Energy Storage:

Moving Forward from

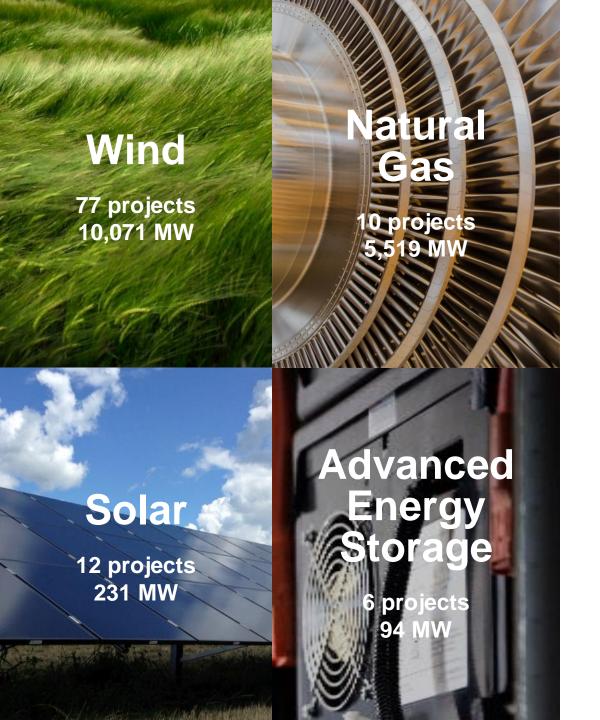
Frequency Regulation

John Fernandes
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for the





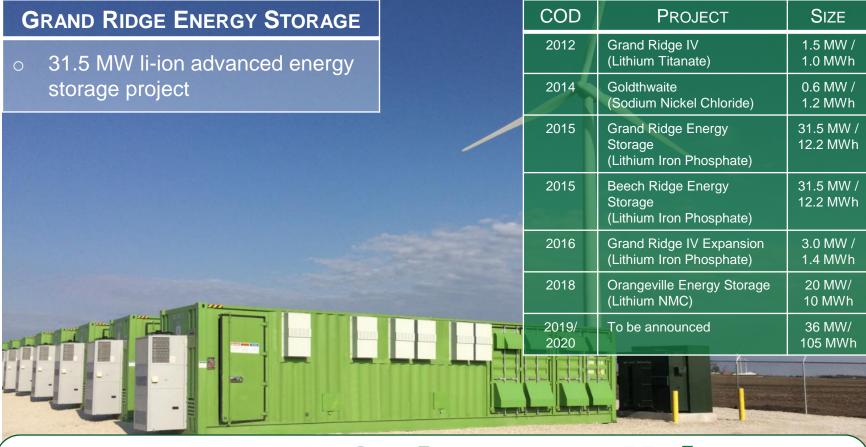


# **Broad Expertise**

We develop, own and operate large-scale renewable and other clean energy generation and storage facilities in North America, Latin America, Japan and Europe.

<sup>\*</sup> As of June 1, 2017; includes projects that are operating, in construction or contracted. Renewables include wind, solar and storage.

# **Developed Projects**



ENERGY STORAGE PROJECTS IN THE US 94 MW OF NAMEPLATE CAPACITY

PRIVATELY
HELD
ADVANCED
ENERGY STORAGE
OWNER/OPERATOR

## Frequency Regulation – Launchpad for Storage

#### FERC Order 755 – Pay for Performance

Order 784 – Still recognizes capability

#### **PJM**

800:5:30

#### **Lessons Learned**

- Yup, it's fast
- Decreases Reserve Requirements Net Savings
- State-of-Charge Management

## **Early Market Evolution**

#### **Balancing & Ancillary Services**

Solar Integration – PR & HI

### "Capacity"

- CA Resource Adequacy
- "Capacity Performance"

#### **Reliability & Multiple Services**

- Glacier PSE
- BQDMP ConEd



Bellingham Herald - 2016

# **Scoping the Next Wave**

#### What is "Flexible Capacity"?

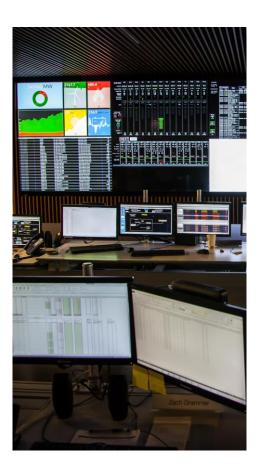
- Serving the Peak
- Optimizing the Fleet
  - Ramping
- Incremental & Mobile Installations

#### **Additional FERC Activity**

- RM17-8: Interconnection
  - Grand Ridge Energy Center
  - Supply vs. T&D
- RM16-6 & 16-1: Frequency Response & Reactive Power

#### **Technology Advancements**

Carts & horses, chickens & eggs



## **Market Product Structure**

**Meet NERC Standards** 

**Market-Wide or Zonal Eligibility** 

**Pay for Performance** 

- Does duration become a factor?
- Performance-based Dispatch

State-of-Charge Management & Intra-Hour Co-optimization



