Value of Solar and Grid Benefits Studies

Alternative Approaches and Results

2014-2016 Era

EUCI NEM Workshop

Presented by Jim Lazar

July 21-22 2016
About RAP

• RAP is a global non-profit that works with utility regulators and policymakers in the transition of the power sector.
• Based in Vermont
• Offices in Beijing, Brussels, and Delhi
About Jim Lazar

• Economist based in Olympia, Washington
• RAP Senior Advisor (since 1998)
• Expert witness in over 30 jurisdictions on rate design, resource planning, and energy efficiency.
• Author of *Electricity Regulation in the US: A Guide*, and 11 other handbooks
Overview of Net Metering and Value of Solar Ratemaking

• Net-Metering:
  – Simple
  – No new metering required
  – Typically not TOU based
  – Considered an infant-industry subsidy by many

• Value of Solar Analysis
  – Can be narrow (short-run) or broad in scope
Two Views of Cost Recovery

Traditional Utility View
• DG customer “uses” the grid and should pay for it;

Solar Advocate View
• Value of distributed resource is greater than the retail rate;

Energy solutions
for a changing world
Range of Solar Valuation Studies

• Narrow studies
  – Short-run cost savings from solar additions

• Long-Run studies
  – Generation capacity and energy value

• Broad Utility Sector Studies
  – Generation, transmission, distribution, and other utility system values.

• Extensive Societal Studies
  – Utility system and societal benefits
# Categories of Costs Considered

<table>
<thead>
<tr>
<th>Type</th>
<th>Variable</th>
<th>Capital</th>
<th>Externalities</th>
<th>Societal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-Run</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad Utility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Extensive</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Some Costs Treated Very Differently

- Production Capital Costs
- Transmission Capital Costs
- Distribution Capacity Credit
- Marginal or Average Line Losses
- Current or Future Environmental Costs
- Fuel Cost and Fuel Supply Risk
- Macroeconomic Effects
RMI Survey Of Multiple Studies: Average: $0.1672/kWh
Traditional Ratemaking

Utility Average Cost of Service

Retail Rates
Critical View of Net Metering

Lost Revenues from Net Metering

Short-run Fuel and Purchased Power Costs Avoided By Net Metering
Solar Advocate View of Net Metering

Lost Revenues From Net Metering

Long-Run Avoided Cost for Generation, Trans, Dist
+ Reduced Emissions
+ Avoided Fuel Cost Risk
+ Avoided Fuel Supply Risk
+ Local Economic Development
+ Future Carbon Costs
+ Shading Benefits on AC Load
+ Much, much more
Narrow Studies

• Consider short-run marginal cost avoidance only
  – Fuel and purchased power
  – Line losses
  – Out of pocket environmental compliance

• Some look only at power supply
Example Narrow Study
NV Energy 2015

• Used Promod to determine hourly avoided costs.

• Cost Categories
  – Customer
  – Facilities (services and transformers)
  – Demand (circuits)
  – No transmission benefits
  – Generation capacity and energy costs
Result of NV Energy Study

• Dramatic increase in fixed charge
• Proposed residential “maximum demand” charge
• Dramatic reduction in energy charge.
• PUC rejected demand charge in favor of higher fixed charge for NEM customers.
• TOU energy charge retains generation and transmission capacity costs.
Long-Run Studies
E3 for Nevada

- Generation capacity
- Transmission capacity
- Distribution capacity
- Losses
- Ancillary services
- Criteria pollutants
- Avoided RPS Costs
Long-Run Studies E3 for Nevada
Long Run Studies: E3 for Nevada Costs and Benefits Very Close
Broad Utility Sector Studies

• Mississippi (Synapse)
• Maine (Clean Power Research)
• Austin
• Minnesota (State Energy Office)
# Broad Utility Sector Studies

*Synapse for Mississippi*

<table>
<thead>
<tr>
<th>Avoided Costs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided Energy</td>
<td>All fuel, variable operation and maintenance emission allowance costs and any wheeling charges associated with the marginal unit</td>
</tr>
<tr>
<td>Avoided Capacity</td>
<td>Contribution of distributed generation to deferring the addition of capacity resources, including those resources needed to maintain capacity reserve requirements</td>
</tr>
<tr>
<td>Avoided Transmission and Distribution Capacity</td>
<td>Contribution to deferring the addition of transmission and distribution resources needs to serve load pockets, far reaching resources, or elsewhere</td>
</tr>
<tr>
<td>Avoided System Losses</td>
<td>Preventing energy lost over the transmission and distribution lines to get from centralized generation resources to load</td>
</tr>
<tr>
<td>Avoided RPS Compliance</td>
<td>Reduced payments to comply with state renewable energy portfolio standards</td>
</tr>
<tr>
<td>Avoided Environmental Compliance Costs</td>
<td>Avoided costs associated with marginal unit complying with various existing and commonly expected environmental regulations, including pending CO₂ regulations</td>
</tr>
<tr>
<td>Market Price Suppression Effects</td>
<td>Price effect caused by the introduction of new supply on energy and capacity markets</td>
</tr>
<tr>
<td>Avoided Risk (e.g., reduced price volatility)</td>
<td>Reduction in risk associated with price volatility and/or project development risk</td>
</tr>
<tr>
<td>Avoided Grid Support Services</td>
<td>Contribution to reduced or deferred costs associated with grid support (aka ancillary) services including voltage control and reactive supply</td>
</tr>
<tr>
<td>Avoided Outages Costs</td>
<td>Estimated cost of power interruptions that may be avoided by distributed generation systems that are still able to operate during outages</td>
</tr>
<tr>
<td>Non-Energy Benefits</td>
<td>Includes a wide range of benefits not associated with energy delivery, may include increased customer satisfaction and fewer service complaints</td>
</tr>
</tbody>
</table>
Broad: Synapse/MS vs Long-Run: E3 Nevada

- Included in E3
  - Generation
  - Transmission
  - Distribution
  - Losses
  - Avoided RPS

- Not Included in E3
  - Solar admin costs
  - Market Price Effects
  - Price Risk
  - Grid Support Services
  - Outage costs
  - Non-energy benefits
Mississippi Results

Levelized Costs vs. Levelized Benefits (2013 $/MWh)

Costs | All Low | Mid Case | All High

Benefits, Combined Scenarios

- Administrative
- Risk
- Environmental Compliance
- System Losses
- T&D
- Capacity
- Energy
- Cost of solar
Broad Utility Sector Studies

Average US Residential

Energy solutions for a changing world
Expansive Societal Studies

• Consider values in addition to those in the utility revenue requirement
  – Environmental benefit including future carbon costs
  – Local economic development
  – Value of energy independence

• Often show significant value generated for public even with full net-metering.
Expansive Study: Crossborder Energy / Colorado

<table>
<thead>
<tr>
<th>Benefits to PSCo Ratepayers</th>
<th>Fully Valued</th>
<th>Undervalued</th>
<th>Not Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoided energy (including fuel)</td>
<td>![Green Icon]</td>
<td>![Green Icon]</td>
<td></td>
</tr>
<tr>
<td>Avoided T&amp;D line losses</td>
<td>![Green Icon]</td>
<td>![Green Icon]</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
<td>![Orange Icon]</td>
<td>![Orange Icon]</td>
</tr>
<tr>
<td>Avoided generation capacity</td>
<td>![Orange Icon]</td>
<td>![Orange Icon]</td>
<td>![Orange Icon]</td>
</tr>
<tr>
<td>Avoided T&amp;D capacity and fixed O&amp;M</td>
<td>![Orange Icon]</td>
<td>![Orange Icon]</td>
<td>![Orange Icon]</td>
</tr>
<tr>
<td>Grid support services</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Financial</td>
<td></td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Fuel Hedging</td>
<td>![Green Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Avoided RPS or renewables costs</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Grid security and resiliency</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
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<tr>
<td>Environmental</td>
<td></td>
<td>![Red Icon]</td>
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<tr>
<td>Air pollutants (NOx, SOx, PM, &amp; CO2)</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
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<tr>
<td>Reduced water usage in power production</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Avoided land costs for generation or T&amp;D</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Societal benefits (not direct ratepayer benefits)</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Job creation benefits</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Economic development, including local taxes</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
<tr>
<td>Avoided health impacts</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
<td>![Red Icon]</td>
</tr>
</tbody>
</table>
# Expansive Study: Colorado

<table>
<thead>
<tr>
<th>Benefit / (Cost)</th>
<th>Low Gas</th>
<th></th>
<th>Base Gas</th>
<th></th>
<th>High Gas</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/MWh</td>
<td>%</td>
<td>$/MWh</td>
<td>%</td>
<td>$/MWh</td>
<td>%</td>
</tr>
<tr>
<td>Avoided Energy Costs</td>
<td>35.80</td>
<td>24%</td>
<td>52.10</td>
<td>31%</td>
<td>76.10</td>
<td>39%</td>
</tr>
<tr>
<td>Fuel Hedge Value</td>
<td>6.60</td>
<td>4%</td>
<td>6.60</td>
<td>4%</td>
<td>6.60</td>
<td>3%</td>
</tr>
<tr>
<td>Avoided Emissions</td>
<td>27.40</td>
<td>18%</td>
<td>27.40</td>
<td>16%</td>
<td>27.40</td>
<td>14%</td>
</tr>
<tr>
<td>Avoided Generation Capacity</td>
<td>50.60</td>
<td>34%</td>
<td>50.60</td>
<td>30%</td>
<td>50.60</td>
<td>26%</td>
</tr>
<tr>
<td>Avoided Distribution</td>
<td>6.00</td>
<td>4%</td>
<td>6.00</td>
<td>4%</td>
<td>6.00</td>
<td>3%</td>
</tr>
<tr>
<td>Avoided Transmission</td>
<td>18.00</td>
<td>12%</td>
<td>18.00</td>
<td>11%</td>
<td>18.00</td>
<td>9%</td>
</tr>
<tr>
<td>Avoided Line Losses</td>
<td>4.70</td>
<td>3%</td>
<td>6.20</td>
<td>4%</td>
<td>8.30</td>
<td>4%</td>
</tr>
<tr>
<td>(Solar Integration Costs)</td>
<td>(0.50)</td>
<td></td>
<td>(1.80)</td>
<td></td>
<td>(4.40)</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>148.60</td>
<td>100%</td>
<td>165.10</td>
<td>100%</td>
<td>188.60</td>
<td>100%</td>
</tr>
<tr>
<td>10% Adder for Societal Benefits</td>
<td>14.90</td>
<td></td>
<td>16.50</td>
<td></td>
<td>18.90</td>
<td></td>
</tr>
<tr>
<td><strong>Total Net Benefits / (Costs)</strong></td>
<td>163.50</td>
<td></td>
<td>181.60</td>
<td></td>
<td>207.50</td>
<td></td>
</tr>
</tbody>
</table>
Observations

• The answer you get depends on the question you ask.
  – Long-run vs. Short-run
  – Utility direct effects only?
  – Utility direct and future effects?
  – All societal effects

• Valuation of risk and environmental costs have a significant impact.
About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

Jim Lazar   Senior Advisor    jlazar@raponline.org