Making the Business Case for Reliability-Driven Spending
(presented at 2012 MEA Electric Operations Conference)
About PSE

• Founded in 1974

• Headquartered in Madison, WI with offices in MN, OH, IN, IA, and SD

• Serving utilities & regulators

• Engineering, Economics, Rates, Technology Experts in the Utility Industry
Necessary to Balance Total Costs (Rates) and Reliability

- Balancing rates and reliability requires realistic and strategic goals of how the two should be weighted with a long-term outlook.
- Benchmarking can help inform the cost/reliability picture
- Spending levels can impact long-term reliability levels
- Management choices of projects can impact long-term reliability levels
Is there a way we can prioritize investments in a more economic and defensible way?

Our customers really want better reliability! We need to increase our system investment.

Our customers really want lower rates! We need to decrease spending.

How Best to Balance Rates and Reliability?
Supply and Demand of Reliability

**Demand-side:** Customers demand reliable service and incur economic losses when outages occur.

**Supply-side:** Improving reliability costs utilities and their ratepayers money.

[Graph showing the relationship between reliability and economic costs with labels for Total Economic Costs, Demand, and Supply.]

Want to find minimum
Answer is Specific to Each Utility

- Each utility (and areas within the utility such as substations and feeders) will have a different supply curve for reliability
  - Service territory characteristics affect achievable reliability levels given a fixed amount of spending
    - A low density, high vegetation utility cannot achieve the same reliability level that a high density, low vegetation utility can (given the same amount of spending)

- Each utility (and areas within the utility) will have a different demand curve for reliability
  - Customer types (residential/C&I), attributes, types, and equipment/appliances, back-up generation all play into the demand for reliability
Top Down and Bottom Up

“Top Down” Benchmarks

• Given historical industry data where is a reasonable level of spending?

“Bottom Up” Model

• What projects are in the economic best interests of our service territory?
## The Good and the Bad

<table>
<thead>
<tr>
<th><strong>“Top Down” Benchmarks</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides objective basis for spending proposals</td>
<td>Provides objective basis for spending proposals</td>
<td>Industry could be wrong</td>
</tr>
<tr>
<td>Puts utility in line with industry and assures rate trends won’t drastically deviate from peers</td>
<td>Special utility circumstances may not be reflected in benchmarks</td>
<td>A lot of estimates and assumptions</td>
</tr>
<tr>
<td>Can identify and incorporate possible historic underfunding</td>
<td>Does not help to identify specific projects and their merits</td>
<td>Data intensive and requires a multi-year commitment to the approach</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>“Bottom Up” Model</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicitly examines the economic merits of projects and provides NPV and benefit/cost ratios</td>
<td>Useful for project prioritization even if assumptions are off</td>
<td>Can provide spending amounts that are significantly different than historic and/or industry norms</td>
</tr>
</tbody>
</table>
Ideal Planning Process for Reliability-Driven Projects

Industry benchmarks set initial spending range
- Reliability
- Historical Capex and O&M
- Customer demand

Project-specific NPV’s determine prioritization of funding and adjust benchmark up or down
- Projects evaluated and funded based on their ranking in benefit/cost analysis

Business case and spending plan
- How much
- What projects to fund

System knowledge and corporate goals
- Adjust business case and plan for in-house knowledge and to better meet corporate goals
“Top Down” Method of Determining Spending Levels

“Top down” method of benchmarking to industry norms on:

1. **Reliability levels and trends** (given our service territory conditions what would be the expected reliability level?)

2. **Historical and expected capex and O&M spending levels** (given our service territory conditions what would be the expected level?)

3. **Consumer reliability demand** (do our customers demand more or less reliability than the industry average?)
A Quick Word on Benchmarking

- Benchmarking is a means of establishing data value expectations using industry data and *external factors*

\[
\text{SAIDI Performance} = \frac{\text{Actual SAIDI}}{\text{Benchmark SAIDI}}
\]

- Need to make “apples-to-apples” comparisons
  
  Challenging given the large differences in utility circumstances (e.g., customer density, forestation, undergrounding)
Top Down: Reliability Benchmarking

- Compare reliability to industry and examine trend
- Does reliability need to improve or just be maintained?
- Need to adjust for territory circumstances

![Diagram](image_url)

- Customer Density
- # of Customers
- Percentage of Undergrounding
- Vegetation
- Reliability Index
- MED definition
Top Down: Reliability Benchmarking

- Looking at the reliability trend, as well as the level, is important
Top Down: Capex Benchmarking

• Capex needed for “growth” and for “replacement”
  – With slower load growth, less replacement is occurring due to growth factors… culture change necessary as systems age to focus more on replacement spending

No new utility revenues, tougher to justify and prioritize

Replacement Spending  
Customer and Load Growth Spending
Top Down: Capex and O&M Benchmarking

- Benchmarking can determine if historical levels of spending are on par with the industry and what the expected spending amounts are now
  - Given the system growth, size, and other characteristics of the utility
- What should a utility like mine be spending on replacements per year?
- Do we need to make up for the under-investment in prior years?
Top Down: Customer Demand for Reliability

• Last piece to supplement the cost and reliability benchmarking

• Should your utility have better or worse reliability than the industry norm given your circumstances?
  – If customers have a higher demand for reliability than average than the utility should have better reliability than average (and spend more to do that)
  – Break down of industries and customer characteristics to determine this
Example: Putting it all together (Top Down)

- Reliability: Currently 25% below the industry norm and steady for last 5 years
- Historical Capex: Last 20 years has been below average by 10% per year
- O&M Level: Average
- Current Capex Benchmark: Given growth projections, the industry norm ranges from $80M to $120M
- Customer Demand for Reliability: Average

Conclusion: Capex budget should be over $120M
Bottom Up Approach

- If we decide that $150M is in-line with the industry and an appropriate amount to spend, the next question is... on what projects?
  - Need to spend money on new customer connections and upgrading capacity where necessary
    - This is really non-discretionary

Other Funding Possibilities:

- Worst performing feeders
- Replacement or increased maintenance of assets
- New technologies and states (e.g. feeder automation, AMI, underground conversion)

Bottom Up approach can help identify and prioritize projects
A Quick Word on Customer Interruption Costs

• Reliability-driven projects have an economic impact on the customers who will receive a different level of system reliability

• Customers will be impacted differently

• These economic impacts should be incorporated into the business case

<table>
<thead>
<tr>
<th>Duration</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
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<tbody>
<tr>
<td>Momentary</td>
<td>$2.18</td>
<td>$605</td>
<td>$1,893</td>
</tr>
<tr>
<td>1 Hour</td>
<td>$2.70</td>
<td>$886</td>
<td>$3,253</td>
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<tr>
<td>Sustained Duration</td>
<td>$2.99</td>
<td>$1,067</td>
<td>$4,227</td>
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</tbody>
</table>

## Top Ten Substations in Terms of Economic Losses Incurred from Transmission Outages in 2007-2009

<table>
<thead>
<tr>
<th>Substation</th>
<th>Frequency</th>
<th>Duration</th>
<th>Residential</th>
<th>Non-Residential</th>
<th>Total</th>
<th>Residential</th>
<th>Non-Residential</th>
<th>Cost per Hour &amp; Consumer ($)</th>
<th>Consumers w/ Outage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINCOLN</td>
<td>1</td>
<td>1,200</td>
<td>231,024</td>
<td>25,072,993</td>
<td>25,304,016</td>
<td>3.87</td>
<td>3,181.85</td>
<td>2,981</td>
<td>394</td>
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<tr>
<td>CENTER HARBOR</td>
<td>7</td>
<td>743</td>
<td>188,336</td>
<td>14,385,413</td>
<td>14,573,749</td>
<td>2.96</td>
<td>1,011.03</td>
<td>5,135</td>
<td>1,149</td>
</tr>
<tr>
<td>DERRY</td>
<td>9</td>
<td>2,943</td>
<td>288,338</td>
<td>8,564,134</td>
<td>8,852,471</td>
<td>4.07</td>
<td>1,293.33</td>
<td>1,443</td>
<td>135</td>
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<tr>
<td>WATerville</td>
<td>2</td>
<td>1,057</td>
<td>68,349</td>
<td>8,444,668</td>
<td>8,513,016</td>
<td>2.75</td>
<td>2,250.50</td>
<td>1,411</td>
<td>213</td>
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<tr>
<td>NEW DURHAM</td>
<td>18</td>
<td>3,396</td>
<td>373,054</td>
<td>7,767,009</td>
<td>8,140,064</td>
<td>4.53</td>
<td>1,009.02</td>
<td>1,455</td>
<td>136</td>
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<tr>
<td>DEERFIELD</td>
<td>27</td>
<td>4,905</td>
<td>414,499</td>
<td>7,636,303</td>
<td>8,050,802</td>
<td>4.04</td>
<td>983.27</td>
<td>1,256</td>
<td>95</td>
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<tr>
<td>BRENTWOOD</td>
<td>13</td>
<td>4,658</td>
<td>184,876</td>
<td>6,825,835</td>
<td>7,010,711</td>
<td>4.44</td>
<td>2,198.10</td>
<td>536</td>
<td>40</td>
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<tr>
<td>THORNTON</td>
<td>4</td>
<td>1,074</td>
<td>77,544</td>
<td>5,945,718</td>
<td>6,023,262</td>
<td>2.05</td>
<td>1,267.80</td>
<td>2,112</td>
<td>262</td>
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<tr>
<td>CORNISH</td>
<td>10</td>
<td>2,828</td>
<td>158,187</td>
<td>5,646,973</td>
<td>5,805,160</td>
<td>4.52</td>
<td>1,141.03</td>
<td>742</td>
<td>105</td>
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<tr>
<td>ALTON</td>
<td>16</td>
<td>3,683</td>
<td>1,432,621</td>
<td>4,095,810</td>
<td>5,528,431</td>
<td>4.26</td>
<td>939.79</td>
<td>5,477</td>
<td>71</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>107</strong></td>
<td><strong>26,487</strong></td>
<td><strong>3,416,827</strong></td>
<td><strong>94,384,856</strong></td>
<td><strong>97,801,683</strong></td>
<td><strong>3.62</strong></td>
<td><strong>1,502.52</strong></td>
<td><strong>22,548</strong></td>
<td><strong>2,600</strong></td>
</tr>
</tbody>
</table>

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## How to Use Feeder-Level Information In Decision-Making

Shows benefit/cost ratio based on “Worst Performing Feeder” analysis

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Annual Economic Damage</th>
<th>Proposed Project Capital Cost</th>
<th>Annual Cost</th>
<th>Benefit / Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Woodstock to Beebe River Loop</td>
<td>$13,354,855</td>
<td>$90,000</td>
<td>$9,450</td>
<td>1413.2</td>
</tr>
<tr>
<td>Alton and New Durham Radial</td>
<td>$4,556,165</td>
<td>$9,090,000</td>
<td>$954,450</td>
<td>4.8</td>
</tr>
<tr>
<td>Madbury to Chester Loop</td>
<td>$5,744,599</td>
<td>$12,558,000</td>
<td>$1,318,590</td>
<td>4.4</td>
</tr>
<tr>
<td>Lee Radial</td>
<td>$2,683,291</td>
<td>$558,000</td>
<td>$58,590</td>
<td>45.8</td>
</tr>
<tr>
<td>Derry Metering Point</td>
<td>$2,950,824</td>
<td>$2,300,000</td>
<td>$241,500</td>
<td>12.2</td>
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<tr>
<td>Cornish Metering Point</td>
<td>$1,935,053</td>
<td>$5,800,000</td>
<td>$609,000</td>
<td>3.2</td>
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<tr>
<td>Center Harbor Radial</td>
<td>$4,857,916</td>
<td>$11,058,000</td>
<td>$1,161,090</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$36,082,704</strong></td>
<td><strong>$41,454,000</strong></td>
<td><strong>$4,352,670</strong></td>
<td><strong>8.3</strong></td>
</tr>
</tbody>
</table>
Graphical Representation of Previous Slide

- North Woodstock to Beebe River
- Alton and New Durham Radial
- Madbury to Chester Loop
- Lee Radial
- Derry Metering Point
- Cornish Metering Point
- Center Harbor Radial

Annual Economic Damage vs. Proposed Project Annual Cost

- $6,000,000
- $5,000,000
- $4,000,000
- $3,000,000
- $2,000,000
- $1,000,000
- $
Bottom Up: Proactive Replacement of Assets

- Existing assets have a risk of failure
  - The risk of failure is affected by items such as like age, condition, weather, exposure to over-loading and faults

- When assets fail there are consequences
  - Outages to customers resulting in customer interruption costs
  - Utility response, restoration, and replacement costs

- Risk-cost = Prob. of failure * Consequences ($)

- Can perform a cost/benefit analysis on costs of replacement vs. risk-cost of assets
Bottom Up: Value Proposition

- NPV of decision based on expectations of outcomes

Examine different options including replacement this year, in 5 years, enhanced maintenance, and the baseline of “do nothing”
Bottom Up: New Operational States

- Evaluate new technologies, “smart grid”, undergrounding, etc…
The upfront cost of most overhead installations are considerably less than their underground equivalents.

However, reliability is typically much better for underground lines, especially during severe weather.

**Key Question:** Is the reliability impact worth the extra costs?

**Answer:** It depends, some feeders should be others should not.
Bottom Up: Economic Evaluation of New State

- Combine estimated reliability impacts with avoided interruption costs and project costs to determine NPV and benefit-cost ratio

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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$1,500</td>
<td>$5,000</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>($11,500)</td>
<td>Overhead</td>
</tr>
<tr>
<td>B</td>
<td>$4,500</td>
<td>$43,000</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>$29,500</td>
<td>Underground</td>
</tr>
<tr>
<td>C</td>
<td>$2,500</td>
<td>$48,500</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>$33,000</td>
<td>Underground</td>
</tr>
<tr>
<td>D</td>
<td>$2,000</td>
<td>$14,000</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>($2,000)</td>
<td>Overhead</td>
</tr>
<tr>
<td>E</td>
<td>$3,500</td>
<td>$20,500</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>$6,000</td>
<td>Underground</td>
</tr>
<tr>
<td>F</td>
<td>$2,500</td>
<td>$7,500</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>($8,000)</td>
<td>Overhead</td>
</tr>
<tr>
<td>G</td>
<td>$2,000</td>
<td>$31,000</td>
<td>$2,000</td>
<td>$95,000</td>
<td>$75,000</td>
<td>$15,000</td>
<td>Underground</td>
</tr>
</tbody>
</table>
Put the Bottom Up Evaluations Together

• Rank the Benefit/Cost Ratios by category
  – Worst performing feeders
  – Proactive replacement
  – New operational states

• Rank them together

• Include value for non-monetized project attributes
  – Public and employee safety
  – Customer service and satisfaction
  – Property value enhancement (e.g. undergrounding)
  – Public relations
Putting the Approaches Together

• Adjust rankings for system knowledge and input, corporate goals, and non-monetized attributes

• Fill-up the $150 million in spending with necessary growth spending and then the highest ranking projects
  – Adjust the “Top Down” estimate of $150 million if certain projects have projects at the margin have very high (or low) B-C ratio’s
  – May want some money for each category even if one category dominates the B-C ratio’s.
Combined Approach

- Utilities can use each approach without the other
- Combined approach has the advantage of:
  1. Provides an objective business case to management and regulator
  2. Puts reliability spending in-line with customer/industry expectations
  3. Projects are funded (or not funded) according to their economic merits
  4. Historic under-funding and system age considerations are addressed
Questions?

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