Energy Storage in the Mountain State

Opportunities for Growth
Agenda

Q&A at the end

1. Fluence Introduction
2. Energy Storage Applications and Use Cases
3. Energy Storage Technology and Products
4. Opportunities for Storage in West Virginia
“After a 100-year Hiatus, Batteries are Helping Again”

More than 120 years ago, batteries were commonplace on the power grid. Thanks to Thomas Edison’s vision, many central station power plants and distribution networks utilized battery systems in the 1890s. This chart shows a 19th century “duck curve” for New York City, and demonstrates the key role that batteries played in smoothing the peaks and valleys of electricity demand throughout the day and night in Edison’s time.

Energy Storage Market Poised for rapid growth throughout the 2020s as new markets, applications, and customers emerge

Market breaks 10 GW despite COVID-19

$33 Billion in annual investment into ESS
Fluence Introduction
Where we started....

12 MW Los Andes Array
Chile, Atacama Desert
Transform the way we power our world
Today we are creating an ecosystem with three business lines

**FLUENCE ENERGY STORAGE PRODUCTS**
4,250+ MW of energy storage

**FLUENCE SERVICES**
2,900+ MW of assets under management

**FLUENCE IQ DIGITAL PLATFORM**
5,000+ MW of AI-optimized bidding of renewables and storage
Fluence has grown the energy storage industry at home

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>HIGHLIGHTS</th>
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<tbody>
<tr>
<td>Harding Street INDIANAPOLIS, IN</td>
<td>• Largest storage project (20 MW) in the Midcontinent ISO (at the time)</td>
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<td></td>
<td>• Stabilizing the Midcontinent ISO grid</td>
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<tr>
<td></td>
<td>• Operational since 2017</td>
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<tr>
<td></td>
<td>• Co-located with existing natural gas combined cycle plant</td>
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<tr>
<td>Punkin Center PUNKIN CENTER, AZ</td>
<td>• Innovative storage-as-transmission-asset deployment</td>
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<td></td>
<td>• Alternative to traditional transmission upgrade at less than half the cost</td>
</tr>
<tr>
<td></td>
<td>• Operational since 2018</td>
</tr>
<tr>
<td>sPower Luna Project, CALIFORNIA</td>
<td>• Fluence’s First Storage Peaker Using Gridstack</td>
</tr>
<tr>
<td></td>
<td>• Supply capacity peak power to the local grid</td>
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<td></td>
<td>• Commissioned in 2021</td>
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</table>
Including West Virginia!

- Largest lithium-ion project in the world at time of commissioning (32 MW, 2011)
- Co-located with wind farm; early test of using storage to optimize renewable revenues
- Providing grid balancing services to PJM region
Energy Storage Applications and Use Cases
Benefits of Storage and Value Stacking

• Bidirectional – charge and discharge – allows it to perform more services

• Versatile services – Both Real and Reactive power capabilities

• Delivers value for owners and operators alike
There are three categories of energy storage applications to address the full spectrum of customer use cases:

<table>
<thead>
<tr>
<th>TRANSFORM YOUR NETWORK</th>
<th>TRANSFORM YOUR GENERATION</th>
<th>TRANSFORM YOUR ENERGY USE</th>
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<tbody>
<tr>
<td>Peak Load Relief</td>
<td>Frequency Regulation</td>
<td>Back-up Power</td>
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<tr>
<td>Congestion Management</td>
<td>Flexible Peaking Capacity</td>
<td>Energy Cost Control</td>
</tr>
<tr>
<td>Contingency Back-Up</td>
<td>Wholesale Energy Trading</td>
<td>Microgrids</td>
</tr>
<tr>
<td>Distribution Reliability</td>
<td>Renewables Co-located</td>
<td></td>
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</table>
Steep battery price decline is unlocking a range of business cases

Growing number of applications for energy storage both in front and behind the meter

![Battery Cell Price, 2010-2025 ($/kWh)](image)

- Frequency Regulation
- Generation Enhancement
- Capacity Peak Power
- Energy Cost Control
- Microgrid/Islands
- Renewable Integration
- T&D Enhancement
- Critical Power

Source: BNEF
FLEXIBLE PEAKING POWER

AES Alamitos
Long Beach, California, United States
100 MW / 400 MWh

SERVICES
• Capacity, local reliability
• Peak power/off peak mitigation
• Ancillary services

IMPACT
• Competitive bid vs thermal peaker, cost effective
• Replaces environmental retired units
• Meets flexibility (duck curve)
Daily Net Load Profile with Energy Storage

- Peak clipped at 12 MW

BENEFITS
- Flatten a facility’s energy load profile
- Reduce peak demand charges by up to 50%
- Prevent facility interruptions with critical power
Energy Storage Technology and Products
What is battery-based energy storage?

Large-scale batteries for utility and industrial applications

**PCS.** Prequalified to work with leading power conversion systems from tier one global suppliers

**Safety.** Standard safety components include fire detection and suppression, deflagration panels, incipient gas detection, and more

**Batteries.** Cubes come pre-assembled with batteries, BMS, controllers, fuse panel, fast-stop, and DC disconnect switch

**Comms.** Extensible edge communications and controls equipment, power supply, fire protection panel, and aux panel

**Connections.** Standard cube-to-cube connections kits, flexible DC busbars, cable tray and power cable cover

**Cooling.** Integrated cooling system (air or liquid-cooled) maintains optimal temperature within each Cube
Battery-based Energy Storage technology is mature and field proven technology

1. Purpose-built energy storage products to meet the needs of specific customer segments

2. Technology Stack provides a solid foundation for repeatable yet configurable products that can be manufactured at scale

3. A proven track record in deploying energy storage in 30 markets worldwide

14 years of storage innovation

- **First generation**
  - Norristown, PA, USA
  - 2008

- **Second generation**
  - Atacama Desert, Chile
  - 2009

- **Third generation**
  - Laurel Mountain, WV, USA
  - 2010

- **Fourth generation**
  - Escondido, CA, USA
  - 2011

- **Fifth generation**
  - Ballarat, Australia
  - 2012

- **Sixth generation**
  - Luna, CA, USA
  - 2013

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Energy Storage System hierarchy and terminology

**CUBE**
Single physical container

**NODE**
Cube or string of cubes connected to a DC bus

**CORE**
Collection of Nodes connected to a transformer

**ARRAY**
Collection of Cores connected to an interconnection – also called a system

GRIDSTACK
SUNSTACK
EDGESTACK
Fluence 6th generation technology stack

**Fluence IQ**  
Digital applications improve system decision-making, asset performance, and revenue generation with AI-driven insights, price forecasting, and automated bidding.

**Fluence OS**  
Fully integrated operations platform gives operators comprehensive control, optimal asset management, and system visibility across single sites or entire fleets.

**Fluence Cube**  
Modular, factory-built, standardized form factor delivers safe, scalable, cost-effective systems configurable with the latest storage components.
Fluence Cube – Safety Features

1. Battery Management System (BMS)
2. Fast Stop (F-Stop)
3. Incipient Gas Detection: Carbon Monoxide
4. Fire Detection and Suppression System
5. Deflagration Panels
6. Lockable Disconnect Switch
7. Open Door Sensor
8. Gas Spring Damper
9. Sliding Door Lock
Opportunities for Storage in West Virginia
PJM - Energy Storage Early Mover

- Early Mover: Market driver in PJM has been the ancillary services market
- Shallow market, limited potential for energy storage volume
- Alternative revenue/value streams need to be unlocked in the market

Commissioned energy storage projects located in U.S. ISO/RTO regions

<table>
<thead>
<tr>
<th>Region</th>
<th>MW</th>
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<tbody>
<tr>
<td>CAISO</td>
<td>865</td>
</tr>
<tr>
<td>PJM</td>
<td>274</td>
</tr>
<tr>
<td>ERCOT</td>
<td>162</td>
</tr>
<tr>
<td>ISO-NE</td>
<td>121</td>
</tr>
<tr>
<td>MISO</td>
<td>70</td>
</tr>
<tr>
<td>NYISO</td>
<td>46</td>
</tr>
<tr>
<td>SPP</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: BloombergNEF, Energy Storage Project Database, EIA 861m Note: While projects are located in the region, projects are not necessarily be actively participating in the wholesale market. Excludes pumped hydro capacity.
Early Signs of a Rapidly Changing Generation Mix

Recent Queue Trends: AB2 – AG2

Generation Interconnection Requests – Requested Energy

- Natural Gas
- Solar
- Storage
- Wind
- Other

- Biomass
- Coal
- Diesel
- Hydro
- Methane
- Nuclear
- Wood

MW

- 2015
- 2021

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Promising Signs for Energy Storage Growth in West Virginia

Standalone storage emerged with strength in 2021

West Virginia Queue, MW (Year Resource Entered Queue)
Policy and Regulatory changes at PJM impacting energy storage in West Virginia

Even as Order 841 Models are approved, ongoing initiatives at PJM and efforts in WV can impact energy storage valuation and economic opportunity

**Capacity Market Value**
- Current market: “10-hour rule” no longer exists and shorter duration storage is more highly valued than before (no artificial constraints to storage)
- Filing with FERC currently to move to Effective Load Carrying Capacity (ELCC) structure

**Storage-as-Transmission**
- Current initiative to develop rules for integrating SAT in PJM planning
- Proper valuation of storage as a transmission/reliability asset
- Effort ongoing to consider planning and operational impacts

**Order 2222 – Distributed Energy Resources**
- Estimated to be approximately 16 MW of behind-the-meter resources
- Expand ability of DERs (including storage) to participate in PJM markets
- Compliance filing date: February 1, 2022
Setting an Energy Storage Deployment Goal – an immediate Opportunity to Promote Energy Storage Growth

**What?**
- Establish deployment targets/goals in the state for energy storage
- Set clear indication of the recognized value of energy storage for West Virginians

**Why?**
- Drive learning-by-doing among utilities, regulators, and agencies
- Send demand signals to developers and investors that West Virginia is open for business

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**Michigan ready to become 10th US state with an energy storage target**

By Andy Colthorpe

April 25, 2022

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**N.J. sets ‘aggressive’ 2 GW storage target by 2030**

The latest energy storage goal could inspire more states to follow.

Published May 29, 2018

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**Virginia regulators outline Dominion path toward 2.7 GW storage by 2035**

Published Sept. 15, 2020 • Updated Dec. 23, 2020
Thank You

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