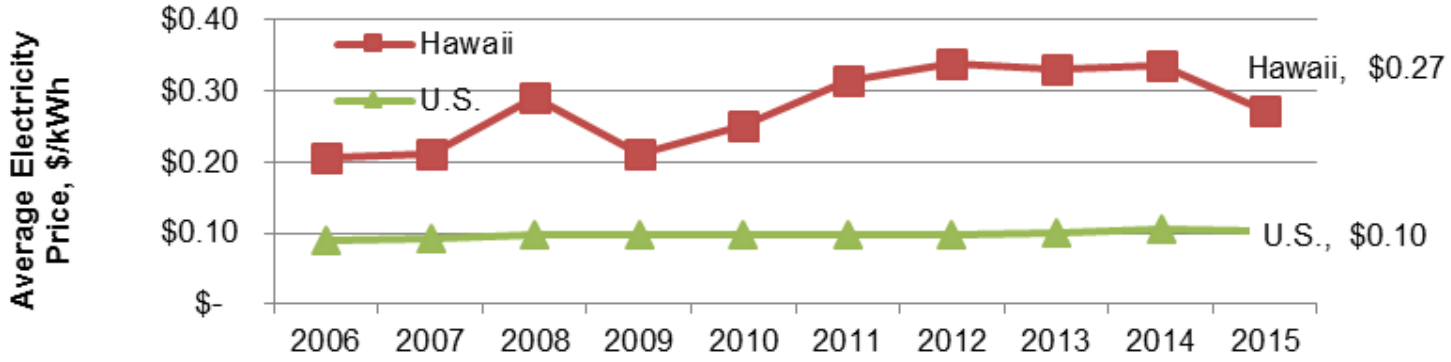
Fuel Source and Impact on Price

Hawaii Electricity Production by Source, 2013



U.S. Electricity Production by Source, 2013

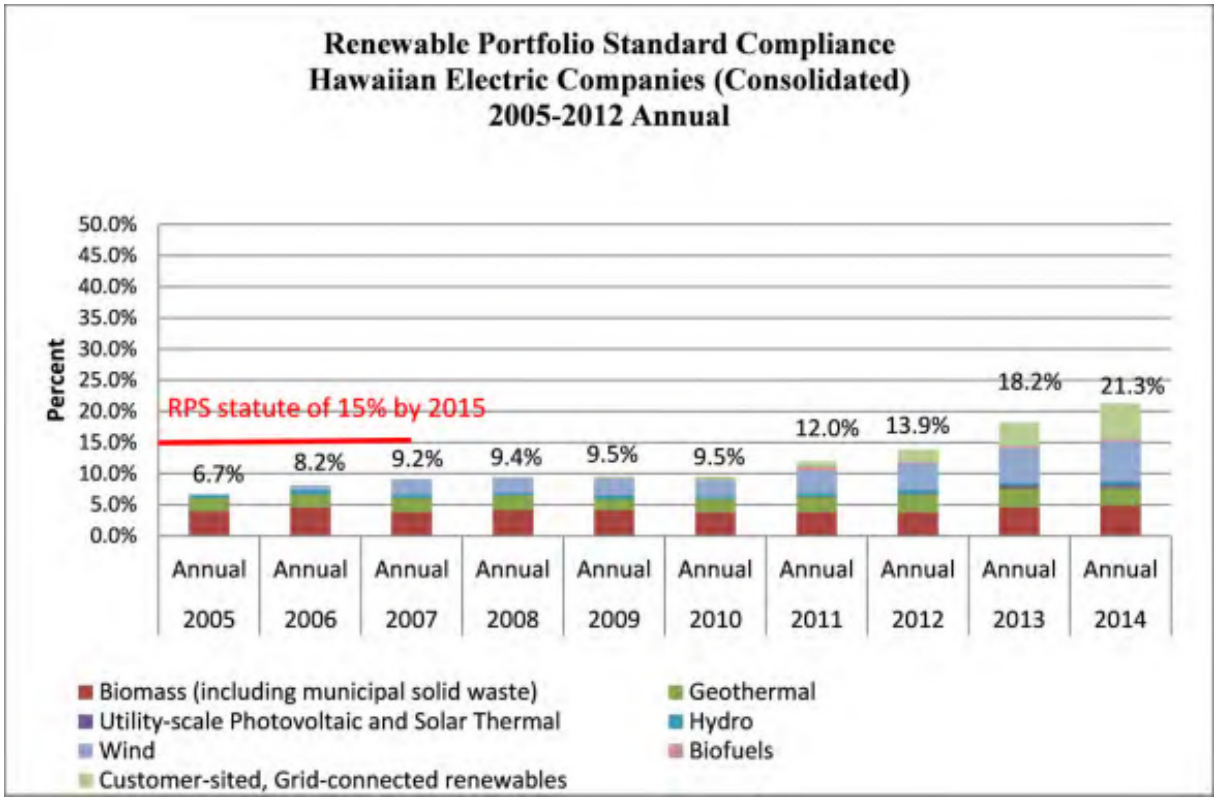




Source: Hawaii State Energy Office

RPS Status

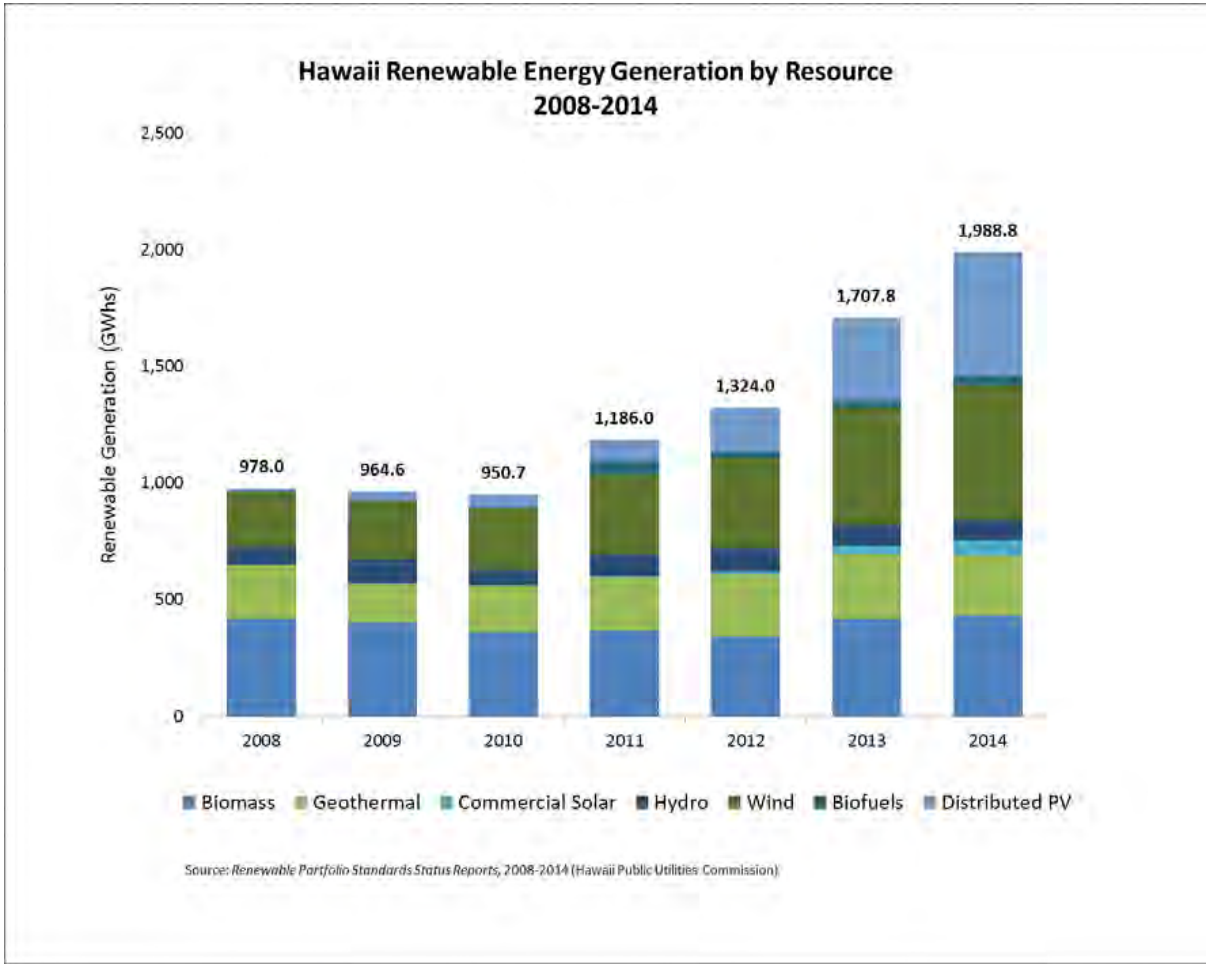
- Until 2015, HI had an RPS law which required 40% by 2030
- New law HB 623 (2015) requires 100% renewables, measured as percentage of sales, by 2045
- Renewables have increased substantially in recent years, but have a long way to go



Source: Hawaii State Energy Office

Renewable Generation

- The biggest increases in recent years have been in intermittent resources
- Distributed PV grew very quickly, although interconnection issues slowed growth in recent years
- Wind is also growing rapidly



Utility Scale Storage

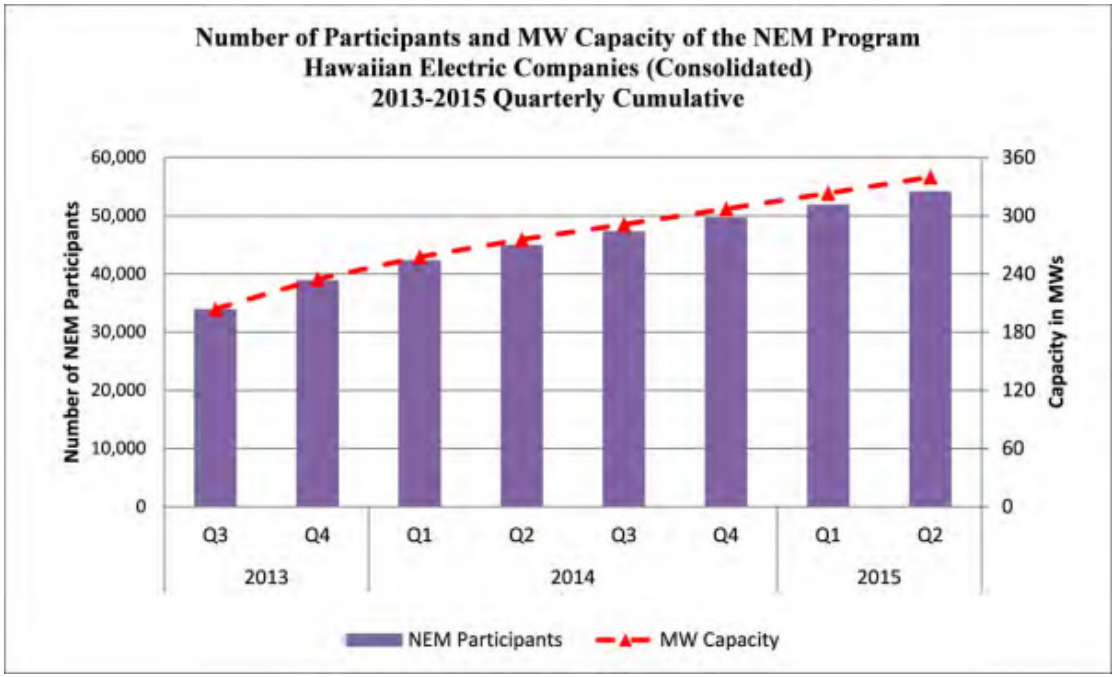
- Will be critical for getting to 100% renewables
- HECO Companies
  - 2014 RFP – 60-200 MW of 30 minute storage; has 60 proposals and selected three battery projects; but put on hold
  - Currently working on a new power supply improvement plan in light of the new 100% RPS standard that will include energy storage – especially looking at batteries, pumped hydro, and flywheels
- KIUC has a 20 year PPA with Solar City for 13 MW Solar PV/52 MWH lithium ion battery system which will use Tesla batteries – *i.e.* a dispatchable solar PV facility – at cost of 14.5 cents/MWh
- Several other small projects, including use of EV batteries

Artist's impression of Tesla's utility-scale storage systems. Image via Tesla Motors.

KIUC Dispatchable Solar PV Project – Planned Tesla Battery Area

Rooftop Solar

- Level of rooftop solar that far surpasses any state or utility in the US
  - Has the highest percentage of customers with rooftop solar – 17% percent of HECO Company residential customers have it or have signed up for it
  - Has the highest installed capacity of rooftop solar relative to the size of each island grid
- Most are in Net Energy Metering ("NEM") program



Source: Hawaii State Energy Office

NEM and DG Developments

- In 2014 the HECO Companies where required to file a new distributed generation plan, including new rules for interconnection
- Phase I decision issued on October 12, 2015, in Docket No. 2014-0192
  - Streamlines interconnection process
  - Caps the NEM program at existing levels
  - Creates new options for customers who wish to invest in rooftop solar and other distributed energy resources
    - **The Self-Supply Option** is for customers that primarily intend to consume all of the energy produced by their solar system onsite at their home or business, and do not need to export excess energy to the grid.
    - **The Grid-Supply Option** is similar to the existing NEM program, but the energy credits on monthly bills will be somewhat less than under the NEM program and there is a cap to ensure each island grid can accommodate Grid-Supply systems, complemented by community-based renewable projects, and utility-scale projects.
  - Also indicates that consumers will be given option of using **time-of-use metering** under new rules that are being developed now

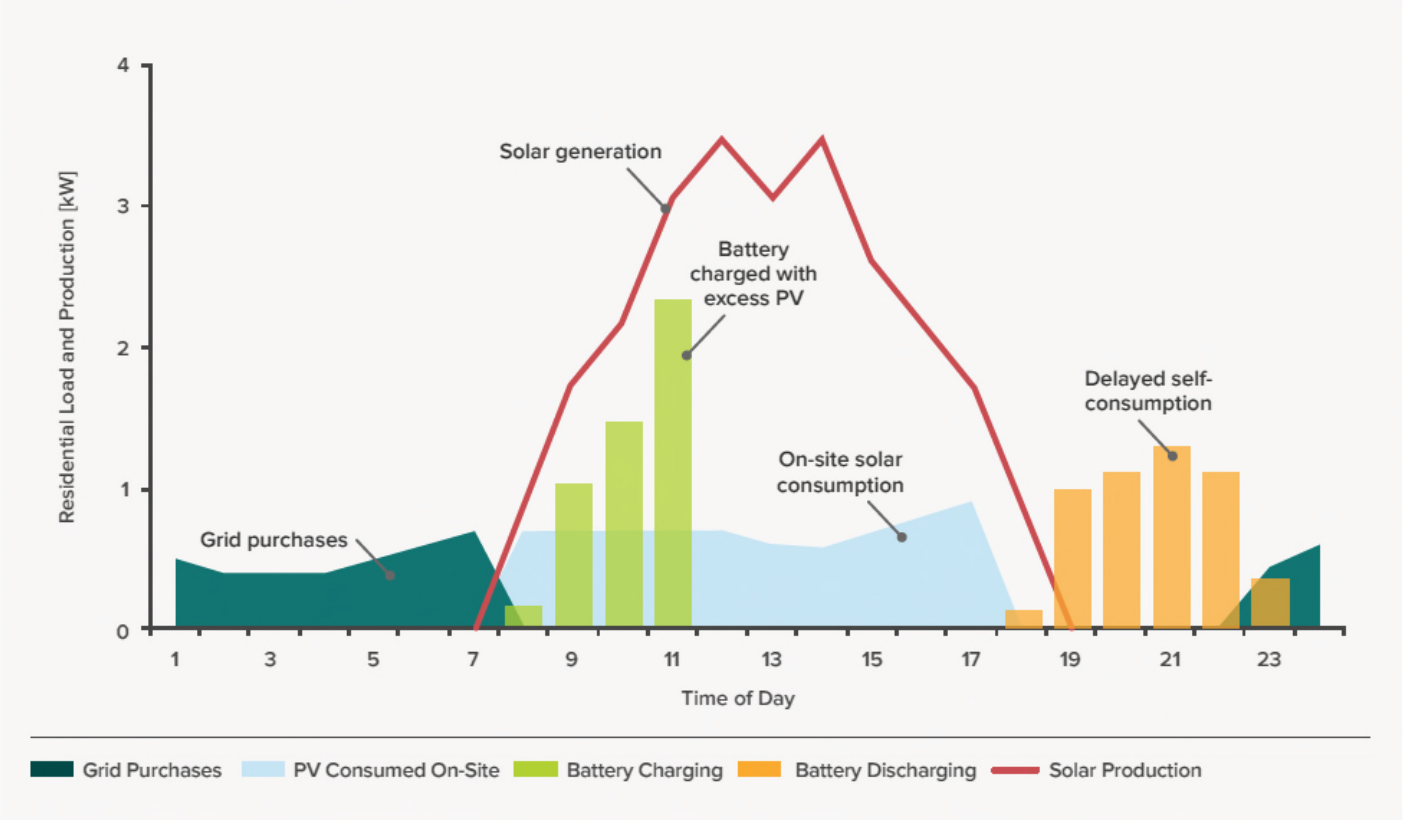
Impact of Regulatory Developments on Customer Storage

- Despite the changes to NEM, the HECO Companies believe there will be tripling of distributed solar
- The new ruling could also provide a significant incentive for customer storage
  - Self-Supply Option - This option incentivizes energy storage, as the excess solar energy generated during the day can be saved for use at night. Each kilowatt-hour stored saves $0.25+/kWh when it is used later.
  - Grid-Supply Option
    - For the first two years of the new tariff, the credit rate will range between 15 and 27 cents per kWh, depending on the island, which is based on the on peak avoided cost, but less than the retail rate
    - Since Hawaiian retail rates will be higher than the credit amount, this spread in pricing creates an incentive for customers to store their energy rather than selling it back to the grid. For instance, for Oahu the credit rate will be $0.15/kWh and the retail rate will be approximately $0.25/kWh.
  - Time-of-Use Tariff, when available, will permit energy arbitrage – generate and store energy when it's cheap, use energy when it's expensive.

Residential Solar Plus Storage

FIGURE 10

RESIDENTIAL LOAD AND PV PRODUCTION BEFORE AND AFTER ENERGY STORAGE IS DEPLOYED



Source: Rocky Mountain Institute, The Economics of Battery Energy Storage, 2015

Cost-Effectiveness of Storage

	Low Cost, Many Cycles	Moderate Cost, Moderate Cycles	High Cost, Few Cycles
Storage Costs per kWh Before Incentive	$1,000	$1,500	$2,000
Federal Incentives (30% discount)	($300)	($450)	($600)
Post-Incentive Cost of Storage ($/kWh)	**$700**	**$1,050**	**$1,400**
Storage Cycles	7,000	4,000	2,000
Storage Value per Cycle ($/kWh)	**$0.10**	**$0.26**	**$0.70**
Utility Price of Electricity ($/kWh)	$0.25	$0.25	$0.25
Savings from Storage ($/kWh)	**$0.15**	**-$0.01**	**-$0.45**

Source: B. Korgaonkar, Renewable Energy World, Dec. 21, 2015

FERC DEVELOPMENTS

PAM TSANG

FERC Developments

- Chairman Bay recently stated that FERC Staff will likely examine steps to ease the transition for large batteries onto the nation's power grid.
  - "Developments in storage have the potential to bring economic and reliability benefits to consumers, perhaps even to be game changers."
  - Recent analysis indicates that energy storage costs will decrease by 50% over the next five years.
- Over the last few years, FERC has taken steps to encourage energy storage development through a series of orders.

Frequency Regulation Service

Order No. 755: *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, 137 FERC ¶ 61,064 (2011).

- Created new compensation rules for frequency regulation.
  - What is frequency regulation?
  - Which resources provide frequency regulation service?
- RTOs and ISOs must compensate frequency regulation resources based on the actual service provided and adopt a two-party market-based compensation method for frequency regulation services that rewards faster-ramping resources.
  - (1) Capacity payment reflecting opportunity costs; and
  - (2) Market-based performance payment.

Third Party Provision of Ancillary Services

Order No. 784: *Third Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technologies*, 144 FERC ¶ 61,056 (2013), *order granting and denying clarification*, 146 FERC ¶ 61,114 (2014).

- FERC revised its policy on regulating ancillary-service sales at market-based rates to public utility transmission providers. Order No. 784 opens the ancillary services markets to storage project developers.
- Public utility transmission providers must take into account speed and accuracy of resources.
- FERC revised the accounting and reporting regulations to better account for and report transactions associated with energy storage devices.

Order Nos. 792 and 819

Order No. 792: *Small Generator Interconnection Agreements and Procedures*, 145 FERC ¶ 61,059 (2013).

- Revised the *pro forma* Small Generator Interconnection Agreements and Small Generator Interconnection Procedures to specifically make energy storage eligible to connect to the grid
- Revised the definition of Small Generating Facility to explicitly include storage devices.

Order No. 819: *Third-Party Provision of Primary Frequency Response Service*, 153 FERC ¶ 61,220 (2015).

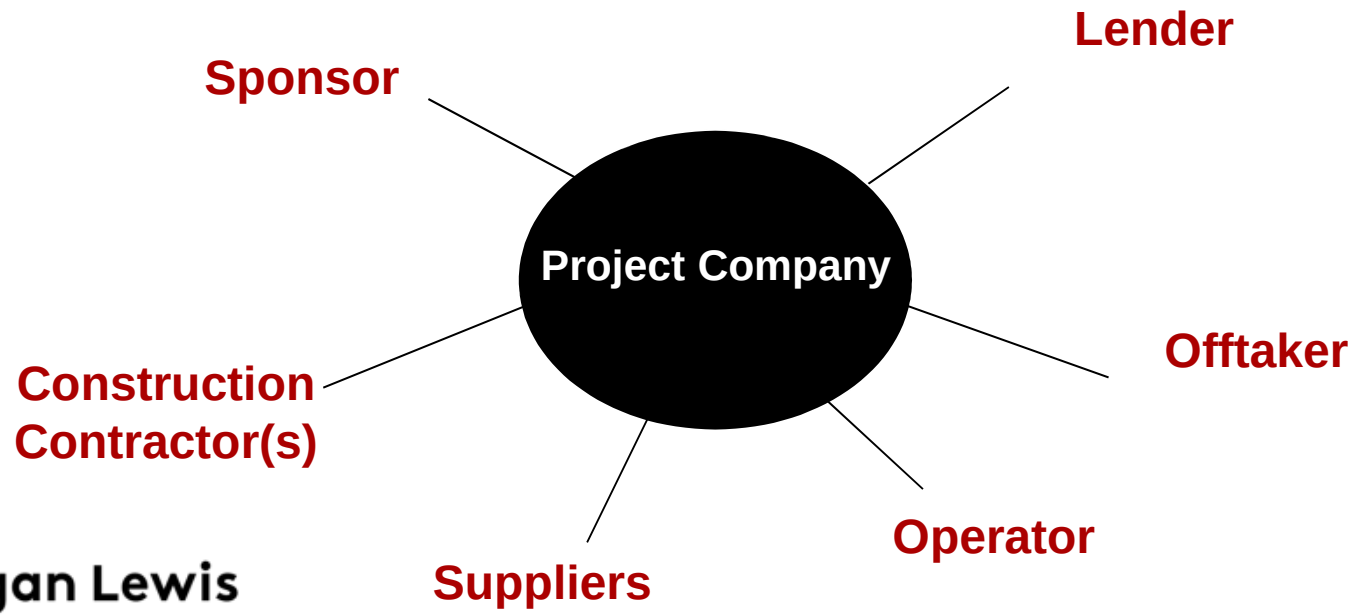
- Permits voluntary sales of primary frequency response service at market-based rates by sellers with market-based rate authority for sales of energy and capacity.

EMERGING ISSUES IN STORAGE PROJECT FINANCE

NEERAJ ARORA

Financing Energy Storage

- How will emerging energy storage projects get financed?
- Project finance markets have traditionally been used for energy infrastructure
- Project Finance in a Nutshell:
  - Fund the cash flows of the project and not the balance sheet of the sponsor
  - Can be expensive to structure but it allows a sponsor to leverage the credit of the off-taker rather than rely on its own balance sheet, which can (i) limit sponsor downside exposure and (ii) reduce cost of capital.



The Good - Project Revenues

- **Can the project generate *any* cash flows?**
  - Technology risk must be addressed
  - Operating profile must be consistent with technology
- **What do the cash flows look like?**
  - What is the structure of the off-take arrangement? (capacity, energy, ancillary services?)
  - Traditional performance degradation limited to: (i) output capacity and (ii) efficiency (heat rate)
  - Energy storage must also consider: (iii) charging speed; (iv) volume of energy stored; and (v) rate of loss for stored energy (which may be dynamic based on how much is stored)
- **Counterparty risks**
  - May be a utility, end-user or both!

The Bad - Project Costs

- **Capital Costs**
  - Uncertainty around (i) construction costs; (ii) financing costs; and (iii) amortization period
- **Input Costs**
  - Input is the same as the output!
    - Performance degradation may affect input requirements
    - Operating profile may affect input requirements
  - Treatment of parasitic load may be important to project economics
- **Non-input costs (fixed and variable)**
  - Uncertainty around O&M costs for certain battery technologies

The Ugly - Project Financier's Toolkit

- **Debt Sizing Metrics**: More stringent financial ratios for debt sizing, including
  - Higher debt service coverage ratios
  - Higher loan life coverage ratios
  - More equity in the project relative to debt
  - Contingent Equity
- **Keep Cash**: Reserve Accounts, cash sweeps and additional and tighter conditions to distributions
- **Tenor**: Shorter tenors
- **Contractual Risk Shifting**: Requirement to contractually shift risk away from project company to other project stakeholders (i.e., offtakers / technology vendors)
- **Debt Reduction**: Debt buy-down at Term Conversion based on performance
- **Tax Structure Considerations**: Storage projects may be eligible for federal tax credits if paired with renewable generation, subject to meeting certain criteria

QUESTIONS?

Our Global Reach

Africa
Asia Pacific
Europe
Latin America
Middle East
North America

Our Locations

Almaty
Astana
Beijing
Boston
Brussels
Chicago
Dallas
Dubai
Frankfurt
Hartford
Houston
London
Los Angeles
Miami
Moscow
New York
Orange County
Paris
Philadelphia
Pittsburgh
Princeton
San Francisco
Santa Monica
Silicon Valley
Singapore
Tokyo
Washington, DC
Wilmington

Morgan Lewis

THANK YOU