Energy Storage and Duke Energy

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Energy Storage Project Summary

Testing different sizes at various grid locations (transmission, distribution and behind a customers meter) along with numerous chemistries.

36 MW / 24 MWh
Advanced Lead Acid
West Texas (with commercial group)

402 kW / 282 kWh
Sodium Nickel Chloride
Mt. Holly, NC

75 kW / 42 kWh
Lithium Titanate
Indianapolis, IN (Carmel)

250 kW / 750 kWh
Lithium Polymer
Charlotte, NC

25 kW / 25 kWh
Lithium Ion
Charlotte, NC

200 kW / 500 kWh
Lithium Iron Phosphate
Charlotte, NC
Distributed Energy Storage – Emerging Tech Focus

- Installed cost
- Slope of price curve?
- Current Technology
- Potential Transformational Technology?
- Safety Procedures?
- Operational Processes?
- Is equipment “Utility Grade”? 
- What are these values for Duke?
- Which values can be “stacked”? Are mutually exclusive? Must be de-rated?
- Customer Value / Other
- Volt / Var Mgmt
- Ancillary services
- “Grid Parity” with CT (or highest single application value)
Finding the Highest Value Point for Energy Storage

<table>
<thead>
<tr>
<th>Battery Size</th>
<th>Large</th>
<th>Substation Scale</th>
<th>Community Energy Storage</th>
<th>Customer Sited</th>
<th>End-Use Device</th>
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</thead>
<tbody>
<tr>
<td>Installed Cost ($/kWh)</td>
<td>Low</td>
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<td></td>
<td>High</td>
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</tbody>
</table>

- **End-Use Device**
- **Customer Sited**
- **Community Energy Storage**
- **Substation Scale**
- **Central Plant Scale**
- Battery Cell & Module costs coming down quicker than installed system cost
- “Utility Grade” Reliability is still a question mark for Distributed energy storage systems.
- Existing Rate tariffs and Interconnection standards do not anticipate ES and could have unintended consequences
- Multiple, not easily quantified, value streams that stack across grid operations make ES business cases difficult
- The inverter is a key component of the ES value proposition for distributed systems