Agenda

1. Overview on PV and BESS Services

2. Case Study of Indian DISCOM BRPL
   - Case 1: Reduction of Transformer Loading
   - Case 2: Balancing of Scheduled and Actual Consumption
   - Case 3: Energy Shifting

3. Conclusions and Recommendations
Overview on PV and BESS Services

- Frequency support
- Reactive Power Provision and Voltage support services
- Load peak reduction – Assets' upgrade deferral
- Reduction of Losses
- Congestion Avoidance
- Reduced PV Curtailment
- Energy Shifting (utility scale)
- Energy Shifting (behind the meter)
- Contribution to DISCOMS' Renewable Purchase Obligation

Provided independently by PV or BESS Systems:
- Black start and Island operation
- Balancing support services
- Fast Frequency Regulation

Provided by BESS only:
- Ramp Rate Control

Provided only by PV Systems:
- 1

Provided only in combination with PV (typically in hybrid Systems):
- 2
- 3
## Summary of Services Analysed for BRPL

<table>
<thead>
<tr>
<th>Level of Analysis</th>
<th>Grid Support Service</th>
<th>Economic value for DISCOMS</th>
<th>Service provided by</th>
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<tbody>
<tr>
<td><strong>DT Level</strong></td>
<td><strong>Load Peak Reduction</strong></td>
<td>Distribution assets upgrade deferral</td>
<td>PV and/or BESS</td>
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<tr>
<td></td>
<td><strong>PV Peak Reduction</strong></td>
<td>Distribution assets upgrade deferral</td>
<td>BESS</td>
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<td><strong>Voltage support</strong></td>
<td>Improved Voltage</td>
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<td><strong>Reactive Power Provision</strong></td>
<td>Avoided reactive power balance penalties</td>
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<td><strong>Reduction of Losses</strong></td>
<td>Avoided cost of power losses</td>
<td>PV systems</td>
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<td><strong>DISCOM Level</strong></td>
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<td>Avoided Deviation charges</td>
<td>BESS</td>
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<td><strong>Energy shifting</strong></td>
<td>Avoided PPA variable costs</td>
<td>BESS</td>
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<td></td>
<td><strong>Power demand reduction by PV</strong></td>
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<td><strong>Contribution to DISCOMS’ RPO</strong></td>
<td>Avoided purchase cost of REC</td>
<td>PV systems</td>
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Reduction of Transformer Loading for Assets Upgrade Deferral

BESS with 200 kWh

Load peak shaving if the consumption exceeds the transformer capacity

Transformer lifetime increased by 4 years
Economic Analysis Results: Grid Asset Upgrade Deferral

Curve decline indicates that revenue from service does not even cover yearly maintenance + losses!

Large Investment required!

BESS with 200 kWh
Cost Comparison BESS vs. Transformer

Cost in € for 1 MW System

- Transformer: 4,200 €
- BESS: 300,000 € (x 15)

Legend:
- x 15
Balancing of Scheduled and Actual Consumption to avoid Deviation-Charges

Battery balances mismatch between scheduled and actual consumption.
Economic Analysis Results: Balancing avoiding Deviation Charges

Positive Cash-Flow, but not sufficient to cover initial costs!
Sensitivity Analysis Results on Balancing

More than 50% price reduction required to reach positive payback!
Energy Shifting to avoid PPA costs

Reduce costs by shifting energy from high to low load phases.
Economic Analysis Results: Energy Shifting

Curve decline indicates that revenue from service does not even cover yearly maintenance + losses!

→ No business case due to low price spread!
Economic Analysis Results: Energy Shifting

Yearly savings are lower than maintenance costs.
## Overview: Economic Analysis of Battery Storage

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<td>PV Peak Reduction</td>
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<td>20 MWh</td>
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</table>

Assumed BESS cost: 300 €/kWh

Many use cases but no business cases!
Conclusions and Recommendations on BESS in Distribution Systems

There are many benefits for DISCOMS to install BESS in their distribution system…

…but on the SHORT TERM, handle with care:
  • No real business case for DISCOMS has been identified!
  • Operation costs might even be higher than savings!
  • BESS will produce additional losses in the system!
  • Individual situation needs to be evaluated, it is not yet the time for a massive rollout.

…and on LONG TERM, with a massive increase of renewable energies, storage will be inevitable, thus storage should be supported:
  • A regulatory and market framework should be developed including among others the definition of tariff structure, incentives, grid connectivity and operational norms.
Thank you for your attention!
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