Xtreme Power

The Power to Control.

CESA

CALIFORNIA ENERGY STORAGE ALLIANCE

PANEL 1: Need for Energy Storage

Importance of Energy Storage to California's Renewable Future

Amanda Stevenson, Director Market Policy & Regulatory Affairs
Xtreme Power, Inc.

2011 Integrated Energy Policy Report Committee
Workshop on Energy Storage for Renewable Integration
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Sacramento, California

About CESA:

Our Mission: *Expand the role of storage technology to promote the growth of renewable energy and create a cleaner, more affordable and reliable electric power system*

- Core principles for a healthy market – diversity is important!
  - Technology neutrality
  - Ownership/business model neutrality
- Explicit support of renewable energy in our mission…and our membership
- Philosophy of 'coalition building' with all stakeholders including renewables (wind, solar, etc..) to strength in diversity
- We have limited resources, and so must be very focused in our efforts
  - California Legislature
  - CPUC
  - CAISO
  - CEC
  - CARB
  - FERC

CESA
CALIFORNIA ENERGY STORAGE ALLIANCE

Grid storage leaders founded CESA in January 2009

Steering Committee

General Members

Company Overview.

Xtreme Power is a U.S. based vertically integrated developer & manufacturer of the Dynamic Power Resource™, a utility-scale, battery-based energy storage system.

- Founded in 2004 in Austin, Texas
- 20+ years of R&D in our technology, Tested & Proven!
- Projects operating, contracted, and in final negotiations: >70 MVA, > 60 MWh
- US-based manufacturing
  - Oklahoma and Texas
  - 200 MWh of capacity
  - Expansion option: > 1 GWh
- Over $50 MM in funding: *SAIL* VP, Bessemer VP, Dow Chemical, Fluor, Dominion Power, BP, POSCO, Skylake Incuvest
- Utility industry leadership on our Board:
  - Pat Wood (Former Chairman of FERC)
  - Foster Duncan

Energy Storage is a very broad asset class

Batteries

- Electrical energy is stored for later use in chemical form. Existing battery technologies are being improved, and new battery technologies are becoming available.
- Example: 34 MW Dynamic Power Resource Battery — 153 MW Duke Notrees wind farm, Texas (Xtreme Power)

Thermal Storage

- Air conditioners create ice at night, when power rates are low. This stored ice then runs a cooling system during the afternoon, when power costs are highest and the power grid is most stressed.
- Example: 12 kW Thermal Storage — Napa Community College (Ice Energy)

Flywheels

- Flywheels convert electrical energy to kinetic energy, then back again very rapidly. Flywheels are ideal for power conditioning and short-term storage.
- Example: 3 MW Mechanical Storage for Ancillary Services — NE ISO (Beacon Power)

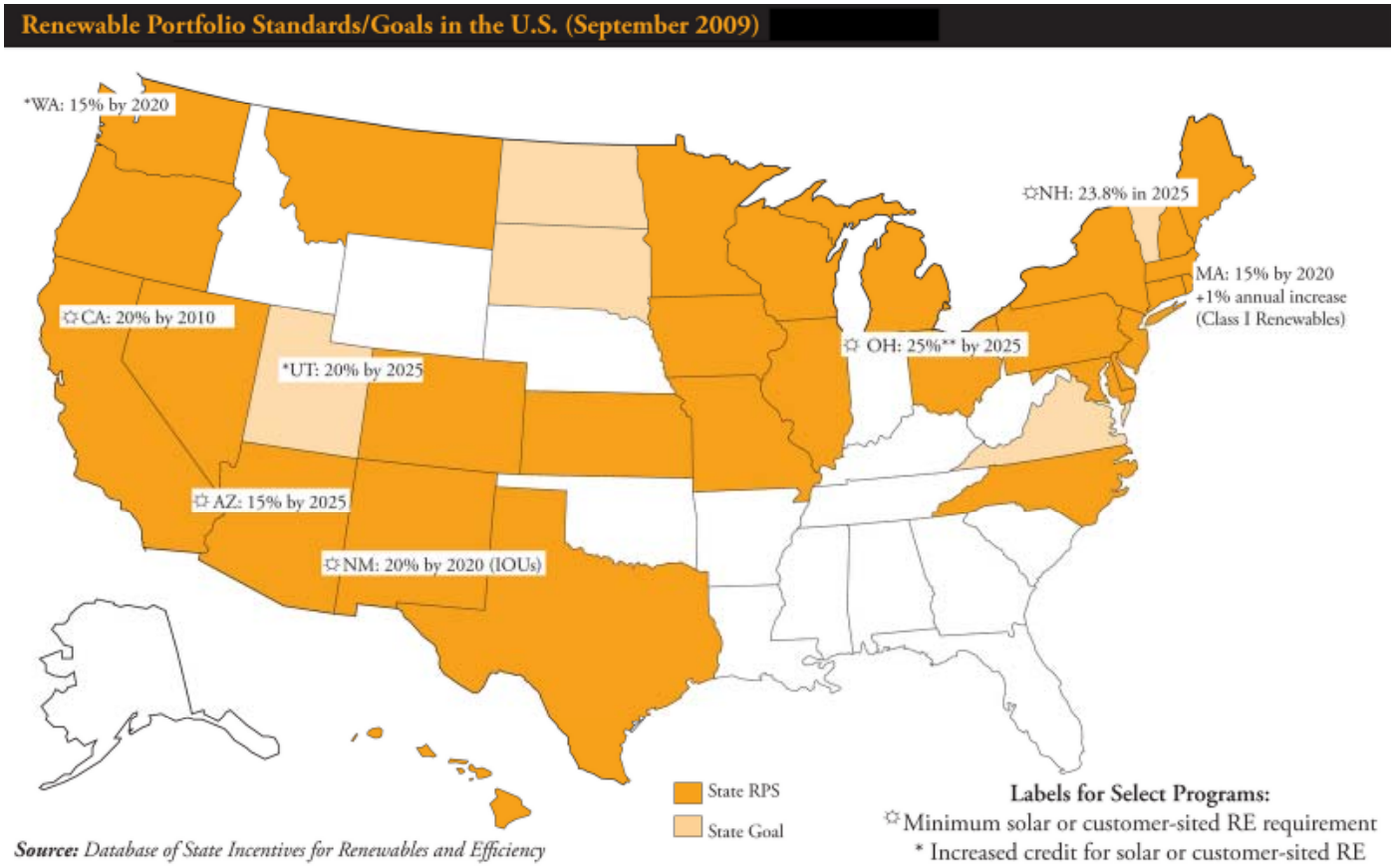
Compressed Air

- Electricity is used to compress air into storage tanks or a large underground cavern. The compressed air is used to spin turbines when electricity is needed.
- Example: 115 MW Compressed Air Energy Storage — McIntosh, Alabama

Pumped Hydro

- Excess electricity is used to pump water uphill into a reservoir. When power is needed, the water can run down through turbines, much like a traditional hydroelectric dam.
- Example: 1,532 MW Pumped Hydro — TVA's Raccoon Mountain

Why Energy Storage in the US?
Renewable Portfolio Standards



- CA = 33% by 2020 NM = 20% by 2020 OH = 25% by 2025

Why Energy Storage in California?

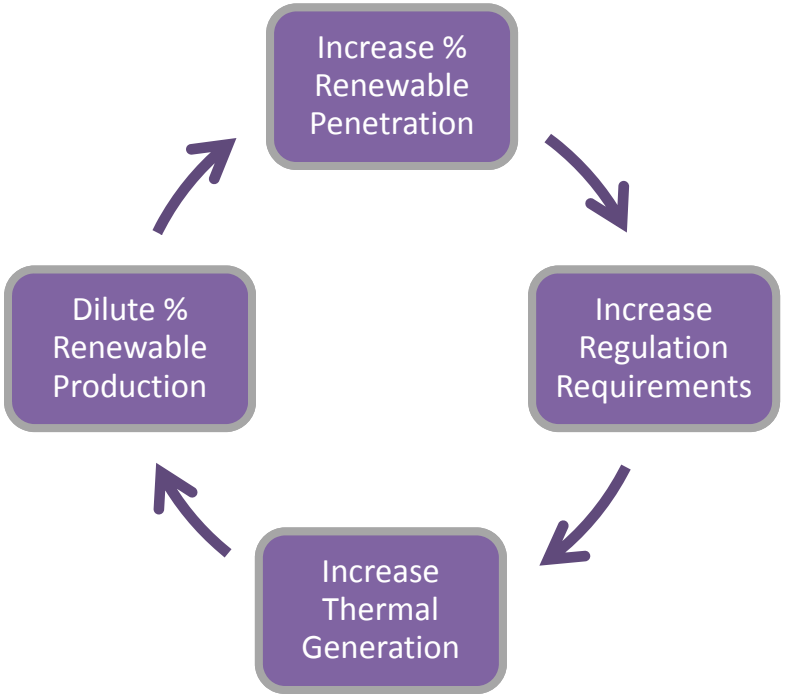
Energy storage is fundamental to many key California ***policy initiatives*** that are shaping the storage market today!

- Its **BIG**: 13% of US GDP, 8th largest economy in the world (if it were a country), ahead of Canada and Spain
- 'Foundational' Legislation
  - **Energy Storage Procurement Targets: (AB 2514):**
  - RPS Legislation (SB 21, introduced)
  - Self-Generation Incentive Program: SGIP (SB 412)
  - Smart Grid Systems (SB 17)
  - **Global Warming Solutions Act of 2006 (AB 32)**
  - Solar Energy System Incentives: CSI (SB 1)
- Pro-storage policy makers in Legislature and at key agencies: California Public Utility Commission, Energy Commission & California Air Resources Board
- Incentives available for customer sited applications via SGIP and possibly PLS too
- Non-Generator Participation in Ancillary Services Stakeholder Process—California Independent System Operator (CAISO)
- Gov. Brown signed SBX1 2 on April 12, 2011!

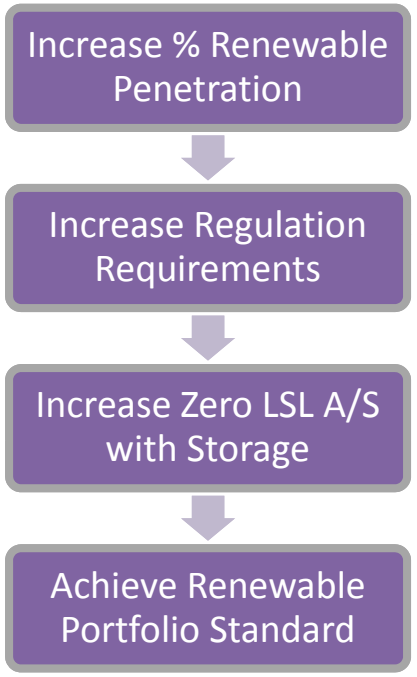
CESA is driving results-oriented change in all of these areas.

Why Energy Storage Now: Can Meet RPS More Efficiently with Storage?

Meet RPS without Storage



Meet RPS with Storage

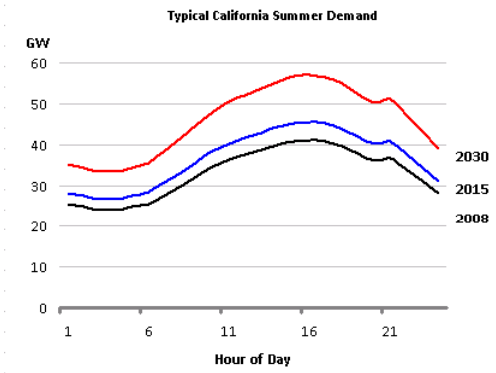


- To reach its 33% RPS, CAISO must increase regulation by 165%[1]
- Insufficient down ramping capabilities will result in curtailment of wind in off peak hours[2]

1. Energy Storage – a Cheaper, Faster, & Cleaner Alternative to Conventional Frequency Regulation, Strategen Strategies for Clean Energy, February 2011
2. ISO Study of Operational Requirements and Market Impacts at 33% RPS, California ISO, August 2010

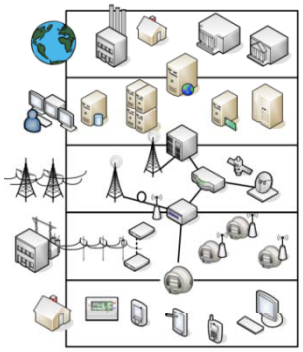
Other Key Drivers of Growth for Grid Storage:

Peak Load Growth & GHGs

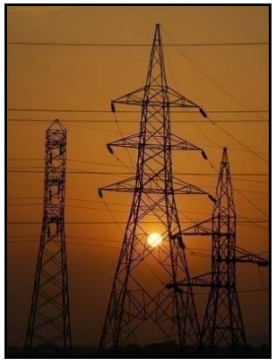


Renewables Integration

Smart Grid



Transmission Constraints

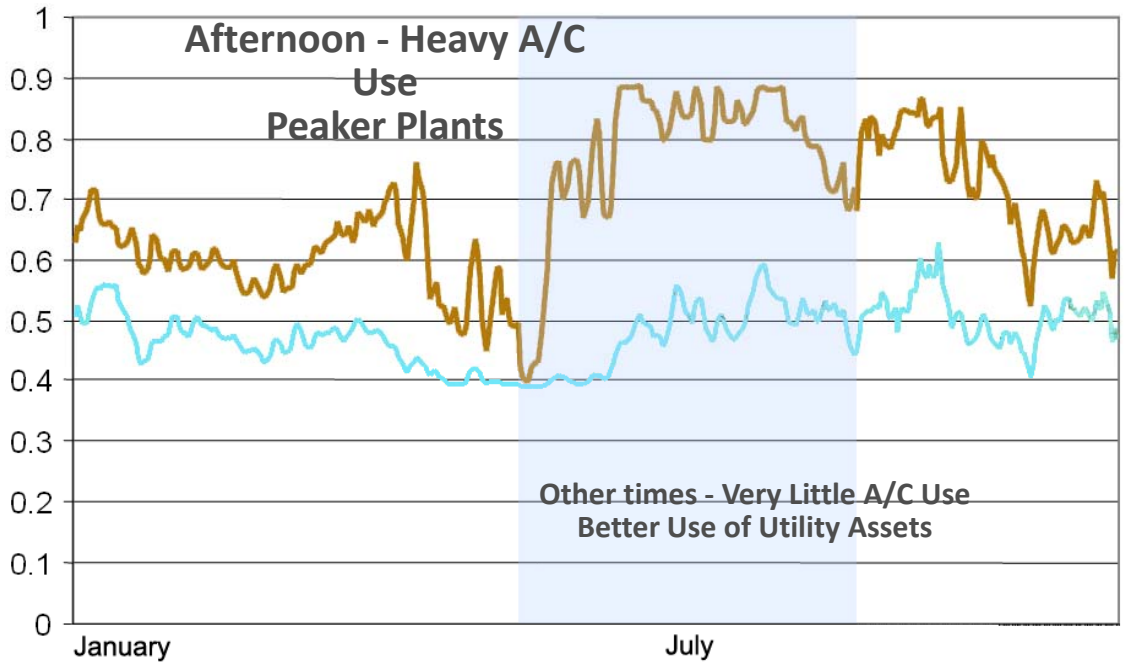


Another Key Driver: Global Warming Solutions Act of 2006 (AB 32): Storage Reduces GHG Emissions

- Percent CO_2 / MWh Reduction Shifting from Peak to Off-Peak:
  - SCE: 33% reduction
  - PG&E: 26% reduction
  - SDG&E: 32% reduction
- Also ~56% lower NO_x emissions

E3 Calculator	Tons CO_2 / MWh		
	Summer On-Peak	Summer Mid-Peak	Summer Off-Peak
Utility			
PG&E	0.67	0.61	0.49
SCE	0.72	0.63	0.49
SDG&E	0.69	0.58	0.47

Peak vs. Off-peak CO_2 Emission Rate[3] (Tons/MWh)



3) Source: Southern California Edison

Why Energy Storage & Renewable Integration?

- ✓ **Energy storage can transform variable generation into dispatchable or baseload generation, all while generating no emissions and without using non-renewable fuels;**
- ✓ **Energy storage has the capacity to increase the value of renewable energy;**
- ✓ **Renewable energy and energy storage provide new and unmatched environmental, operational, and economic benefits to the electric power grid;**
- ✓ **Transmission, generation, and storage complement each other in real time operations and in long term deployment.**

There is VALUE in intelligent, accurate, and sub-second power management:

- **Increases Delivery from Renewable Generation**
  - Zero LSL Grid Services
  - **RPS achievement**

- ***Fast Acting Ancillary Services***
  - Efficient and economic solution for grid reliability (Frequency Regulation)
  - More load can be served by renewable energy

- ***Ramp Rate Control***

- ***Renewable Capacity Firming***

- ***Shave Peak Demand Synergistically***

- ***Emission Free Peak Capacity***

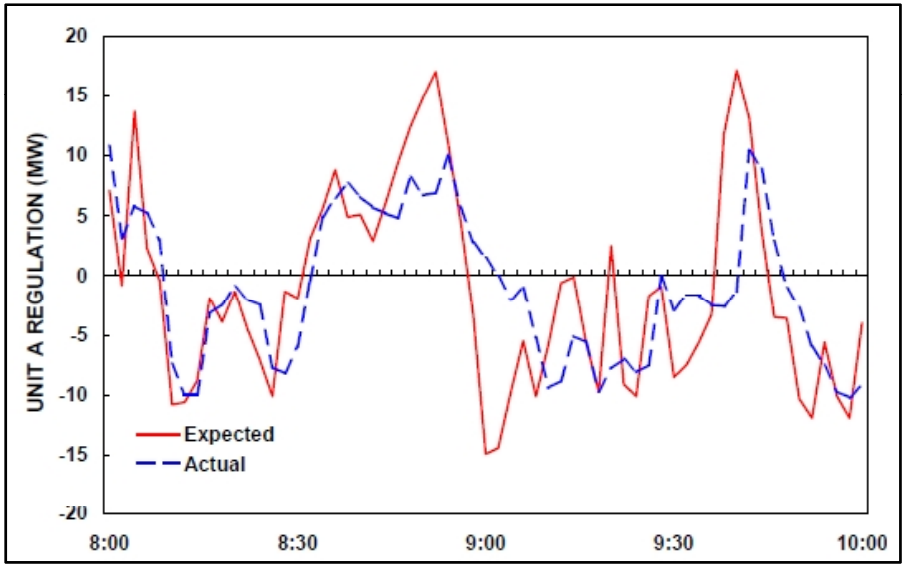
Frequency Regulation

- Why it is important?
  - Balances fluctuations in load and variable energy resources
  - Maintains grid frequency of 60 Hz
  - Critical for any grid's stability and operation

- Why Storage is a great solution!
  - Instantaneous response
  - Provides no unintended energy to grid
  - High efficiency

Benefits of Fast Response

- Storage is 2-3 times more effective than a Peaker [4]
  - Faster, more accurate response can follow load signal directly
  - Generation must "chase" the faster moving load
  - Conventional generation can provide regulation in the wrong direction



[5]

- Allows thermal generation to operate more efficiently[6]
  - Reduces fuel losses and damage associated with cycling
  - Allows generators to operate closer to preferred operating point

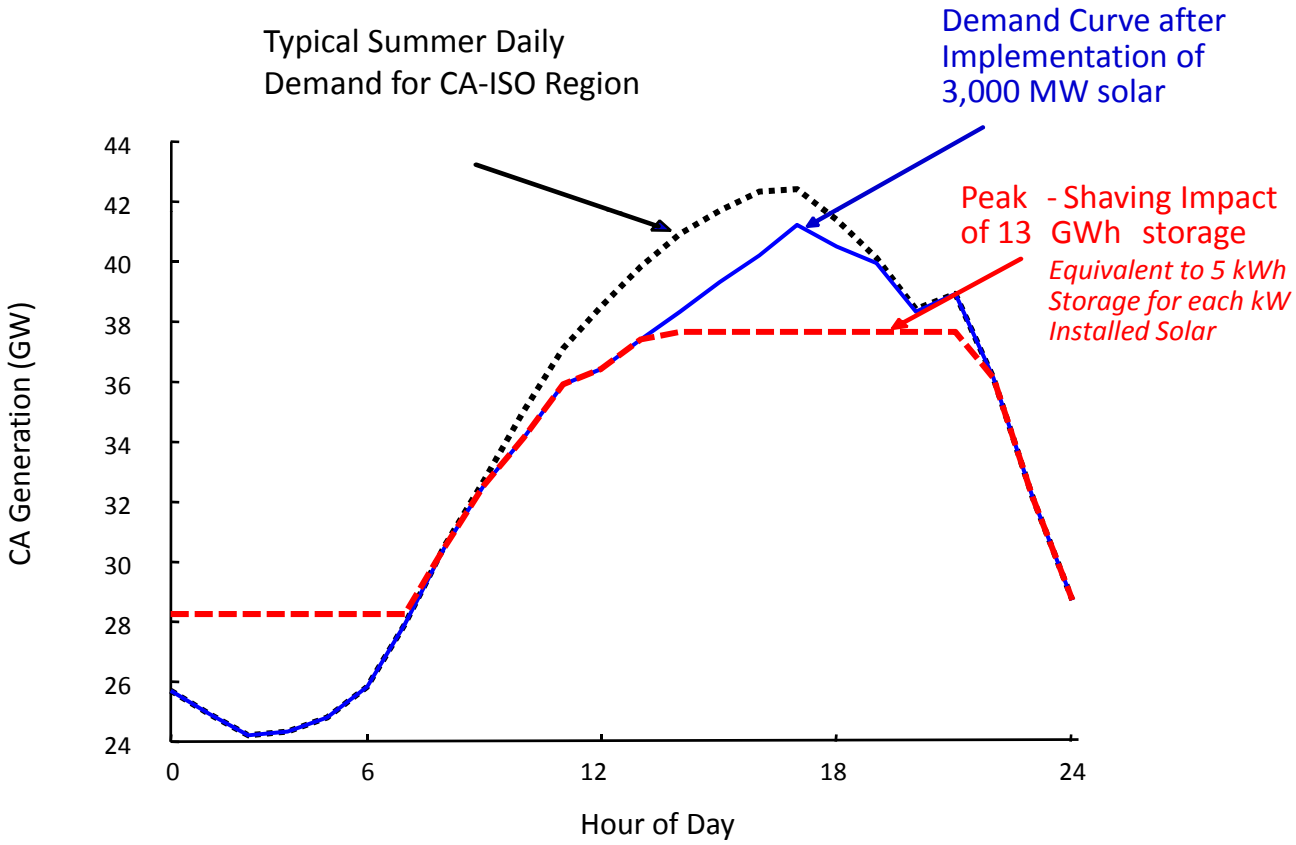
4. Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid, KEMA, June 2010
5. Integration of Renewable Resources, Operational Requirements and Generation Fleet Capability at 20% RPS, California ISO, August 2010
6. Energy Storage – a Cheaper, Faster, & Cleaner Alternative to Conventional Frequency Regulation, Strategen Strategies for Clean Energy, February 2011

Energy Storage can provide peaking/capacity services *without…*

1. Fuel Use
2. Water Use
3. Emissions Pollution
4. Being located far from load.

Storage can shave peak demand synergistically with renewables … solar example

The chart below demonstrates how distributed energy storage – particularly when paired with renewables – can have a significant load shaving impact.



Source: EPRI

Real Projects, Real Solutions, Not just R&D.

Project	Application	DPR™	COD	Services
South Pole Telescope	Microgrid	0.5 MW / 0.1 MWh	Q4 2006	Peak-Shaving, Load-leveling
Maui	Wind	1.5 MW / 1.0 MWh	Q3 2009	Ramp Control
Kahuku	Wind	15 MW / 10 MWh	Q1 2011	Ramp Control, Voltage Regulation
Xcel	Solar	1.5 MW / 1.0 MWh	Q1 2011	Ramp Control, Ancillary Services, Firming/Shaping
Lanai	Solar	1.125 MW / 0.5 MWh	Q2 2011	Ramp Control, Ancillary Services
Ford	End-User	0.75 MW / 2.0 MWh	Q2 2011	Peak-Shaving, Load-leveling
KIUC	Solar	1.5 MW / 1.0 MWh	Q3 2011	Responsive Reserves, Ramp Control, Ancillary Services
KWP II	Wind	10 MW / 20 MWh	Q4 2011	Ramp Control, Curtailment Capture, Responsive Reserves
Fosters*	End-User	3.0 MW/ 2.0 MWh	Q4 2011	Uninterruptible Power Supply
Duke Notrees	Wind	36 MW / 24 MWh	Q4 2012	Ramp Control, Ancillary Services
Tres Amigas	T&D	~ 100 MW / 200 MWh	Q2 2013	Ancillary Services

* Project not yet announced

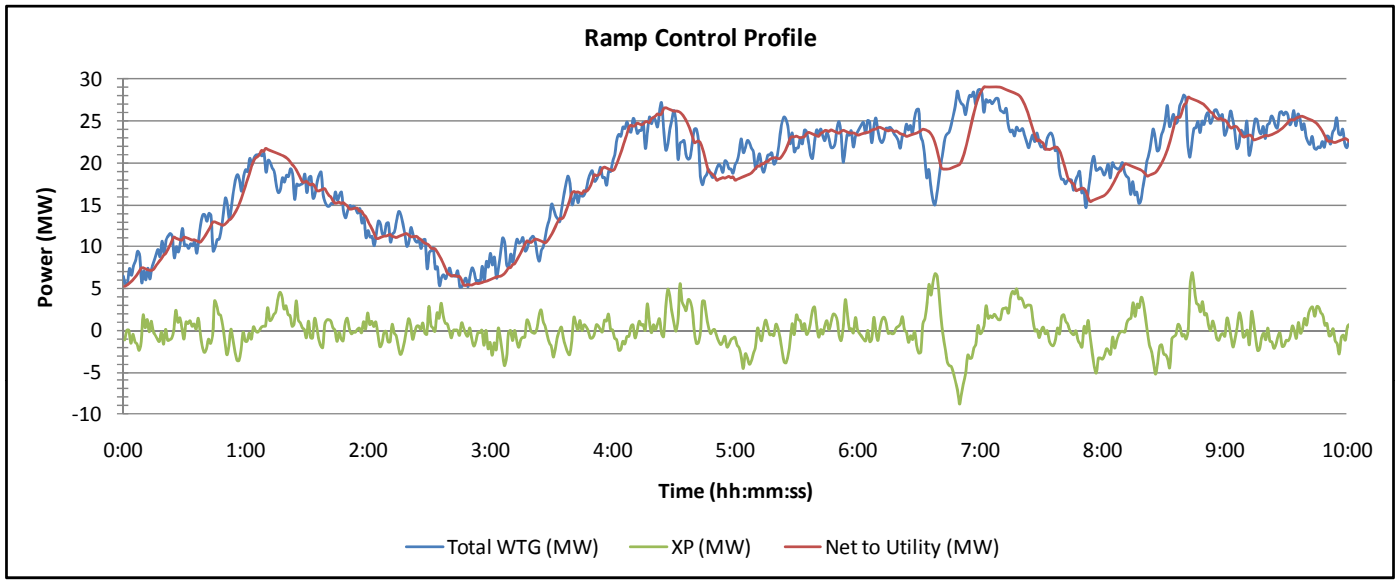
Kaheawa Wind Power

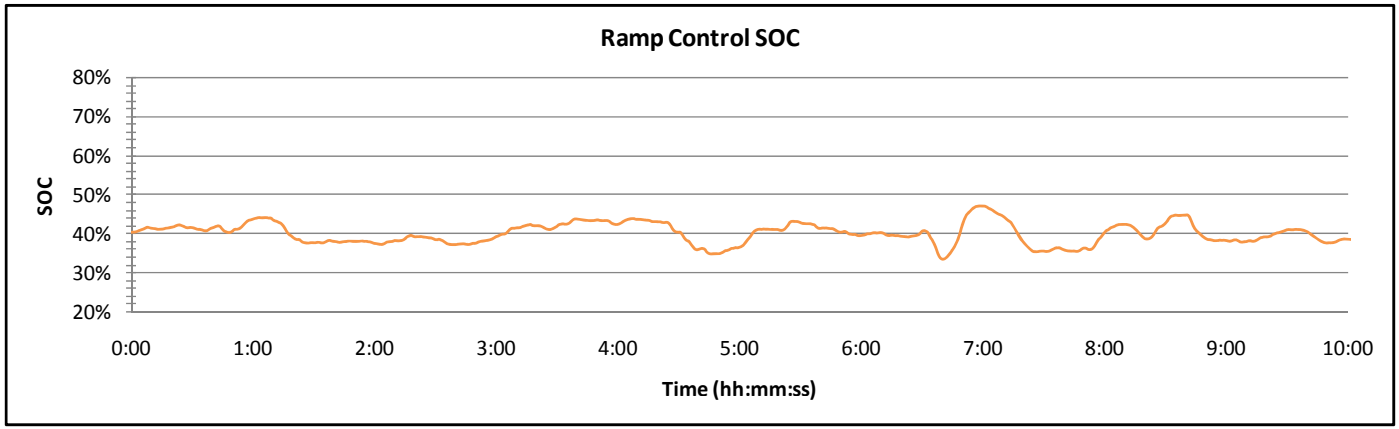
First Commercial Installation with Renewables

Location	Maui, Hi
Application	Wind
DPR™	1.5 MW / 1.0 MWh
COD	Q3 2009
Services	Ramp Control

The first utility-scale Xtreme Power DPR™ operates on a 30 MW wind farm on a 80-200 MW grid. This DPR™ smoothes output to ±100 kW/min and controls ramps to ±1 MW/min.

Proof of Performance





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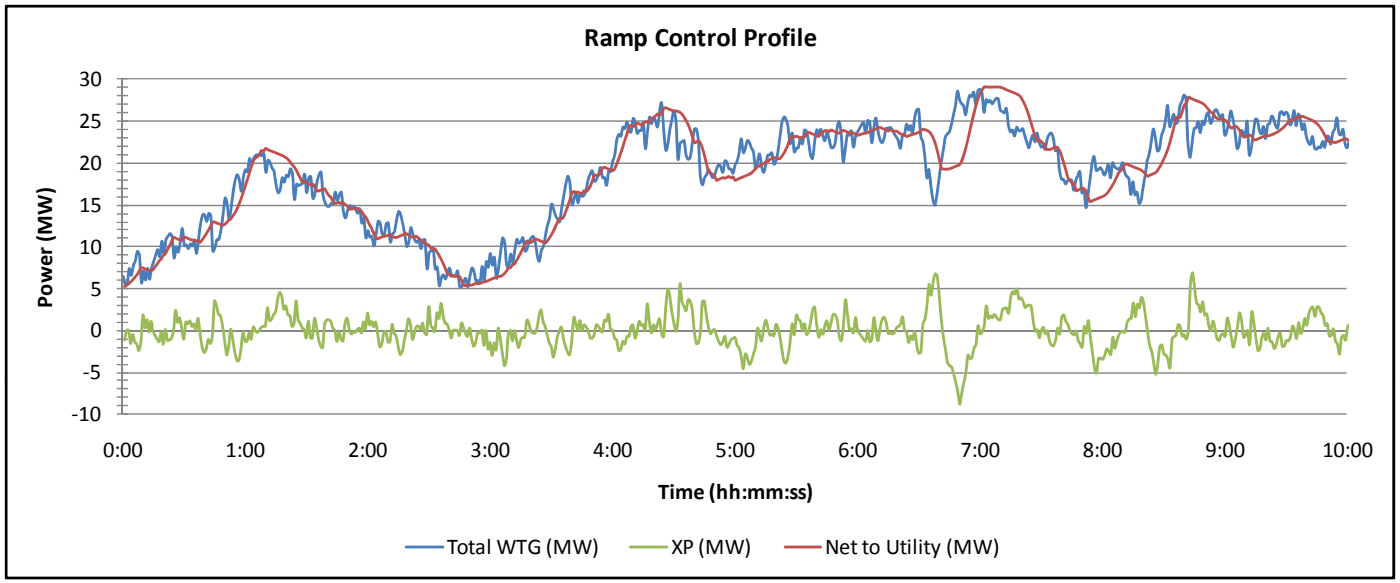

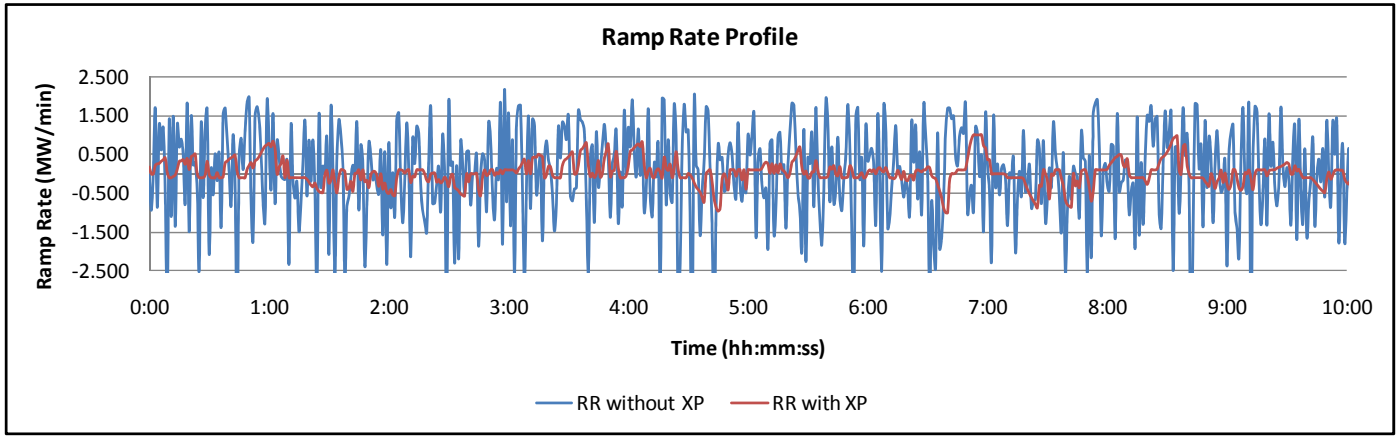

Kahuku Wind Power

Largest North American Installation with Wind

Location	Oahu, HI
Application	Wind
DPR™	15 MW / 10 MWh
COD	Q1 2011
Services	Ramp Control, Voltage Regulation

This DPR™ is operating on a 30 MW wind farm on the island of Oahu to meet PPA ramp control and smoothing requirements.

March 2011
Kahuku WTG Trip Event

- Four WTG's tripped offline causing an ~8 MW drop in power
- DPR immediately discharges ~8 MW, ramps down park successfully

Xcel and SolarTAC

Mainland Installation for Testing with Solar

Location	Aurora, CO
Application	Solar
DPR™	1.0 MW / 1.0 MWh
COD	Q1 2011
Services	Ramp Control, Ancillary Services, Firming/Shaping

SolarTAC Technology Acceleration Center

This system will collect operational data on the integration of energy storage and solar energy systems at the Solar Technology Acceleration Center.

Ford Michigan Assembly Plant

Reducing Costs, Increasing Reliability

Location	Wayne, MI
Application	End-User
DPR™	0.75 MW / 2.0 MWh
COD	Q2 2011
Services	Peak Shaving, Load-leveling

Ford selected the Xtreme Power DPR™ to operate with one of the largest solar power generation systems in Michigan. The DPR™ will help the plant save an estimated $160,000 in energy costs annually by shaving peak demands and leveling load.

Duke Notrees

Largest Battery Energy Storage System in the World!

Location	Odessa, TX
Application	Wind
DPR™	36 MW / 24 MWh
COD	Q4 2012
Services	Ramp Control, Ancillary Services

Duke Energy plans to match a $22 million grant from the U.S. Department of Energy to install DPR™ capable of storing electricity produced by Duke's 153 MW Notrees wind farm. After due diligence, Duke Energy chose Xtreme Power to design, install and operate the largest battery storage system in the world.

THANK YOU!

Amanda Stevenson
Director Market Policy & Regulatory Affairs, West

Direct: 512-924-4910
Email: astevenson@xtremepower.com