Micro Grids:
Fundamentals,
Thoughts,
Moving beyond Economics(?)

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In association with the Richard G. Lugar Center for Renewable Energy
Opinions expressed are those of the author and not necessarily those of the center.
Fundamentals

- Design → Transmission/Distribution
- Use ←
- Variability

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System Examples

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System Examples

- Residential
  - $7.5/W
- Commercial
  - $5.5/W
- Utility
  - $3/W

- Compare
  - Retail $1 ~ 5-6¢
  - Wholesale Cayuga ~ 1.5 ¢

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## Cost Justification (RMI-Homer)

<table>
<thead>
<tr>
<th>Location</th>
<th>Insolation (kWh/m²/day)</th>
<th>2012 Avg Retail Price ($/kWh)</th>
<th>Installed PV (MW)</th>
<th>Market Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westchester, NY</td>
<td>4.5 kWh</td>
<td>$0.15–$0.20</td>
<td>122.02 MW</td>
<td>Deregulated</td>
</tr>
<tr>
<td>Louisville, KY</td>
<td>4.5 kWh</td>
<td>$0.06–$0.08</td>
<td>2.92 MW</td>
<td>Regulated</td>
</tr>
<tr>
<td>San Antonio, TX</td>
<td>6 kWh</td>
<td>$0.05–$0.09</td>
<td>131.16 MW</td>
<td>Deregulated</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>6 kWh</td>
<td>$0.09–$0.17</td>
<td>2074.53 MW</td>
<td>Deregulated</td>
</tr>
<tr>
<td>Honolulu, HI</td>
<td>5.5 kWh</td>
<td>$0.34–$0.41</td>
<td>27.33 MW</td>
<td>Regulated</td>
</tr>
</tbody>
</table>

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Cost Justification (RMI-Homer)

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Cost Justification (is that it?)

- Rationale
  - Car
  - Phone

- Benefits
  - Stability
  - PF (Canada: Whitby Hydro)
  - Reliability
  - New Service/Profits
    - ESCO or Utility

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## Reliability (customer service)

<table>
<thead>
<tr>
<th>Major Blackouts</th>
<th>Date</th>
<th>Cause</th>
<th>People</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>October 2012</td>
<td>Hurricane Sandy</td>
<td>8.2 Million (17 states)</td>
<td>~ 14 days</td>
</tr>
<tr>
<td></td>
<td>June 2012</td>
<td>Derecho Storm</td>
<td>4.2 Million (11 states)</td>
<td>~ 10 days</td>
</tr>
<tr>
<td></td>
<td>October 2011</td>
<td>Snow Storm</td>
<td>3 Million (~10 states)</td>
<td>~ 10 days</td>
</tr>
<tr>
<td></td>
<td>September 2011</td>
<td>Heat &amp; Error</td>
<td>2.7 Million (2 states)</td>
<td>~ 12 hours</td>
</tr>
<tr>
<td></td>
<td>August 2003</td>
<td>Trees &amp; Error</td>
<td>55 Million (8 states)</td>
<td>~ 4 days</td>
</tr>
</tbody>
</table>
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Utility/ESCO

• Utility
  • Must deal with Downsides
  • New service = New $$$
  • Service = Data = Reduced Variability
  • Capital Intensive – Rates Guaranteed

• ESCO
  • New service = New $$$
  • Capital Intensive – Subsidies highly variable

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My Thoughts

• What do you think?