

A photograph of an industrial facility, likely a power plant or refinery, showing a complex network of pipes, valves, and structural steel. The image is partially obscured by a dark grey diagonal overlay.

ENERGY STORAGE OVERVIEW

RMAEE 17TH ANNUAL ENERGY FORUM

OCTOBER 27, 2016

NAVIGANT

INTRODUCTION AND AGENDA

- Focus
 - Energy storage for commercial buildings
 - Systems owned by building owner/operator or third party
- Meeting Objectives:
 - Understand types of energy storage available and what may work
 - Identify use cases for energy storage that provide value to building owner/operator
 - Learn about potential business models and procurement strategies
 - Identify additional resources to help make decisions on energy storage

WHY ENERGY STORAGE NOW?

Industry changes are driving demand for energy storage, while policy, technology, and cost advances are making it a more attractive option.

Strong Demand for Energy Storage

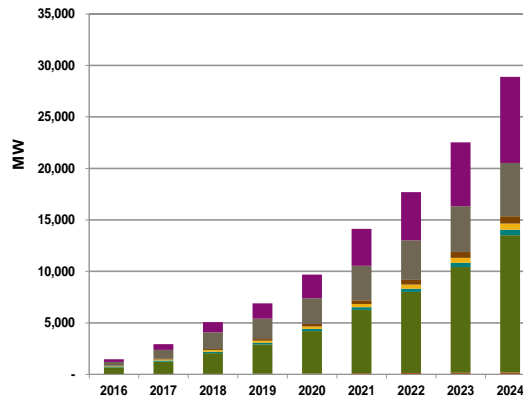
Increasing Intermittent Renewable Generation

Increased Customer Expectations and Engagement

Aging Infrastructure

Utility Transformation from Centralized to Networked Grid

Increased Energy Storage Adoption



Increased Performance at a Decreased Price

Policy Initiatives

Technology Performance Advancements

Technology Demonstration Validations

Cost Reductions

WHAT CAN ENERGY STORAGE DO FOR YOU?

Energy storage has many applications, but only a few are relevant to commercial and institutional buildings.

Electricity Cost Optimization

- Peak/Off-Peak Price Management
- Demand and Power Factor Charge Management
- Renewable Energy Shifting

Capacity

- Generation Resource Adequacy (e.g., capacity markets, capacity contracts, operating reserves, demand response programs)
- T&D Infrastructure Adequacy

Routine Grid Operations

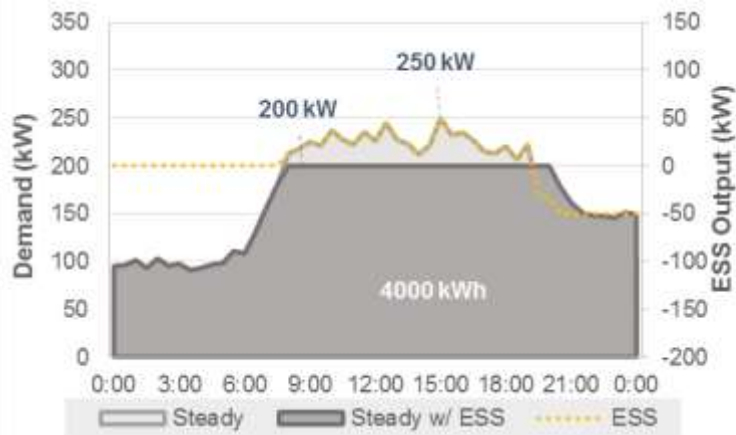
- Frequency Regulation
- Voltage/VAR Support
- Renewable Energy Ramping
- Renewable Energy Smoothing

Contingency Situations

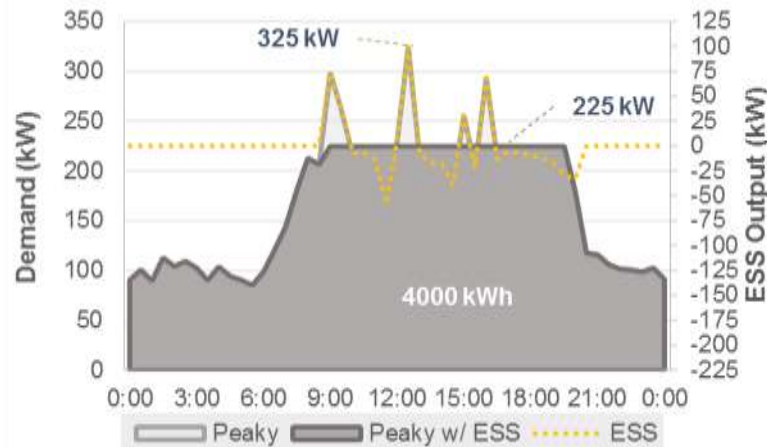
- Black Start
- Sustained Outages
- Momentary Outages

CURRENT USE CASES

Demand charge management is the leading use case being adopted right now.



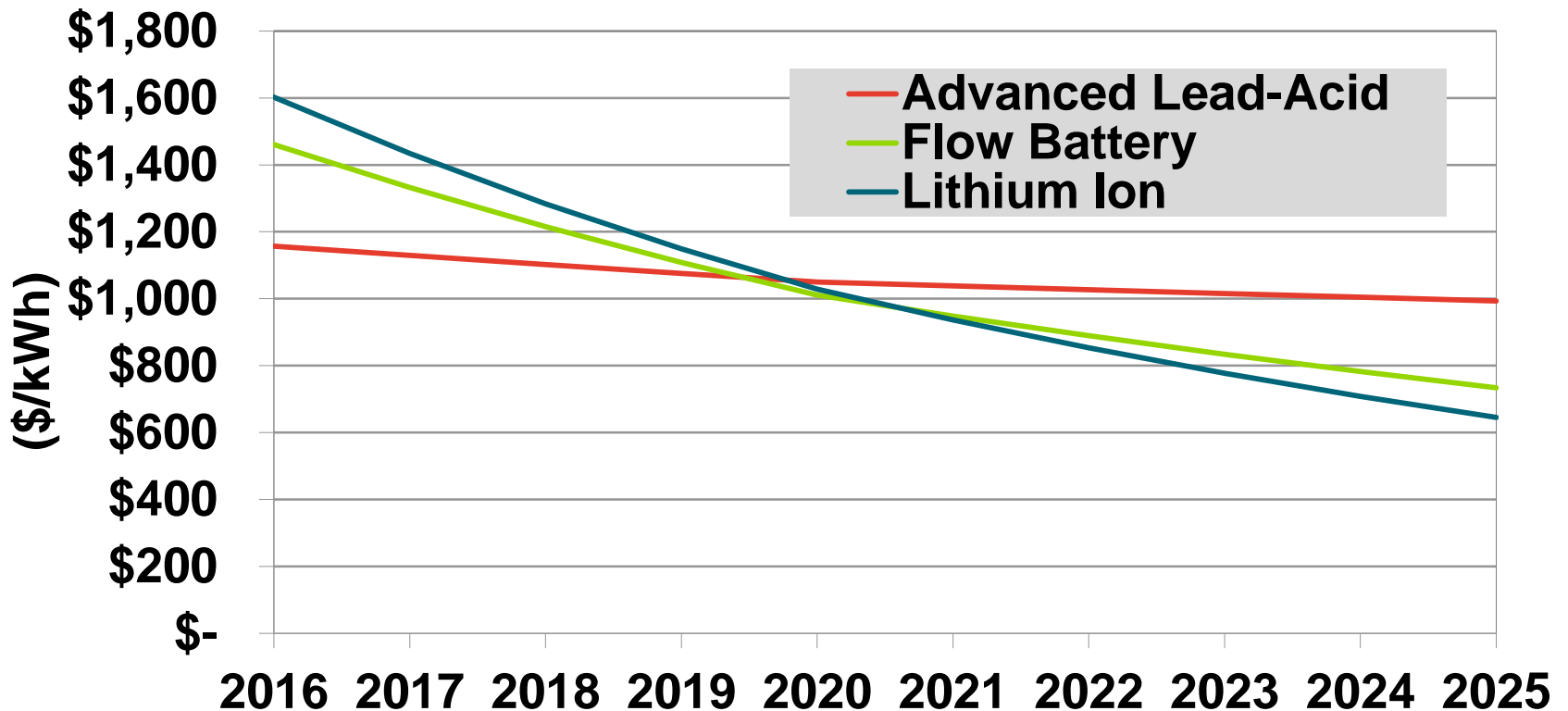
Double the savings between load profiles



Source: Navigant Consulting, 2016

COSTS

There is significant variability in installed cost by technology and by application, and costs are falling rapidly.



Source: Navigant Research, Q2 2016

TECHNOLOGY OPTIONS

Electrical energy storage comes in many forms and only some of them are practical for commercial and institutional buildings.

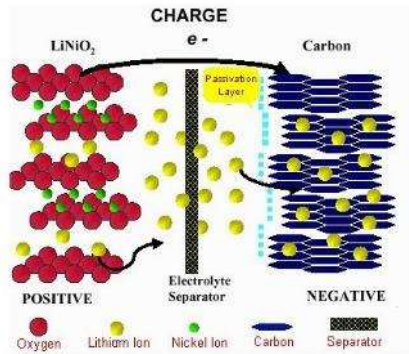
Mechanical



Source: Beacon Power

- Pumped Hydro Storage (PHS)
- Compressed Air Energy Storage (CAES)
- Flywheel

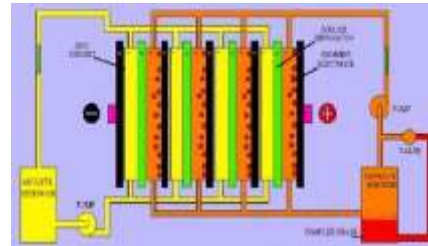
Batteries



Source: SAFT

- Lead Acid
- Advanced Lead Acid
- Zinc Air
- Sodium Sulfur
- Sodium Metal Halide
- Sodium Ion
- Lithium - Ion

Flow Batteries



Source: www.ZBBenergy.com

- Zinc Bromine
- Vanadium Redox
- Iron Chromium
- Other

Other



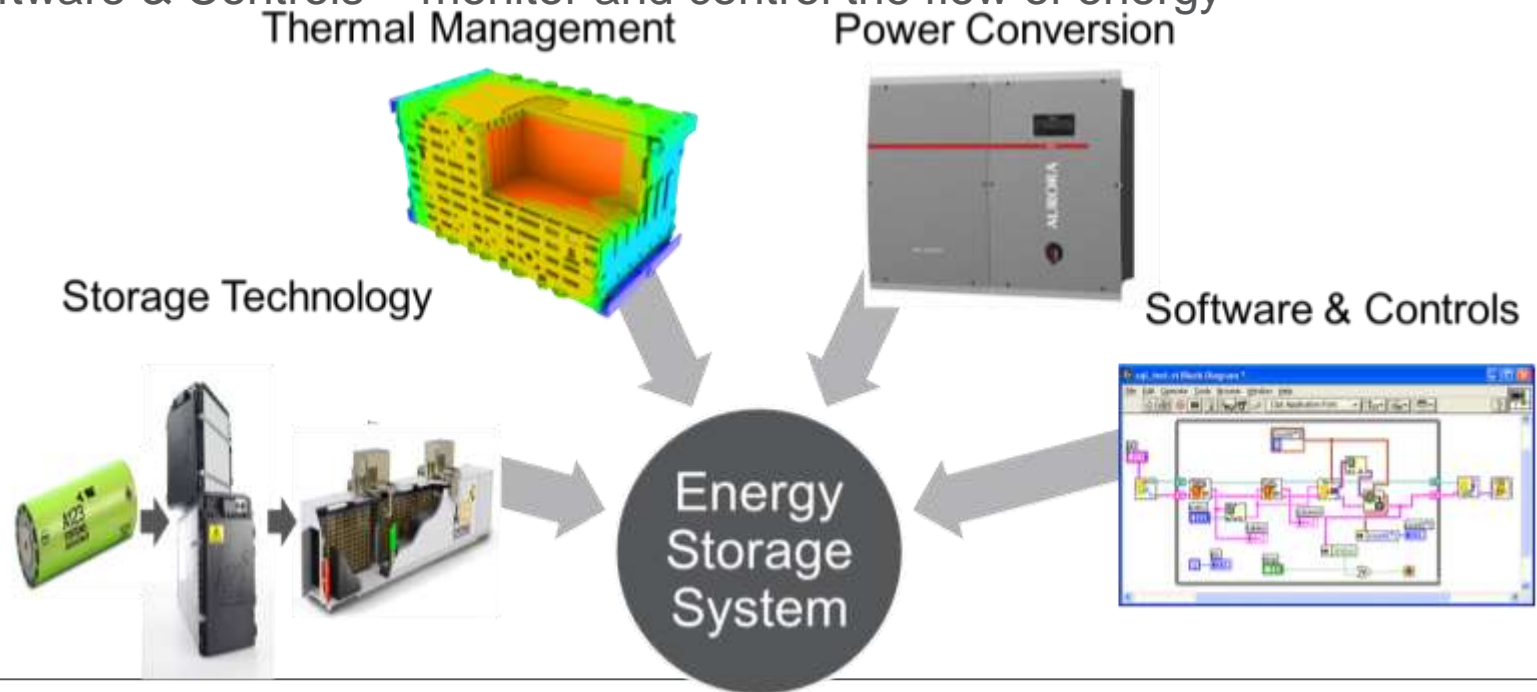
Source: www.smartgrid.gov

- Thermal
- Ice Based
- Thermal Molten Salt
- Power To Gas
- Hydrogen
- Synthetic Natural Gas
- Capacitors
- electric double-layer capacitors, or "supercapacitors" or "ultracapacitors"

PRIMARY COMPONENTS

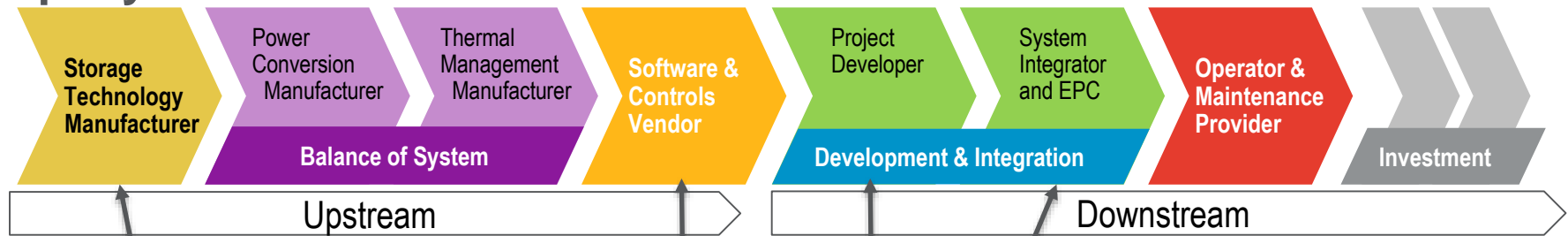
The storage technology is not the only component that drives performance.

- Storage Technology – stores and releases energy
- Thermal Management – keep the storage technology within the required operating temperature range
- Power Conversion - convert the form of the incoming and outgoing energy
- Software & Controls - monitor and control the flow of energy



INDUSTRY CHAIN

The storage industry value chain has many players and is evolving rapidly.



Commercial building owner/operator may be contacted by people all along the value chain.

BUSINESS MODEL OPTIONS

Business models are still evolving, with the most typical options shown below.

Storage Developer - Offers	System Ownership
Shared Savings Model	Third-Party Owner (TPO)
Sale/Lease + Host Control	Host Owned
Utility Procurements	Third-Party Owner (TPO) Utility-controlled
Sale/Lease + Utility Tariff Rate	Host Owned Utility-controlled

- Due to differences in tax treatment for owned assets vs. leased assets, some businesses may prefer an operational lease instead of a capital lease.
- Many customers prefer TPO owned systems for other reasons, including ease of financing, and operation and maintenance services.
- Some utilities are offering special tariffs and pay for systems if they are allowed to control them and able to use them for investment deferrals and during emergencies.

HOW TO EVALUATE IF STORAGE IS RIGHT A BUILDING

- Does the building have a back up generator?
- Are demand charges in the electric rates?
- If so, are they in the mid to high teens?
- Does the building have a “peaky” or flat load profile?
- How predictable is the load?
- Are any state, local or utility incentives available for energy storage?



Thank you for your time today.

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