Battery Storage – Issues, Challenges and Way Forward

September 2019
Fluence today is the global leader in energy storage

19 Countries
80+ Projects
1000+ MW

Note: Operating data as of August 2018
Note: Contracted or in operations
Rohini, New Delhi, India
10 MW / 10 MWh BESS developed
AES, Mitsubishi and Tata Power DDL
Which Storage Technology to use?

- Batteries?
- Lithium Ion batteries?
- Technical specifications?
- Longevity?
- End of Life treatment?
Energy storage – attractive pumped hydro alternative

>300 Hectares*

Same Power

24 Hectares**

*Footprint based on an planned pumped hydro station in West Bengal (1000MW/5hour)

** Approximate number based on calculations (1000MW/5hour)
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
# Lithium Ion Battery Manufacturing Capacities Are Growing Rapidly

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>Tesla Inc, Panasonic Corp</td>
<td>105</td>
</tr>
<tr>
<td>Contemporary Amperex Technology Co Ltd</td>
<td>104</td>
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<tr>
<td>LG Chem Ltd</td>
<td>70</td>
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<tr>
<td>BYD Co Ltd</td>
<td>60</td>
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<tr>
<td>Energy Absolute PCL</td>
<td>50</td>
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<tr>
<td>Samsung SDI</td>
<td>31</td>
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<tr>
<td>Tianjin Lishen Battery Joint-Stock Co Ltd</td>
<td>27</td>
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<td>NorthVolt AB</td>
<td>24</td>
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<tr>
<td>Discovery</td>
<td>20</td>
</tr>
<tr>
<td>Dynavolt Renewable Power Technology…</td>
<td>16</td>
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- **Fully commissioned**
- **Under construction**
- **Announced**
Who is a Suitable Partner?

- System Integrators or Battery OEMs?
- Big name vendors or a startup?
- How important is vendor’s experience?
Battery Storage has numerous risks and opportunities

<table>
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<tr>
<th>PRIORITIES</th>
<th>FOCUS AREAS CRUCIAL TO DELIVERING ON NPV</th>
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</table>
| Minimize Total Cost               | • Minimize project timeline risk and “learning pains”  
                                        • Achieve lowest degradation and ongoing O&M  
                                        • Choose system that avoids technology and supplier lock-in |
| Protect and Enhance Revenue       | • Work with an expert on energy storage, able to lead adaptation to new market rules and conditions  
                                        • Ensure solution can perform over the lifespan of the project and can capture multiple revenue streams simultaneously |
| Enhance Financial Options         | • Maximize option value by ensuring selected technology is financeable  
                                        • Consider debt or equity investments – now and in the future |
Which Battery Applications?

- Energy Arbitrage
- Renewable Integration
- Deviation Settlement
- Peaking Support
- Battery for Round the Clock Power?
- CAPEX Deferral
- Voltage Support
- One or some or all of the above?
1,978 MW publicly Announced/Contracted projects equal or above 1 MW (126 projects) (Oct.‘17 – Sep.‘18)

Source: DOE, Clean Horizon and other sources [Likely understated as projects may not be made public]
How to Price battery and Value its service?

- Decreasing price curve
- Asset life dependent on Use Case
- No comparable resource
- Price paid for closest comparable resource
US Utility Scale BESS Install Cost Outlook 2016:40 – IHS Markit
Project Specific Valuation Studies

- Project specific valuation of battery storage for peaking capacity, fast response, DSM, time to market, valuation of lost load, peak shifting, CapEx deferral and ramp support for coal plant.
Government/Policy Support

- Battery storage as a policy instrument is absent
- Tax regime for batteries is evolving
- No fiscal incentive, subsidy or grant
Policy Support Recommendations

- Economy wide battery storage goal indexed to RE goal.
- Set battery storage deployment goals for central government owned power sector entities and large consumers of electricity
- Reduce GST on battery storage system to 5%. Similar to what has been done for EVs.
- Create a tax incentive for RE projects that are coupled with battery storage.
- Allow a multiple of RECs for RE projects that have battery storage.
8 Projects larger than 100MW

- Neoen Hornsdale: 100 MW/129 MWh – new peaking capacity
- Strata Oxnard: 100 MW/400 MWh – peaking capacity
- AES Alamitos: 100 MW/400 MWh – peaking capacity
- AES Arizona: 100 MW/400 MWh – new peaking capacity
- Moss Landing: 182.5 MW/730 MWh – peaking capacity
- NextEra Skeleton Creek: 200 MW/800 MWh – new peaking capacity
- Moss Landing: 300 MW/1,200 MWh – peaking capacity
- Manatee Energy Storage Center: 409 MW/900 MWh – peaking capacity
Philippines

- Over 500MW of 10MW, 20MW and 50MW 1-hour battery storage projects
- Merchant Plants
- 5-year capacity contract with grid operator
- Spread across 3 islands that make up the country
- Contract for 2x capacity
Rohini, New Delhi, India
10 MW / 10 MWh
Located at a substation owned by Tata Power Delhi Distribution Limited (TPDDL) developed by AES and Mitsubishi Corporation

SERVICES
• Frequency control
• Distribution reliability

IMPACT
• Provide capability to manage frequency and manage load growth in local area.
APTRANSCO BESS EoI – context and proposal

Peaking Power deficit for 2-4 hours twice a day
RE Intermittency for 15-30 minutes from over 6500MW of solar and wind
Smoothening the curve. Generation and demand do not match. Rapid ramping needs.

Solution Presented to APERC

Battery CAPEX

• 500MWH Capacity
• 2 cycles/day
• Fixed Annuity to Developer
• 70% Allocation to Renewable Integration Charges (INR/MW/Month)
  Passed on to RE Developers
• 30% Allocation to Ancillary Service Charges (INR/KWH)
  Passed on to all licensees; OA users; all other users of transmission system
Fluence brings unmatched experience at scale from the partner you can trust

**EXPERIENCE**
11+ years of experience in energy storage from two proven industry pioneers
- World’s leading storage provider
- Deployed or been awarded 80+ projects, in 19 countries, 1000+ MW

**SCALE**
Complete technology and service offerings delivered worldwide
- Proven technology platforms that address full spectrum of applications
- Delivery & integration in 160 countries
- Comprehensive services including financing

**THE RIGHT PARTNER**
Deep understanding of modern power markets, customer needs, and local market challenges
- Collaborate with customers to solve their energy challenges
- Avoid pitfalls of inexperienced packagers and integrators
- Strong financial backing and industry staying power

Created and backed by two industry powerhouses

**SIEMENS**
_Ingenuity for life_

**AES**
_we are the energy_
Thank You