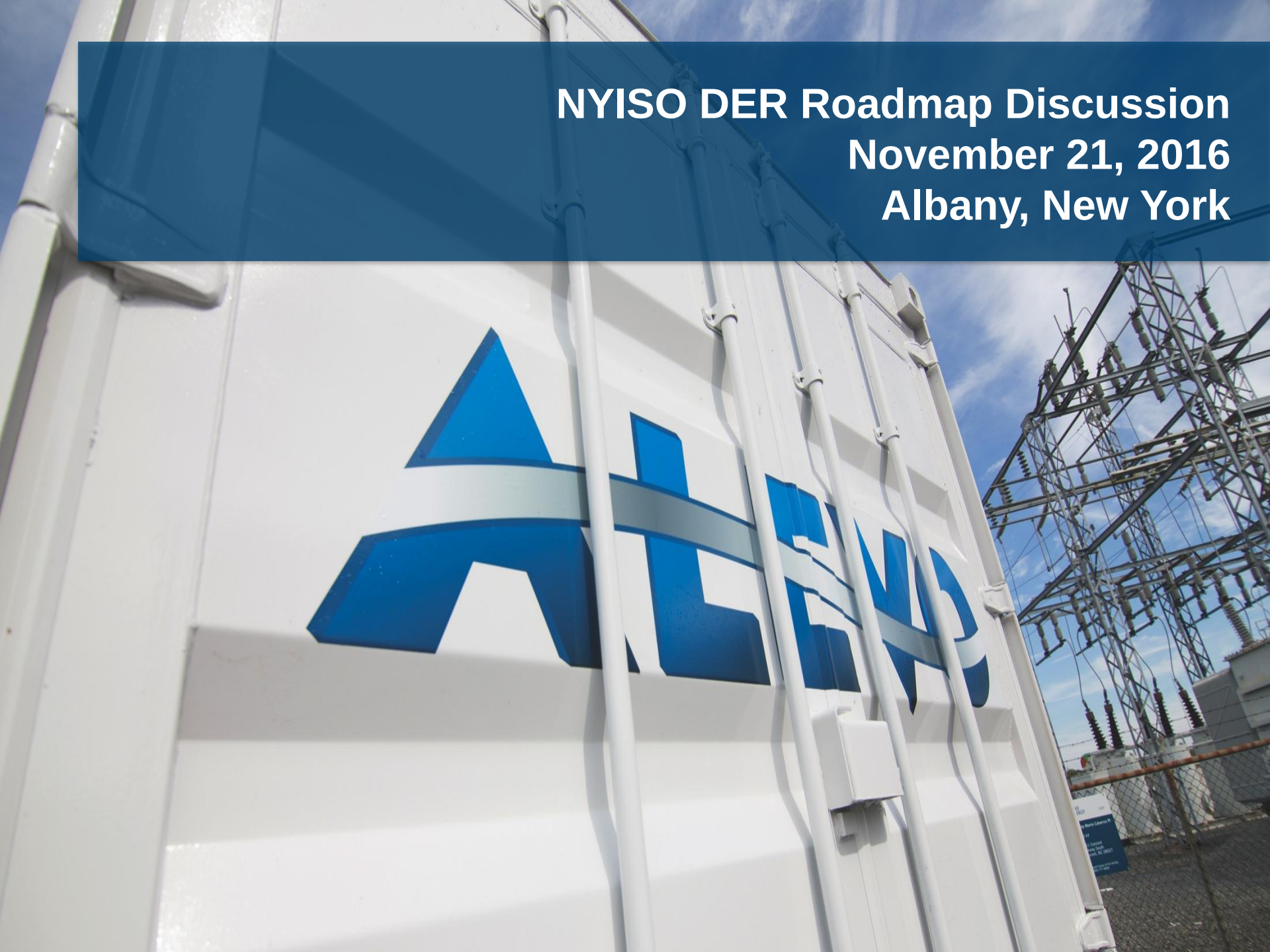


NYISO DER Roadmap Discussion
November 21, 2016
Albany, New York

Today's Discussion

- Company Overview
- Comments on DER Roadmap
- FERC November 17 NOPR on Energy Storage
- Energy Storage Case Studies

Alevo USA Inc. Overview

Two Lines of Business

Alevo Energy

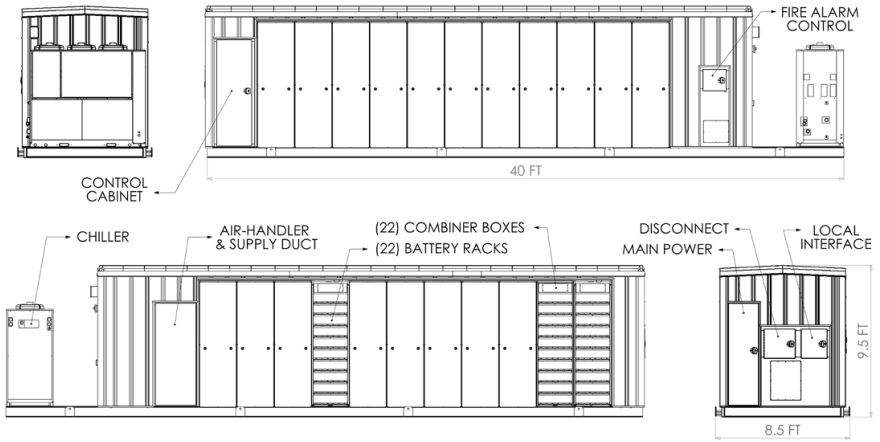
Vertically integrated manufacturer, project developer and systems integrator of in-organic lithium-ion batteries

Alevo Analytics

Analytics consulting firm, specializing in sub-hourly power grid optimization, power market analysis and distributed storage assessments

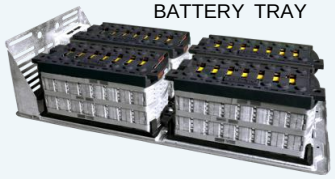
Alevo employs ~200 at its Concord, N.C., manufacturing plant, where it has approximately 2.5 million square feet of manufacturing space

GridBank Configuration



BATTERY CELL

BATTERY MODULE



BATTERY TRAY

22 RACKS IN EACH GRIDBANK

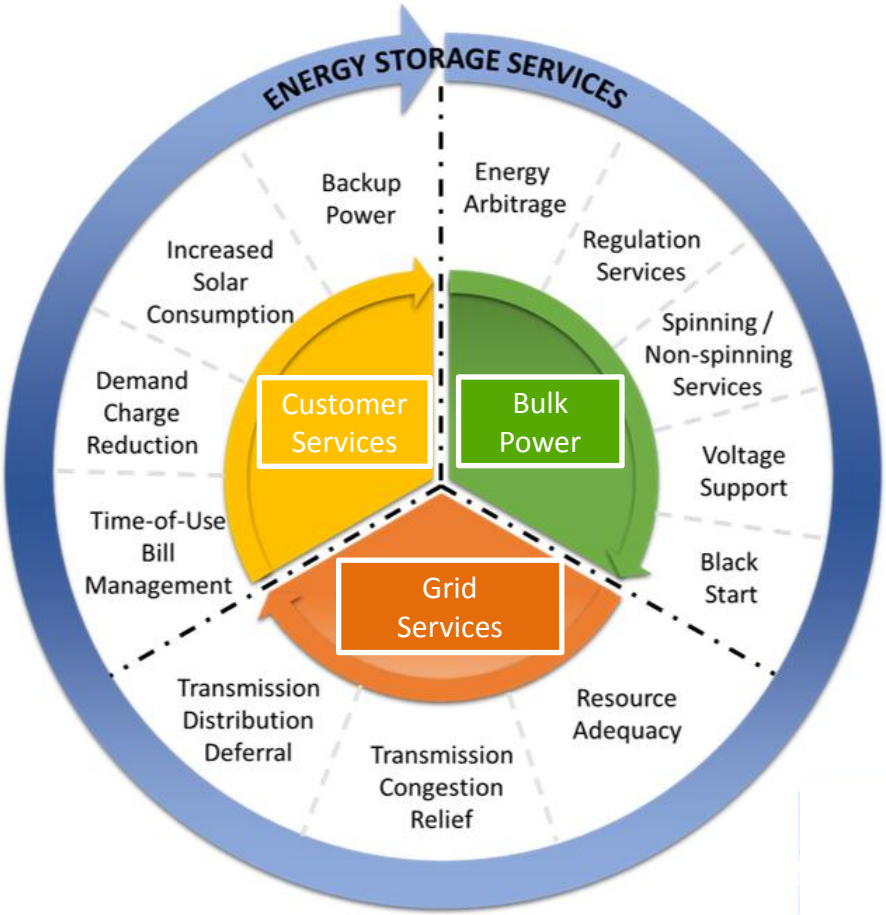
- 14,080 Cells — 8 cells per module
- 1,760 Modules — 4 modules per tray
- 440 Trays — 2 trays per shelf
- 220 shelves — 10 shelves per rack
- 22 racks per GridBank
- **Totaling: 2MW / 1 MWh**

Modular system that is easily transportable and that can be installed for a variety of uses

Alevo vs. Typical Lithium Ion Technology

ORGANIC ELECTROLYTE	VS.	ALEVO INORGANIC ELECTROLYTE
HIGHLY FLAMMABLE		NON-FLAMMABLE
UNSTABLE,UNPREDICTABLE		STABLE, PREDICTABLE
LOW POWER		HIGH POWER
HIGHER MANUFACTURING COSTS		LOWER MANUFACTURING COSTS
INCREASING RESISTANCE		STABLE RESISTANCE

Energy Storage Use Cases



- Bulk Power
  - Time Shifting Energy
  - Frequency Regulation
  - Voltage Support
- Grid Services (T&D)
  - Resource Adequacy
  - Power Quality
- Customer Services (Behind the Meter)
  - Peak Shaving
  - Backup Power

Initial Comments on DER Roadmap

- Alevo commends NYISO for proposing ways for distributed energy resources to participate in the wholesale market
  - Technology neutral market design (IPL case vs. MISO)
  - Supports energy storage aggregation to reach duration requirements for energy / capacity markets
  - Supports multi-use energy storage (stacked services)
  - Supports pay for performance

- Further Discussion
  - Impact of FERC NOPR on roadmap, other energy storage initiatives
  - Energy storage can be installed along entire electric value chain. How does that impact NYISO initiatives?
    - Behind the meter
    - Distribution connected
    - Transmission connected
    - Co-located with Generation

    Need to coordinate DER Roadmap and Energy Storage Initiative
  - Expand focus of DER Roadmap beyond demand response: How does the portfolio of assets work together?
  - Account for resources that provide non-energy benefits (e.g. transmission or distribution service for energy storage devices)
  - Can an energy storage resource installed for distribution improvements participate in the wholesale market?
    - Is this a utility-owned asset or owned by a third party? (REV)

FERC NOPR on Energy Storage (1/2)

- Ensure that electric storage resources are eligible to provide all capacity, energy and ancillary services that they are technically capable of providing in the organized wholesale electric markets;

- Incorporate bidding parameters that reflect and account for the physical and operational characteristics of electric storage resources;

- Ensure that electric storage resources can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price;

- Establish a minimum size requirement for participation in the organized wholesale electric markets that does not exceed 100 kW

- Specify that the sale of energy from the organized wholesale electric markets to an electric storage resource that the resource then resells back to those markets must be at the wholesale locational marginal price

FERC NOPR on Energy Storage (2/2)

RTOs should establish market rules to accommodate the participation of distributed energy resource aggregations, consistent with the following:

- Eligibility to participate in the organized wholesale electric markets through a distributed energy resource aggregator;
- Locational requirements for distributed energy resource aggregations;
- Distribution factors and bidding parameters for distributed energy resource aggregations;
- Information and data requirements for distributed energy resource aggregations;
- Modifications to the list of resources in a distributed energy resource aggregation;
- Metering and telemetry system requirements for distributed energy resource aggregations;
- Coordination between the RTO/ISO, distributed energy resource aggregator, and the distribution utility; and
- Market participation agreements for distributed energy resource aggregators

Energy Storage Case Studies

Lewes – Delaware

Project Overview

- 8 MW/ 4 MWH
- Partnership with City of Lewes, Delaware, Board of Public Works
- Behind the meter installation inside old generator building; *no fire suppression system installed*
- Interconnects to PJM at 13.8 kV

Economic Drivers

- Able to leverage multiple value streams
  - Frequency regulation
  - Peak shaving
- No participation in PJM capacity / energy market; potential for aggregation
- Waiting for path forward to identify and monetize potential transmission benefits

AEP North Texas Energy Storage Proposal

Use Case 1

- AEP proposes to install a utility-scale battery on a radial distribution feeder so that it could provide power during an outage of either the transmission or radial distribution line
- Currently, a one megawatt battery capable of supplying two megawatt hours of power (1MW/2MWh) could be installed at an estimated cost of $1.6 million.
- This is less than the cost of more traditional solutions (i.e., either the construction of a new transmission line and substation or the construction of a new distribution line), which range in cost from $6.0 - $17.2 million

Use Case 2

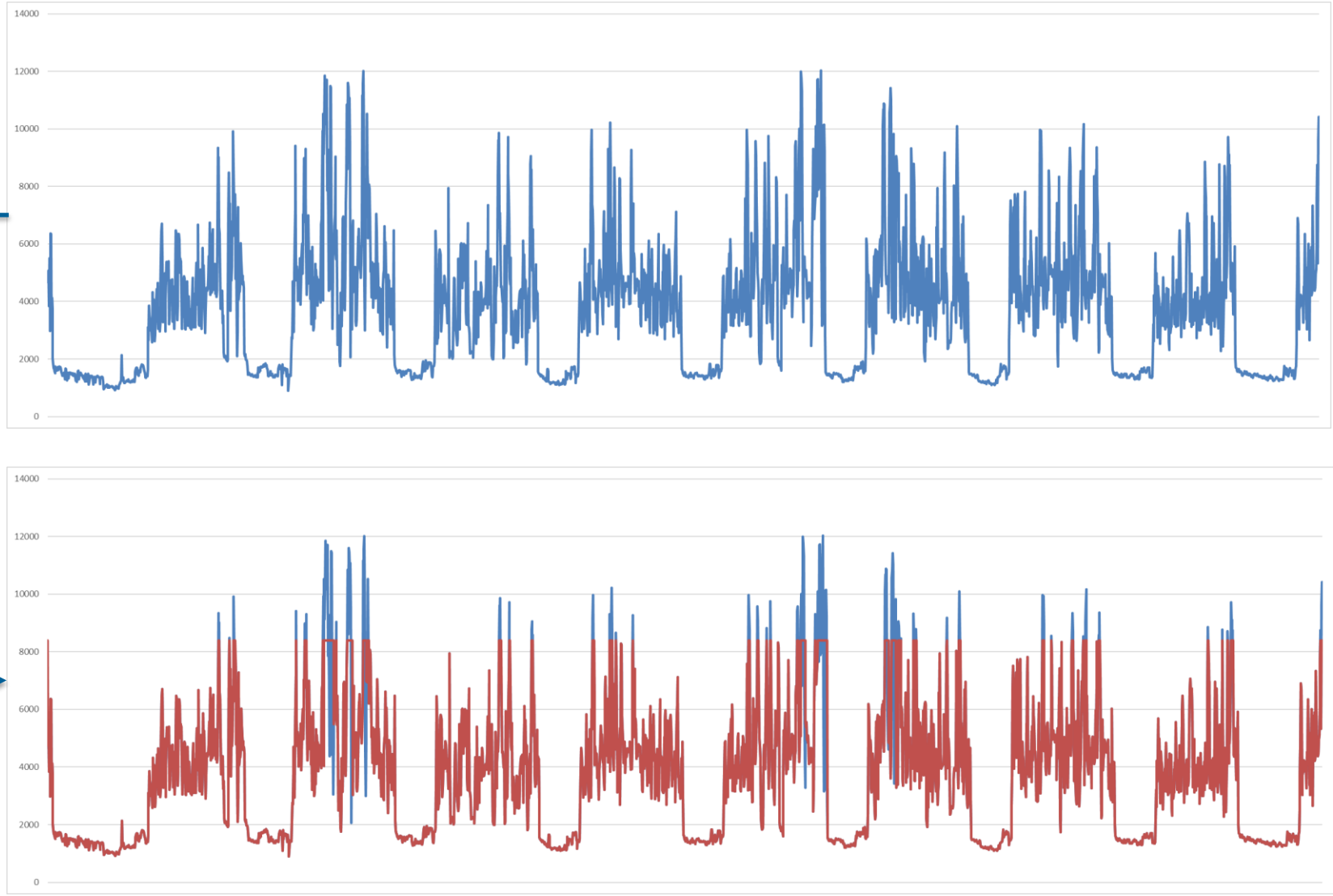
- The peak load on a substation transformers is 1.1 MW, which represents a 10% overload.
- The installation of a battery on the distribution system would allow the Company to forgo a $5.3 million. substation upgrade for both the entirety of TNC's 10-year planning horizon and for the foreseeable future.
- The estimated installation cost of the 500kW/1,000kWh battery is $700,000, approximately 13% of the cost of a more traditional solution.

Discussion Topics for the Texas Proceeding

- PUCT decided it DID NOT want to discuss multi-use energy storage
- Is energy storage is a generating asset and, if so, can it be owned by a utility?
- Is it appropriate for AEP to treat energy from energy storage facility
- What conditions should be placed on the operation of the assets?

Industrial Customer kW Usage Before and After Storage

How energy storage can lower a customer's demand by 3.6 MW



Industrial Customer Use Case Challenges

- Customer asked to investigate using storage to reduce demand rate based on coincident peak hour
- Initial review of load shape made user an attractive target for possible deployment of energy storage
- Primary challenge to business case was lack of additional revenue opportunities for ESS

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