Pricing Trends and Storage Technologies

Battery Energy Storage Workshop
New Delhi, November 30th, 2018
Rupam.Raja@fluenceenergy.com
+918376913417
Price Discussion
10MW/1Hr Battery Storage System, Delhi
Tata Power - DDL Rohini Substation, Client: AES, Mitsubishi, Tata Power; Supplier: Fluence
What is energy storage?
Modular, scalable arrays of proven technologies integrated at utility and industrial scale.

Battery cabinets and battery management system

Power Control Electronics

Low voltage and medium voltage components

Fire detection and extinguishing system

Intelligence:
Array Controls & Application Software

Connection:
Electrical & Other Balance of Plant

© Fluence Energy LLC. All Rights Reserved. Confidential and Proprietary.
What makes up the system?

Multiple disciplines come together to create a Battery Energy Storage Solution

- Chemistry (Batteries)
- Power Electronics (Inverters, PCS, BMS)
- Shipping and Warehousing (Containers, Racks HVAC, Fire Fighting)
- Civil and Electrical (Balance of Plant)
- Applied Electronics (Configuration and telemetry)
What constitutes the system cost?

Equipment and Services

- Batteries + BMS
- Inverters + PCS
- Containers + Racks + HVAC + Fire Fighting
- Balance of Plant
- Commissioning and Installation

Upto 65%  Remaining Cost
What else constitutes the system cost in India?

Cess, Tax and Duties

- Import Duty (10%)
- Social Cess on imported items (1%)
- GST (18%)

Upto 31% of System cost
Key design parameters impacting system cost

- Application
- Power
- Duration
- EPC Turnkey/Core Only
- Power Factor
- Use Case/Number of Cycles per day
- Firm Capacity Period
- Warranty Period
- Commercial Operations Date (COD)
- Enclosure Type
- Ambient Temperature
US Utility Scale BESS Install Cost Outlook 2016:40 – IHS Markit

$/KW

Source: IHS Markit

© Fluence Energy LLC. All Rights Reserved. Confidential and Proprietary.
US Utility Scale BESS Install Cost Outlook 2018:20 – GTM Research

Source: GTM Research

© Fluence Energy LLC. All Rights Reserved. Confidential and Proprietary.
US Utility Scale BESS install cost based on customer feedback, analyst report and Fluence analysis

Reference datapoint: Winning bid, Large Scale, US based project, 2020 Commissioning

Scaling by duration
- Scaled to 1, 2, 4 hours

Overview of approach
- Scales based on battery cost at given COD

<table>
<thead>
<tr>
<th>Duration</th>
<th>USD/kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>$363:$495</td>
</tr>
<tr>
<td>2 hour</td>
<td>$605:$825</td>
</tr>
<tr>
<td>4 hour</td>
<td>$1096:$1495</td>
</tr>
</tbody>
</table>
Reference datapoint: 2 India based project that have proceeded to award stage, 2019 or 2020 Commissioning

India Project 1: 1MW/4 hrs
- USD/kW: USD 1300 – USD 1500

India Project 2: 16MW/0.5hr
- USD/kW: USD360 – USD420
Lithium-Ion Battery Rate of Price Decline to Slowdown
Source: GTM Report February 2018

Forecasted Lithium-Ion Battery Price ($/kWh) vs. Forecasted Cumulative Front-of-the-Meter Lithium-Ion Deployments (MWh), 2017-2022E

Year-Over-Year Decline in Lithium-Ion Battery Prices, 2013-2022E (%)*
*possibly dampened by raw material price development
Rapid rise in EV demand driving battery production scale and cost declines

Expected capacity additions may outpace demand, but expect this to adjust dynamically

Source: BNEF 2018 Long-Term Electric Vehicle Outlook
BNEF 2018 Long-Term Energy Storage Outlook
Lithium Ion Battery Manufacturing Capacities Are Growing Rapidly But Supply Constraints Will Continue Through 2019

- Tesla Inc, Panasonic Corp: 105 GWh
- Contemporary Amperex Technology Co Ltd: 104 GWh
- LG Chem Ltd: 70 GWh
- BYD Co Ltd: 60 GWh
- Energy Absolute PCL: 50 GWh
- Samsung SDI: 31 GWh
- Tianjin Lishen Battery Joint-Stock Co Ltd: 27 GWh
- NorthVolt AB: 24 GWh
- Discovery: 20 GWh
- Dynavolt Renewable Power Technology: 16 GWh

Colors:
- **Blue** = Fully commissioned
- **Teal** = Under construction
- **Light Blue** = Announced
Annual storage installations expected to grow 300 to 500% over 5 years, market data still highly imperfect

External Market Forecast – Annual Installations Grid & C&I (Not Residential)

Raw Material Price Development Has Been favorable to or below last years levels. Another Shortage Or Price Hike Could Be Caused by the Growing Demand With the Production Expansion
Brief Technology Discussion
Battery Games are over. Li-ion won!

Battery Technology Based Distribution, Forecast up to 2025

Deployment in MW by technology (IHS)

Source: IHS Markit – H1 2018

© Fluence Energy LLC. All Rights Reserved. Confidential and Proprietary.
Flag 1 - Energy storage – attractive pumped hydro alternative

106 Hectares

Same Power

less impact

4.9 Hectares

*Footprint based on an existing pumped hydro station (1164MW/6hour)*

© Fluence Energy LLC. All Rights Reserved. Confidential and Proprietary.
Flag 2 - Peaking capacity today: The majority of US peakers have low capacity utilization, and average run times of less than 8 hours per start.

Source: Wood Mackenzie Power & Renewables
Flag 3 - Multiple applications and technology integration in BESS
Flag 4 - Seek no single supplier lock-in.
Fluence was the market leader over previous 12-month period (Oct.’17 – Sep.’18)

1,978 MW publicly Announced/Contracted projects equal or above 1 MW (126 projects)

Source: DOE, Clean Horizon and other sources [Likely understated as projects may not be made public]
Questions?