

# A123 Systems' Energy Storage Projects & Applications Overview



**DOCKET**

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DATE JUN 11 2012

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**California Energy Commission,  
Lead Commissioner Workshop on Renewable  
Integration Costs, Requirements, and Technologies**

**June 11, 2012**

# Storage for Renewable Integration

- Technology is not a barrier
  - + Track record of using storage for grid benefit, 20,000 MW of P.S.
  - + **Unique attributes of new Fast, Modular, Flexible, and Accurate Advanced Energy Storage introduce new solution options and value-add opportunities**
  
- Cost is not a barrier
  - + But, does limit opportunities right now
  
- Regulatory Rules for Storage, needs work
  - + G or T or D - who invests and mechanisms for investment recovery?
  - + Operating experience will support policy effort focus & investment
  - + **Modeling in CAISO and CA IOU and Muni utility transmission and resource planning studies will expand consideration and incorporation of effective storage alternatives**
    - Load Flow and Dynamic Stability
    - Production Simulation

# >90 MW of A123 Advanced Battery Systems Performing Grid Applications

## Completed installations:

- Nov 2008 – 2MVA/500kWh, California (to PJM ‘12) **Frequency Regulation**
- Nov 2009 – 12MVA/4MWh, Atacama, Chile ..... **A/S, and release generation for energy**
- Oct 2010 – 400kVA/100kWh, Denmark ..... **Wind Ramp Rate Control**
- Jan 2011 – 20MVA/5MWh, New York ..... **Frequency Regulation**
- Sep 2011 – 32MVA/8MWh, W. VA/PJM ..... **A/S, and Renewable Integration**
- Oct 2011 – 4MVA/1MWh, California ..... **Smart Grid Resource (Multi-T&D Services)**
- Nov 2011 – 20MVA/5MWh at Angamos, Chile ..... **A/S, and release generation for energy**

## Under construction:

- Aug 2012 – 500kVA/125kWh, China ..... **Renewable Integration Demo**
- Jun 2012 – 2MVA/500kWh, Massachusetts ..... **Frequency Regulation**
- Aug 2012 – 8MVA/32MWh, Tehachapi California.. **Grid-Side Wind Integration Demo**
- Sep 2012 – 500kVA/250kWh, Detroit ..... **PV Integration Demo**
- Oct 2012 – 11MW/4.4MWh Maui ..... **Wind Ramp Rate Control**
- Nov 2012 – 1MVA/3MWh, Europe ..... **T&D Support, Load Shifting & Voltage Reg.**
- Dec 2012 – 1MVA/1MWh, Maui ..... **T&D Support, Load Shifting & Voltage Reg.**
- Dec 2012 – (1) 5MWh & (5) 100KWh systems, U.K. **T&D Support, Load Shifting & Voltage Reg.**

***Traditional Storage is a vital grid resource today at 20 GW of Pumped Storage***

***Advanced Storage is growing . 170 MW per DoE, <http://www.energystorageexchange.org/>***

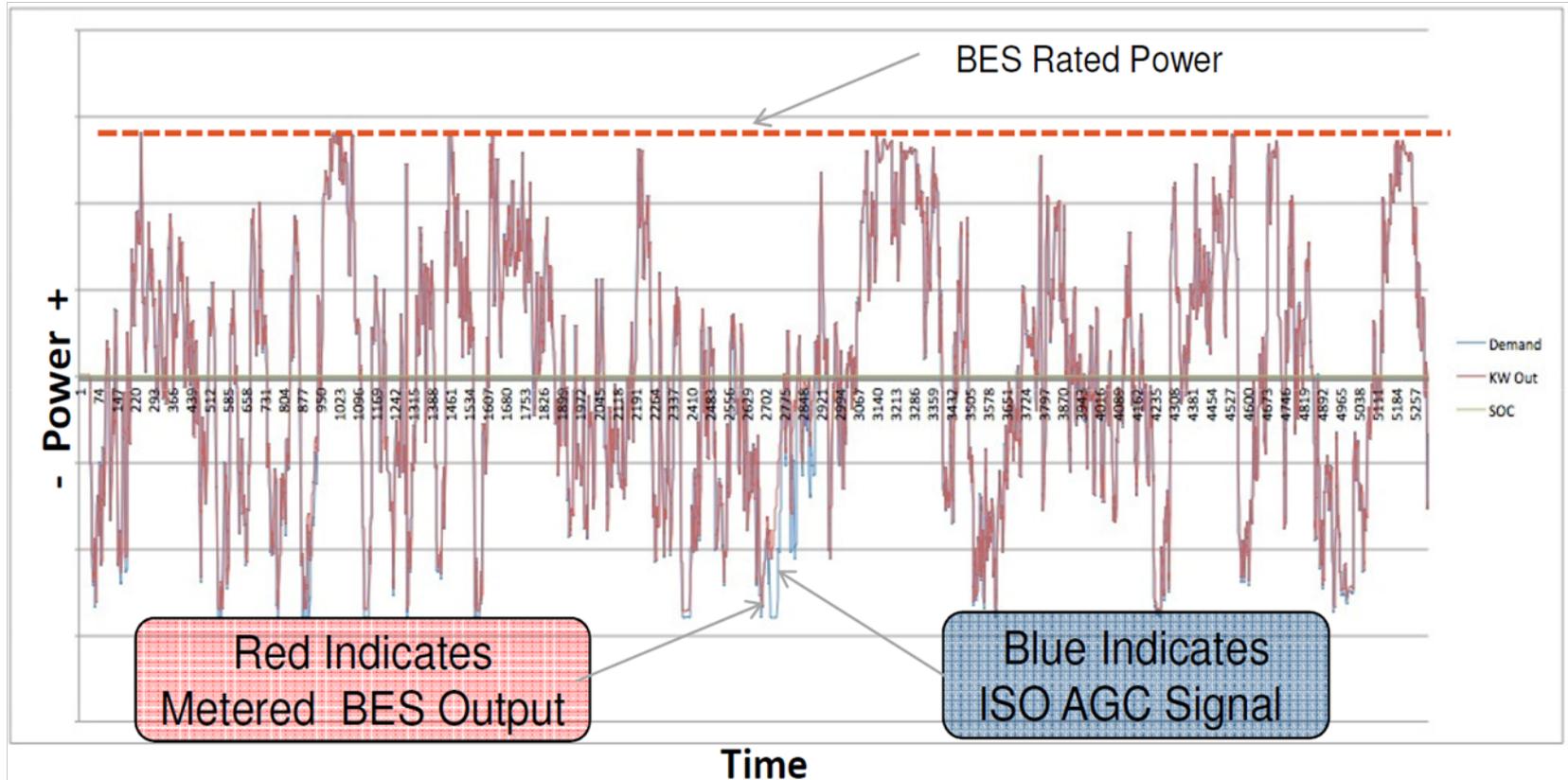


# Frequency Regulation & Wind Integration: 32 MW, PJM, commercial operation 2011



Photo courtesy of AES Storage

# Frequency Regulation (F/R): Sample Output



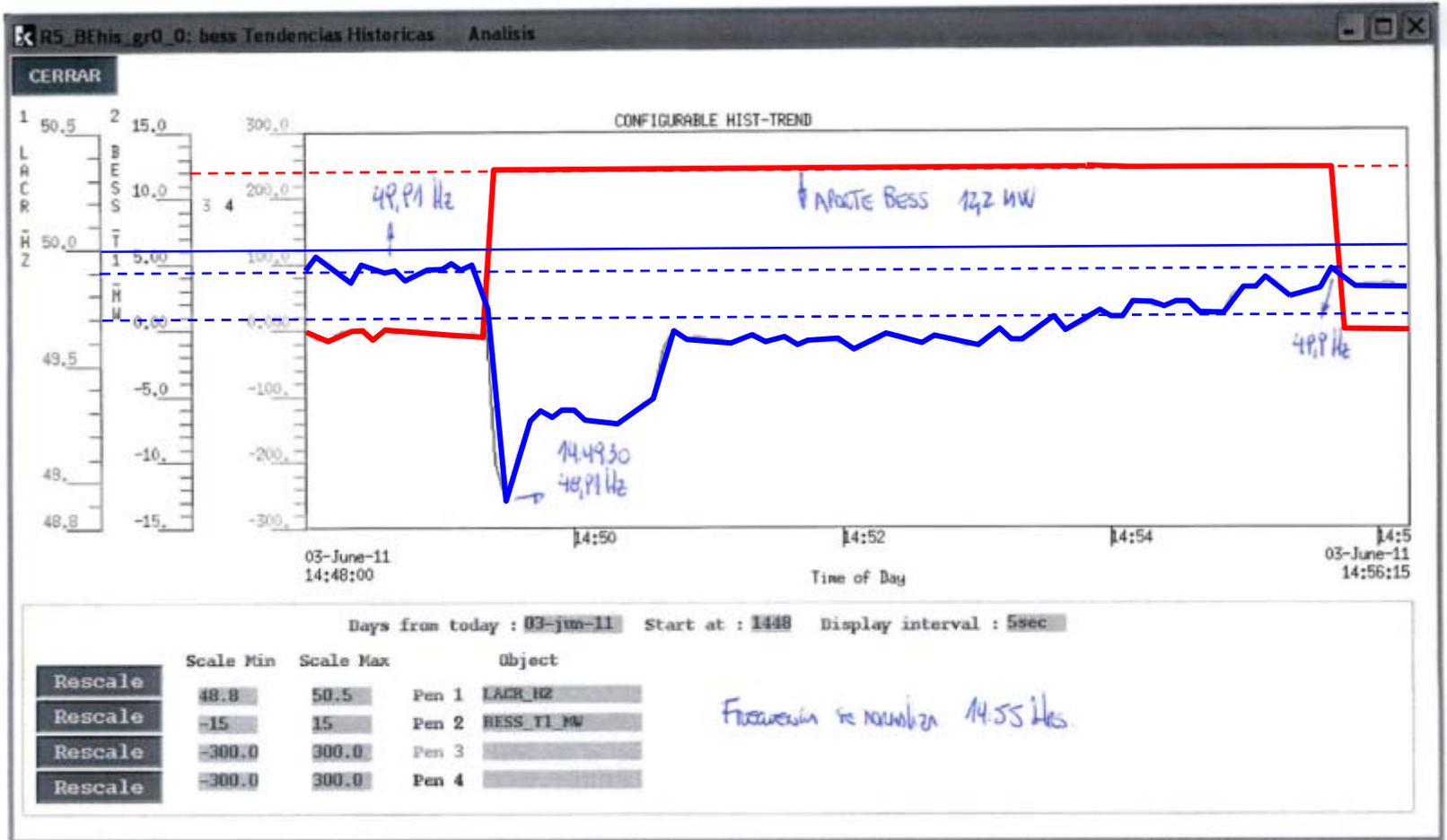
**Faster and more accurate response = better grid system performance, and lower total cost for meeting F/R Ancillary Service requirement**

# Spinning Reserve for Generation Capacity Release: Chile, 12 MW 2012, 20 MW 2011



# Chile System, A123 Response to Grid Outage

## CDEC-SING Fault Report No. 2777, June 3, 2011



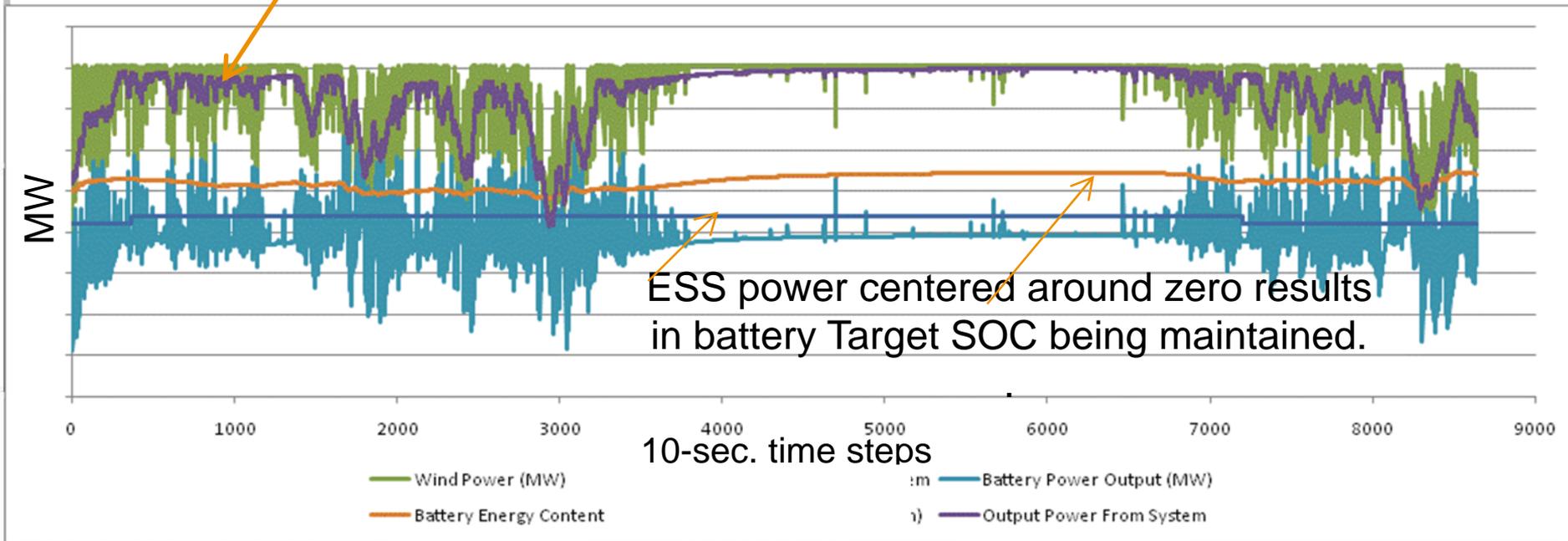
# Renewable Integration Pilot – Denmark 2011

## Ramp Rate Management demo system



# Storage for Meeting Ramp Rate Control Req't

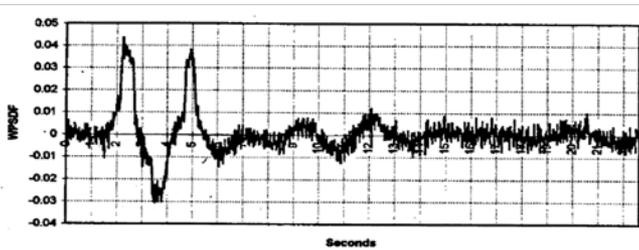
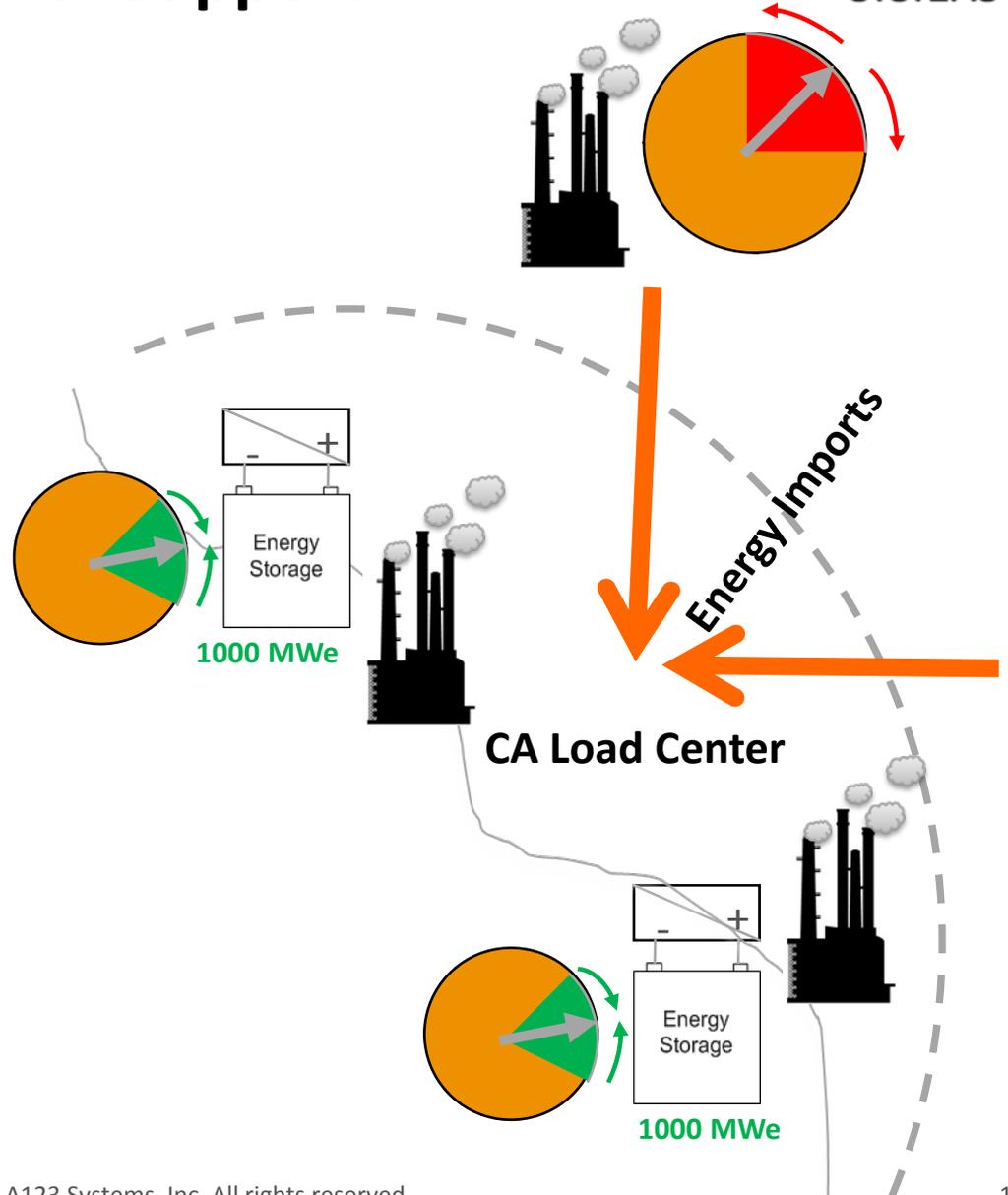
Net power delivered to grid meets performance requirements



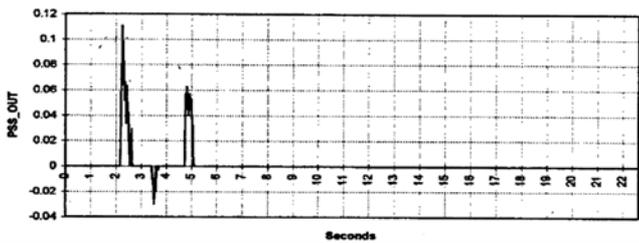
# Extending Advanced Storage App's to Bulk Transmission And Regional Support

PMU-equipped Storage Systems  
Detect and Damp Inter-area  
Oscillations.

*Higher Dynamic Stability Limit =  
More Useable Transmission &  
Import Capacity*



*(GE) ES-PSS, In Action, 1994*



Source, SCE, EPRI

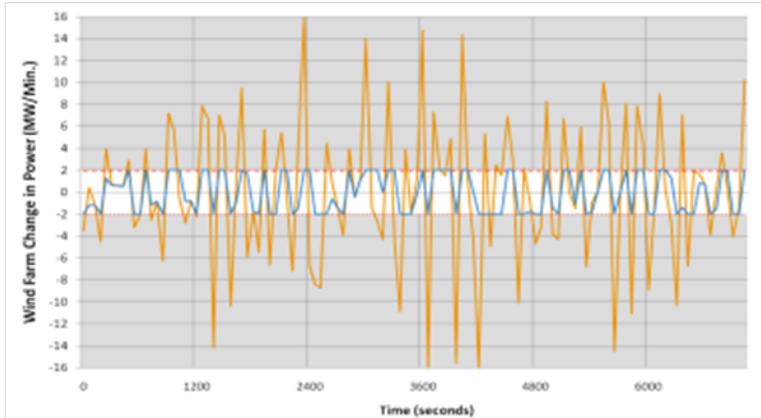


# BACKUP SLIDES

## Applying Energy Storage to Electric Grids

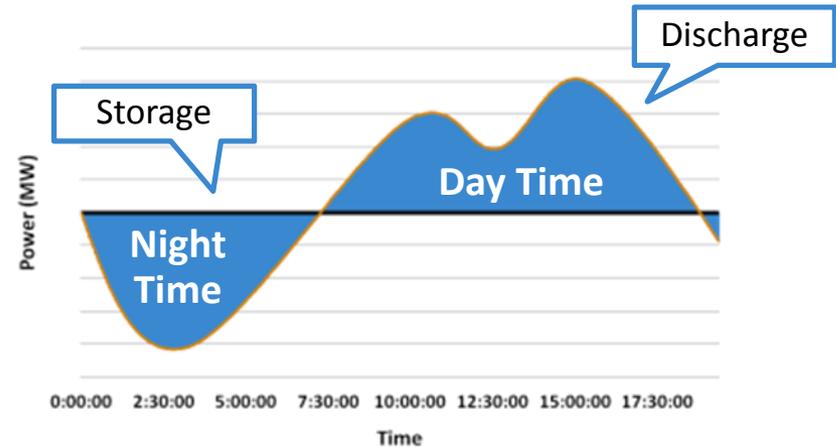
# Multiple Applications for Grid Storage

## High Power Applications:



- Regulation
- Spinning Reserve
- Renewable Integration
  - + Ramp Management
- **Requirements:**
  - + Very high Charge/Discharge Rates
  - + Short Duration (<1hr)
  - + Many cycles (100s per day)
  - + Continuous use

## High Energy Applications:

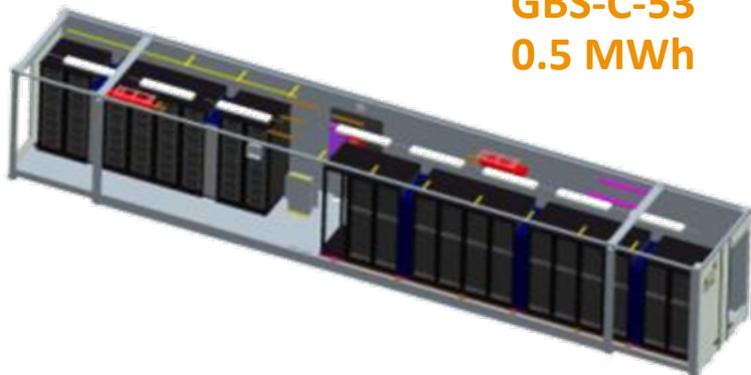


- Peak Load Shifting
- Renewable Integration
  - + Firming, Shifting & Curtailment Recovery
- Energy Arbitrage
- T&D Asset Support
- **Requirements:**
  - + Minimum Size(1+ hrs of energy)



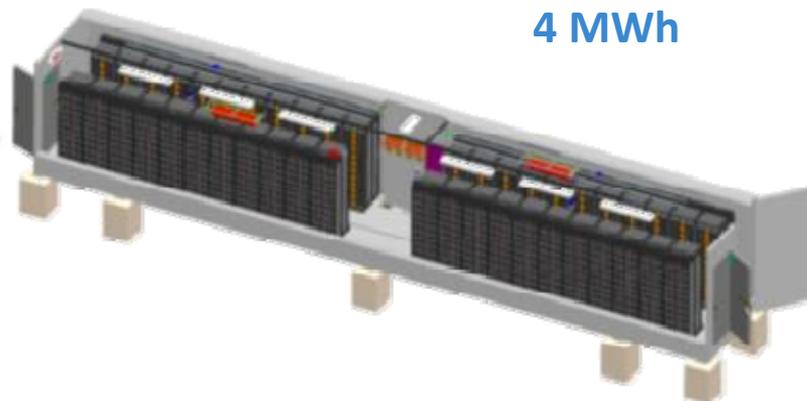
## High Power Applications

GBS-C-53  
0.5 MWh



## High Energy Applications

GBS-P-53  
4 MWh



- Frequency Regulation
- Reserve
- Renewable Ramping
  - + Enabling Access to Full Energy Value

- Peak Shifting and Arbitrage
- Renewable Integration
- Firming, Shifting & Curtailment Recovery
- T&D Support & Investment

# Spec's for Standard GBS-P and GBS-C Systems



	Long-Duration (LD) Grid Battery Systems			High-Rate (HR) Grid Battery System
<b>Model Number</b>	GBS-C53-LD40	GBS-C40-LD28	GBS-C20-LD12	GBS-C53-HR20
<b>Energy Storage</b>	4 MWh (nominal at C/2 rate)	2.8 MWh (nominal at C/2 rate)	1.2 MWh (nominal at C/2 rate)	700kWh (nominal at 1C rate)
<b>Power Rating</b>	4 MW	2.8 MW	1.2 MW	2 MW
<b>Dimensions (LxWxH)</b>	53' x 8.5' x 9.5' (16.2m x 2.6m x 2.9m)	40' x 8.5' x 9.5' (12.2m x 2.6m x 2.9m)	20' x 8.5' x 9.5' (6.1m x 2.6m x 2.9m)	53' x 8.5' x 9.5' (16.2m x 2.6m x 2.9m)
<b>Mass</b>	141,000 lbs	103,000 lbs	49,000 lbs	64,000 lbs
<b>DC Efficiency*</b>	97% [C/2 rate]			96% [1C rate]
<b>DC Voltage</b>	944V nominal (750V – 1050V DC operating range)			960V nominal (750V – 1050V DC operating range)
<b>Ambient Operating Temperature Range</b>	-30°C to + 50°C			
<b>Enclosure details</b>	Containerized, ISO 1496-1 certified, IMO CSC-compliant, designed to IP56 per IEC60529			

\* Inclusive of battery management electronics; excluding auxiliary power consumption by thermal management systems. Long-Duration GBS efficiency measured at full depth of discharge. High-Rate GBS efficiency measured at partial depth of discharge near mid state-of-charge.

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