Developing Resource Plans that Use Capabilities from the Full Palette of Demand and Supply Options

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Regulatory Assistance Project

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Agenda

- Fair Compensation from the Inside-Out: Communicating Net Need to Power Sector Resource Providers
- Fair Compensation from the Outside-In: Qualifying Resource Capabilities for Exchange
- Stuck in the Middle with You: Aligning Regulation, Markets, Operations and Planning to Ensure Fair Compensation and Deliver Value
Fair Compensation from the Inside-Out

- Account for EE, DR and DG Load Impacts as Load Modification
- Account for Must Take resources as “Net Need” Modification
- Communicate Operational and Planning “Net Needs” transparently to Power Sector Resource Providers
Accounting for Load Modification

Are Non-dispatchable EE, DR and DG load modifications reflected in your net need assessments?
CAISO’s Articulation of the Load Modification Step

Load modifying programs result in a more favorable load shape, reducing resource procurement requirements, mitigating over-generation, and moderating ramps
Load Modification affects Energy Demand

EE has met more than 50% of PNW Growth – courtesy of Tom Eckman (NPCC)
And the Load Shape
Example: Orienting Panels West versus South
Removing Non-dispatchable Generation affects Net Need
Fair Compensation from the Outside-In

- Qualify EE, DR, Storage and DG Resources to offer Capabilities that meet Operational & Planning Net Needs
- Qualify Supply Side Resources to offer Capabilities that meet Operational & Planning Net Needs
- Establish Procurement and Market Venues where Power Sector Resources can offer Capabilities
Peak Reducing DR Affects Peak Load and Price of Capacity

Courtesy of Peterson, et al. (Synapse), 2006
What Capabilities on the Demand Side?

Table 11. Ancillary Services that may be Provided by Demand Response

<table>
<thead>
<tr>
<th>Service</th>
<th>Service Description</th>
<th>Response Speed</th>
<th>Duration</th>
<th>Cycle Time</th>
<th>Price Range* (Average, Max) $/MW-hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Conditions</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Frequency Regulation</td>
<td>Online resources, on automatic generation control, that can respond rapidly to changes in frequency.</td>
<td>&lt;30 seconds</td>
<td>Seconds to Minutes</td>
<td>Seconds to Minutes</td>
<td></td>
</tr>
<tr>
<td>Regulating Reserve</td>
<td>Online resources, on automatic generation control, that can respond rapidly to system-operator requests for up and down movements; used to track the minute-to-minute fluctuations in system load and to correct for unintended fluctuations in generator output.</td>
<td>4 Seconds to 5 minutes</td>
<td>Minutes</td>
<td>Minutes</td>
<td>$35-$40 $200-$400</td>
</tr>
<tr>
<td>Load Following</td>
<td>Similar to regulation but slower. Bridges between regulation service and hourly energy markets. This service is performed by the real-time energy market in regions where such a market exists.</td>
<td>~10 minutes</td>
<td>10 min to hours</td>
<td>10 min to hours</td>
<td>-</td>
</tr>
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# Under Contingency Conditions

<table>
<thead>
<tr>
<th>Contingency Conditions</th>
<th>Spinning Reserve</th>
<th>Non-Spinning Reserve</th>
<th>Replacement or Supplemental Reserve</th>
</tr>
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<tbody>
<tr>
<td>Spinning Reserve</td>
<td>Online generation, synchronized to the grid, that can increase output immediately in response to a major generator or transmission outage and can reach full output within 10 min.</td>
<td>Same as spinning reserve, but need not respond immediately. Resources can be used for restoration purposes.</td>
<td>Same as supplemental reserve, but with a 30-60 min response time; used to restore spinning and non-spinning reserves to their pre-contingency status.</td>
</tr>
<tr>
<td></td>
<td>Seconds to &lt;10 min</td>
<td>10 to 120 min</td>
<td>Hours to Days</td>
</tr>
<tr>
<td></td>
<td>&lt;10 min</td>
<td>10 to 120 min</td>
<td>Hours to Days</td>
</tr>
<tr>
<td></td>
<td>&lt;30 min</td>
<td>2 hours</td>
<td>Hours to days</td>
</tr>
</tbody>
</table>
Base Load Resources have Less Value

Life for peaking plants doesn’t change much…

…flexible everyday resources are in much greater demand…

…but traditional base load is poorly matched to net load.
Flexible Resources Have More Value

Net Demand, 1 Jan to 31 Dec 2030

Energy solutions for a changing world
What Capabilities do Supply Resources Have?

- What Capabilities do Renewables Have?
  - Wind
  - Solar PV
  - Solar Thermal w/ Storage
  - Geothermal

- What Type of Gas Fired Resources do We Need?
Stuck in the Middle with You

- High RE Systems can be Reliable
- Cost Effective Solutions Exist Now
- Aligning Regulation, Markets, Operations, and Planning to Ensure Fair Compensation and Deliver Value
High Low Carbon Systems can be Reliable

“The study findings indicate that the PJM system, with adequate transmission expansion and additional regulating reserves, will not have any significant issues operating with up to 30% of its energy provided by wind and solar generation.”
GE Energy Solutions (2013)

“Our models found no technical difficulties accommodating much higher levels of variable wind and solar energy, while fully preserving reliability.”
The Brattle Group (2013)
“By deploying technologies already commercial today, or in late development stage, Europe could reduce greenhouse gases emissions by 80% by 2050 compared to 1990 and still provide the same level of reliability as the existing energy system.”

The European Climate Foundation (2010)

“An assessment of case study regions with the revised IEA Flexibility Assessment Tool (FAST2) showed that annual VRE (Variable Renewable Energy) shares of 25% to 40% can be achieved from a technical perspective, assuming current levels of system flexibility.”

The International Energy Agency (2014)
Cost Effective Solutions Exist Now

➢ Consider Two Situations
  ➢ Approaches to Address Local High Penetration PV
  ➢ Approaches to Address Regional High Penetration Variable Energy
What about this Situation?

[Graph showing net load for March 31, with years from 2012 to 2020 and noting ramp need of ~13,000 MW in three hours and over generation risk.]
Ten Strategies To Align Loads to Resources (and Resources to Loads) with Illustrative Values for Each

1. Targeted energy efficiency
2. Orient solar panels
3. Use solar thermal with storage.
4. Manage electric water heat
5. Require new large air conditioners to include storage
6. Retire older inflexible power plants
7. Concentrate demand charges into “ramping” hours
8. Deploy energy storage in targeted locations
9. Implement aggressive demand response programs
10. Use inter-regional exchanges of power

Not every strategy will be applicable to every utility.
How Did We Do?

Pre-Strategy, without Solar/Wind: 73% LF
Pre-Strategy, with Solar/Wind: 63% LF
Post-Strategy, with Solar/Wind: 83% LF

Hourly Ramp: 340 MW vs. 400 today, and 550 w/o strategies
What about the Regional Integration Challenge?
WREZ Phase III Recommendations

- Expand Sub-hourly Scheduling
- Facilitate Dynamic Transfers
- Implement EIM
- Improve Forecasting
- Leverage Geographic Diversity
- Improve Reserves Management
- Retool Demand Response
- Use Flexibility of Existing Generation
- Focus on Flexibility in New Gas Generation
Achieving Value Alignment

1. Does Demand Reflect Load Modification?
2. Is Demand Net of Must Take Transparent?
3. Are Resource Capabilities Qualified Fairly?
4. Is M&V there to Certify Qualified Resources?
5. Are Regulation, Markets, and Operations Aligned to Deliver Value in the Near Term?
6. Are Regulation, Markets, Operations and Planning Aligned to Support the Right Infrastructure?
Resources

• What Lies Beyond Capacity Markets? (Hogan, Gottstein, et al (RAP))
  http://raponline.org/document/download/id/6041
  http://raponline.org/document/download/id/4854

• Demand Response as a Power System Resource (Hurley, et al. (Synapse for RAP))
  www.raponline.org/document/download/id/6597

• CAISO DR/EE Roadmap: Maximizing Preferred Resources (CAISO)
More Resources

• Teaching the Duck to Fly (Lazar (RAP))
  http://www.raponline.org/document/download/id/6977

• Integrating Renewables at Least Cost in the West
  http://www.raponline.org/document/download/id/5041

• Aligning Power Markets to Deliver Value (Hogan (RAP) for APP)
  http://www.raponline.org/document/download/id/6932

• Capacity Mechanisms for Power System Supply (Keay-Bright (RAP))
  http://www.raponline.org/document/download/id/6805
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 and natural gas sectors. 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

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