PLANNING THE DISTRIBUTED ENERGY FUTURE: SMUD CASE STUDY

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DISTRIBUTED ENERGY
AGENDA

• Utility DER Challenges
• DER Planning Framework
• SMUD Case Study of Integrated DER Planning

*DER = Distributed Energy Resource
INTRODUCING BLACK & VEATCH

A LEADING GLOBAL ENGINEERING, CONSULTING AND CONSTRUCTION COMPANY

- Founded in 1915, employee-owned, global workforce of more than 11,000
- ~$3.0 billion in annual revenues in 2015
- Active in energy, water, and telecom industries
- Completed projects in more than 100 countries, 110 offices worldwide
- Deeply involved in distributed energy resources, grid modernization, and “Utility 2.0” initiatives

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UTILITY DER CHALLENGES
MOVING TOWARD THE DISTRIBUTED ENERGY FUTURE

- Distributed, variable, sustainable resources
- Secure, self-healing, self-optimizing grid
- Consumers/businesses are both users and creators of energy
- Energy-efficient, self-managing homes driven by consumer choice
- Clean transportation, leveraging clean generation and storage of energy
- Self-managing, demand responsive smart buildings
- Unidirectional power distribution from centralized bulk generation
MOST SIGNIFICANT TECHNICAL CHALLENGES TO SUPPORTING A HIGH PENETRATION OF DERS

- System stability or protection challenges: 49.0%
- Inability to appropriately model DER in planning load flows: 33.7%
- Lack of control over DER: 32.7%
- Lack of status information or ability to forecast: 30.6%
- Other challenges: 9.2%
- We do not see this as a challenge: 7.1%
- Don't know: 17.3%

Financial/rate impacts of DER growth are critical to understand as well.

• Need DER planning coordination to overcome siloes
• Growing customer and regulator demands
• Accommodate growing volumes, minimize negative impact
• Difficult to integrate many different systems
DER planning process is an iterative loop that touches many functions within the utility organization.
SMUD CASE STUDY OF INTEGRATED DER PLANNING
SMUD’S INTEREST AND RATIONALE

Dramatic increases in customer and 3\textsuperscript{rd} party DER investments putting pressure on utility business model

Increased risk of stranded assets, overbuild, competitiveness challenges

opportunity to leverage, optimize DER investments to create value for all customers

A first step to defining preferred levels of DERs, developing a strategy, and developing locational value estimates to influence optimal adoption
SMUD INTEGRATED DER ASSESSMENT PROJECT BACKGROUND

• SMUD engaged Black & Veatch to assist in assessing integrated Distributed Energy Resources (iDER)

• Major tasks
  • Review of existing work and processes; tie together approaches
  • DER potential and customer adoption forecast
  • Distribution system impact modeling
  • Bulk system impact modeling
  • Financial impact on utility
  • Strategy and operational changes

• First of a kind study

Technologies assessed:

PV, EE, DR, CHP, ES, EV
### DER POTENTIAL APPROACH

<table>
<thead>
<tr>
<th>Technical Potential</th>
<th>Economic Potential</th>
<th>Achievable Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>• What is technically practical</td>
<td>• What makes financial sense</td>
<td>• What might actually happen</td>
</tr>
<tr>
<td>• LiDAR-based assessment of available rooftop space by building</td>
<td>• Tied technical potential to SMUD customer database</td>
<td>• Application of Market Penetration Potential and Customer Adoption Curves</td>
</tr>
<tr>
<td>• Aerial Imagery analysis of commercial parking lot space</td>
<td>• Cloud-based computing to assess payback of solar for individual customers, under 4 scenarios</td>
<td>• Adoption modeling of individual customers</td>
</tr>
</tbody>
</table>
EXAMPLE MAP OF PROJECTED DER ADOPTION

Includes, technical, economic, and achievable potential estimates for each customer
51 substations (26%), could have voltage violations at service transformers due to PV.

Over- or under-voltage violations, July 2030

Voltages within limits
EV IMPACTS: OVER 12,000 TRANSFORMERS MAY NEED TO BE UPGRADED DUE TO EVS (17% OF TOTAL)

26% of substations could have voltage violations at service transformers due to distributed solar PV.
POTENTIAL DER IMPACTS – NET LOAD
**ECONOMIC ANALYSIS RESULTS ($2015)**

Net Value = Production Cost Savings – Program Cost – Revenue Loss  
*assumes no change in 2017 rate structure*

### Energy Resources

<table>
<thead>
<tr>
<th>Technology</th>
<th>2030 PLEXOS Change Case Targets</th>
<th>2020-2030 Production Cost Savings* ($/MWh)</th>
<th>Incremental Program Cost* ($/MWh)</th>
<th>Revenue Loss* ($/MWh)</th>
<th>Net Value* ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE</td>
<td>1,032 GWh</td>
<td>$84 - 100</td>
<td>$17</td>
<td>$126</td>
<td>$(43) - (59)</td>
</tr>
<tr>
<td>PV</td>
<td>500 MW</td>
<td>$69 - 81</td>
<td>$3</td>
<td>$128</td>
<td>$(50) - (62)</td>
</tr>
<tr>
<td>CHP</td>
<td>127 MW</td>
<td>$79 - 90</td>
<td>$1</td>
<td>$101</td>
<td>$(12) - (23)</td>
</tr>
<tr>
<td>EV</td>
<td>240,000 Cars</td>
<td>$(72) - (75) (higher sales)</td>
<td>$16</td>
<td>$(86) (sales)</td>
<td>$(2) - (5)</td>
</tr>
</tbody>
</table>

*Incremental from PLEXOS base case to change case.

### Demand Resources

<table>
<thead>
<tr>
<th>Technology</th>
<th>2030 PLEXOS Change Case Targets</th>
<th>2020-2030 Production Cost Savings* ($/kW-yr)</th>
<th>Incremental Program Cost* ($/kW-yr)</th>
<th>Revenue Loss* ($/kW-yr)</th>
<th>Net Value* ($/kW-yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR Dispatch (Utility)</td>
<td>274 MW</td>
<td>$42 - 89</td>
<td>$40</td>
<td>$18</td>
<td>$31 - (16)</td>
</tr>
<tr>
<td>DR TOU (Customer)</td>
<td>86 MW</td>
<td>$56 - 96</td>
<td>$0</td>
<td>$77</td>
<td>$19 - (21)</td>
</tr>
<tr>
<td>ES (Customer)</td>
<td>40 MW</td>
<td>$14 - 26</td>
<td>$0</td>
<td>$72</td>
<td>$(46) - (58)</td>
</tr>
<tr>
<td>ES (Utility)</td>
<td>160 MW</td>
<td>$96 - 165</td>
<td>$263</td>
<td>$0</td>
<td>$(98) - (167)</td>
</tr>
</tbody>
</table>
NEXT STEPS FOR SMUD

Process Improvement

• Identify appropriate timing of planning processes to ensure comprehensive valuation and create distribution investment deferral opportunities
• Identify gaps in software tools to allow rapid iteration and scenario analysis, overall DER portfolio optimization
• Methodology refinements (e.g., multi-technology adoption constraints)

Broader Initiatives

• Explore new business models
• Test alternative rate structures to mitigate DER revenue losses and give customers more options
• Develop pilot projects to demonstrate locational value of DERs
• Implement new operational tools for DER/grid optimization (e.g., smart inverter functionality and DERMS)
• Form dedicated DER planning group
A PARTING QUESTION:

• What might your utility/state do differently in the future in terms of planning, to accommodate and/or benefit from DER growth?