policies to decarbonize the power sector

sonia aggarwal

february 28, 2014

aspen global change institute
“Our community needs to get our arms around the policies and regulations that emphasize reliability while driving these technologies.”

“Renewables may not be low-carbon if they end up needing a lot of fossils to balance them.”

“We need to deploy extremely quickly, at scale...CO₂ concentrations continue to rise.”

“We need to focus on targeted policies that get us the kind of system we want in the future.”
CHANGE
80 PERCENT RENEWABLES IS FEASIBLE
AMERICA’S POWER PLAN

~200 experts
8 topics
60+ recommendations

www.americaspowerplan.com
DIVERSE REGULATORY/MARKET REGIMES
UTILITY BUSINESS MODELS
PERFORMANCE BASED REGULATION

**State Regulators**
- Set performance goals
- Establish reward & penalty structure

**Utilities**
- Meet goals
- Receive rewards and/or penalties

**Outcomes**

**Retail Level, e.g.:**
- Reliable service
- Customer satisfaction
- Equity
- Innovative third-party services

**Wholesale Level, e.g.:**
- System-wide least cost
- Resource diversity
- Effective facilitation of open access
- Reliability
- Innovation

UTILITY BUSINESS MODELS
 PERFORMANCE BASED REGULATION

UTILITY BUSINESS MODELS

PERFORMANCE METRIC

today

target

~3-8 years

TIME

sanction

penalty

reward

today
CAISO Net Load --- 2012 through 2020

Typical March Day – significant change starting in 2015

Potential Over-generation
MARKET DESIGN
DISTRIBUTED ENERGY RESOURCES
**Utility Business Models**

**Energy Bill Credit:** $32.13

**DISTRIBUTED ENERGY RESOURCES**

<table>
<thead>
<tr>
<th>BILLING MONTH</th>
<th>BILL TO DATE</th>
<th>SUMMER ON</th>
<th>SUMMER OFF</th>
<th>WINTER ON</th>
<th>WINTER OFF</th>
<th>TOTAL ENERGY</th>
<th>ENERGY CHARGES/CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEB 2007</td>
<td>02/05/07</td>
<td>-54</td>
<td>330</td>
<td>18</td>
<td>495</td>
<td>513</td>
<td>$38.55</td>
</tr>
<tr>
<td>JAN 2007</td>
<td>01/05/07</td>
<td>-118</td>
<td>323</td>
<td>68</td>
<td>534</td>
<td>602</td>
<td>$46.42</td>
</tr>
<tr>
<td>DEC 2006</td>
<td>12/06/06</td>
<td>-165</td>
<td>329</td>
<td>23</td>
<td>450</td>
<td>473</td>
<td>$35.72</td>
</tr>
<tr>
<td>NOV 2006</td>
<td>11/04/06</td>
<td>-190</td>
<td>168</td>
<td>-95</td>
<td>53</td>
<td>320</td>
<td>$11.53</td>
</tr>
<tr>
<td>OCT 2006</td>
<td>10/06/06</td>
<td>-210</td>
<td>182</td>
<td>-55</td>
<td>194</td>
<td>205</td>
<td>$9.83</td>
</tr>
<tr>
<td>SEP 2006</td>
<td>09/05/06</td>
<td>-205</td>
<td>150</td>
<td>-22</td>
<td>164</td>
<td>205</td>
<td>$22.47</td>
</tr>
<tr>
<td>AUG 2006</td>
<td>08/07/06</td>
<td>-95</td>
<td>65</td>
<td>-28</td>
<td>132</td>
<td>132</td>
<td>$4.91</td>
</tr>
<tr>
<td>JUL 2006</td>
<td>07/08/06</td>
<td>-32</td>
<td>65</td>
<td>-55</td>
<td>132</td>
<td>132</td>
<td>$4.91</td>
</tr>
<tr>
<td>JUN 2006</td>
<td>06/07/06</td>
<td>-95</td>
<td>65</td>
<td>-55</td>
<td>132</td>
<td>132</td>
<td>$4.91</td>
</tr>
<tr>
<td>MAY 2006</td>
<td>05/08/06</td>
<td>-95</td>
<td>65</td>
<td>-55</td>
<td>132</td>
<td>132</td>
<td>$4.91</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>2,304</strong></td>
<td><strong>$32.13</strong></td>
</tr>
</tbody>
</table>

**Notes:** Energy Charges/Credits (-) include all energy related amounts and taxes.
Utility business models
<table>
<thead>
<tr>
<th>POLICY IMPACT PATHWAY</th>
<th>POTENTIAL IMPACT ON FINANCING COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of Revenue Support (<em>Market and Commercial Risks</em>)</td>
<td>Whether support is concentrated in early years or spread over the life of a project determines how a project is financed and thus the cost. For example, increasing the term of a contract or support policy from 10 to 20 years decreases financing costs by 10-15 percent.</td>
</tr>
<tr>
<td>Revenue Certainty (<em>Market and Commercial Risks</em>)</td>
<td>Exposure to price risks of commodity markets can reduce the amount of debt a project can support and the cost of both debt and equity, potentially increasing financing costs by 5-10 percent.</td>
</tr>
<tr>
<td>Risk Perception (<em>Policy and Technical Risks</em>)</td>
<td>Higher perceived risks may lead investors to demand higher returns or more security to compensate, increasing financing costs by 2-9 percent.</td>
</tr>
<tr>
<td>Completion Certainty (<em>Policy and Technical Risks</em>)</td>
<td>The risk of delayed revenues due to late project completion can reduce achievable leverage and may increase financing costs by less than 5 percent.</td>
</tr>
<tr>
<td>Cost Certainty (<em>Policy and Technical Risks</em>)</td>
<td>The risk of unexpected costs – sometimes policy driven – can also increase the costs of financing by less than 5 percent due to the reduced amount of debt providers are willing to commit.</td>
</tr>
<tr>
<td>Risk Distribution (<em>Policy and Technical Risks</em>)</td>
<td>The ability to and cost of bearing certain risks will vary among investors, suppliers, consumers, and others. By changing which risks (e.g. commodity prices or inflation) are absorbed by which project stakeholder, policy can reduce or increase the financial cost of projects.</td>
</tr>
<tr>
<td>Development Risks (<em>Policy and Technical Risks</em>)</td>
<td>The cost and success rate of developing a project will affect the attractiveness of the industry. A more attractive industry will have more competition, driving costs down.</td>
</tr>
</tbody>
</table>
today: renewable integration drives a large share of transmission expansion

Source: NERC 2009.

tomorrow: transmission and interties must expand further

TRANSMISSION & OPERATIONS