“Capacity” Adequacy & Adequate System Flexibility: The secret to getting both at least cost

Workshop on the Future Design of the Hungarian Electricity Market – Budapest, Hungary

Michael Hogan
Senior Advisor
The Regulatory Assistance Project (RAP)®

Sunapee, New Hampshire
United States

mhogan@raponline.org
raponline.org
Start with the short answer:

“It’s the economy energy price, stupid.”

- Bid-based
- Security-constrained
- Economic dispatch
- With Locational Marginal Pricing
Resource adequacy, by the numbers
How much adequacy is enough?

Imputed Average Value of Lost Load

Source: Adapted from Hogan, W., Harvard University
System flexibility: what is it, what’s it worth, from whom?

Hint: It’s NOT “backup” capacity
Capacity value lies in energy services

...so market model should reflect this
Rapid growth in range of needed services

- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery

- Ramping Margin
- Dynamic Reactive Power
- Steady-state Reactive Power
Rapid growth in range of needed services
Co-optimizing energy & services to reveal value

ISO supports the Western Grid when the blue bars are above 100% (green line).

ISO leans on other BAs when the red bars are less than 100%.
3 Energy price formation and investment
This is what bad practice looks like:

- **Average VoLL**
- **Price cap**
- **Capped supply curve**
- **"Energy-only" demand curve**

<table>
<thead>
<tr>
<th>Price (€/MWh)</th>
<th>Quantity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td></td>
</tr>
</tbody>
</table>

$P_1 = 80$
This is what good practice looks like:
And what good practice enables:

\[ P_3 = 800 \]

Price (€/MWh)

Marginal cost supply curve

Average VoLL

Energy plus reserves demand (2)
Administrative measures (e.g., reserve shortage function) ensure demand for reliability is priced…

...creating volume & price risks that drive bilateral contracting (e.g., ~95% of energy consumed in ERCOT is under bilateral contracts)

What about capacity mechanisms?
CRMs: be careful what you wish for…

**Extent of capacity intervention**

<table>
<thead>
<tr>
<th>Region</th>
<th>Avg annual new-build as % of 2014 peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERCOT</td>
<td>4.5</td>
</tr>
<tr>
<td>NYISO</td>
<td>3.2</td>
</tr>
<tr>
<td>PJM</td>
<td>3.0</td>
</tr>
<tr>
<td>ISO-NE</td>
<td>3.5</td>
</tr>
<tr>
<td>NEM</td>
<td>3.8</td>
</tr>
<tr>
<td>SWIS</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Ratio of actual to target reserve margins (2015)**

- North America
- Australia

- ERCOT: 1.2
- NYISO: 1.5
- PJM: 1.8
- ISO-NE: 2.2
- NEM: 2.0
- SWIS: 3.0
Creeping over-procurement

PJM Reserve Margin Expansion since adoption of capacity market

Source: PJM data, compiled by J. Chen, Nicholas Institute for Environmental Policy Solutions, Duke University.
What’s wrong with capacity markets?

- They’re the tail that soon wags the dog
- Lead to structural over-procurement
- Unnecessarily constrain market participation and thus raise costs
- Not well suited to differentiating value of capacity based on operational attributes
- Lock-in of energy price distortion, undercutting smart demand and DERs

…if you must have one, render it vestigial ASAP.
“There are only two fundamental products: energy and reactive power. Most other products are essentially options on energy in different timeframes.”

David Patton, Ph.D  
President, Potomac Economics  

Source: Presentation to the US Energy Information Administration Energy Conference, 4 June 2018
Resources

- Hogan, M., “Follow the Missing Money: Ensuring reliability at least cost to consumers in the transition to a low-carbon power system.” *The Electricity Journal*, vol. 30, issue 1, pgs 55-61


- Pope, S., “Price Formation in ISOs and RTOs: Principles and Improvements.” FTI Consulting, October 2014
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org
Sources and Notes:
Data from PJM. Forecasts shown here exclude territory expansions in order to enable comparisons across time, thus current load forecast including all current PJM zones are substantially higher.
How administrative instruments go rogue:

- A: CT Net CONE, Current Curve
- B: CT Net CONE, 1% Left-Shift
- C: CC Net CONE, Current Curve
- D: CC Net CONE, 1% Left-Shift
- E: CC Net CONE, 1% Left-Shift, 70% Gross CONE Cap
- F: CC Net CONE, 1% Left-Shift, 60% Gross CONE Cap
The real supply curve:

![Supply Curve Diagram]

- **Marginal cost (€/MWh)**
- **Value of load**
- **Price cap**
- **Generation merit order**
- **Emergency gen & other**
- **Drawdown of required reserves**

Supply Curve

Regulatory Assistance Project (RAP)®