June 13, 2019

A Renewable Electricity System and the Value of Flexible Resources

The 6th National Conference on Next Generation Demand Response – Boston, MA

Mark LeBel
Associate
Regulatory Assistance Project (RAP)®

50 State Street, Suite 3
Montpelier, Vermont 05602
USA

802-498-0732
mlebel@raponline.org
raponline.org
Agenda

- Renewables Integration Issues and Solutions
- Value Propositions from Renewables
- Policy Solutions
Renewables Integration Issues and Solutions
Variable Renewable Generation is Growing Quickly

New Challenges to Solve with Variable Renewables

- Changes to seasonal net load
- Changes to daily net load
- Changing need for ancillary services
- Potential for additional distribution-level issues from customer-sited renewables

Flexible resources are key solutions!

*Flexible operation of variable renewables is part of the answer.*
Sources of Flexibility

- Flexible generation
- Existing storage
- RE curtailment
- Thermal storage
- Electricity storage
- Flexible loads
- Markets

Penetration of variable renewable energy vs. Flexibility cost
Flexibility Strategies Now Span Many Timescales

Unpredictability of Renewables Varies

“Net Load” Presents New Shape

Illustrative Daily Load in 2020

- **Total Load**
- **Load Net of Wind and Solar**

**MW**

- 0
- 500
- 1,000
- 1,500
- 2,000
- 2,500
- 3,000
- 3,500
- 4,000

**Hours**

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Variable Renewables Can Be Complementary

Source: Slusarewicz and Cohan (2018) and ERCOT load data
Value Propositions from Renewables
Inverter-Based Technologies Provide Important System Benefits
Wind, Solar, and Batteries are Valuable in Real Time

Source: www.milligangridsolutions.com
You may have noticed that inverter-based technologies excel at being fast...

Source: www.ascendanalytics.com
Responsive Load Can “Shimmy” to Meet Short-Term Grid Needs

Charging is varied UP and DOWN from a “bid in” base line.
## Options for Flexible Solar Resources

<table>
<thead>
<tr>
<th>Solar Operating Mode</th>
<th>Solar can be curtailed</th>
<th>Solar can contribute to footroom requirements</th>
<th>Solar can contribute to headroom requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must-Take</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Curtailable</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Downward Dispatch</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Full Flexibility</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Planning Around Uncertainty

Value of Flexibility for Utility-Scale Solar

Finding Optimal Resource Mix

Policy Solutions
Flexibility Needs Must be Modeled and Capabilities Compensated

... Make It So
Opening up Wholesale Markets to Aggregated DERs and Storage (Like California)

CAISO initiated Electricity Storage and Distributed Energy Resources (ESDER) Initiative in 2014 to:

- Enhance ability of ISO connected and distribution-connected resources to participate in ISO markets

- Phase 3 completed in 2018, market participation enhancements included providing a bidding mechanism that allows behind-the-meter resources to offer load-using and load-curtailing service
Inviting Advanced Technology Alternatives to Traditional Resources

PG&E and East Bay Clean Energy project, Oakland Clean Energy Initiative (OCEI): replaces a retiring 165 MW Dynegy gas peaker, obviates need for 115 kV and 230 kV transmission

Combination of resources includes:
  • 25-40 MW combination of EE, DR, PVDG (minimum 19 MW of load reducing response)
  • 10 MW/40 MWh storage
  • Substation upgrades and line re-ratings
... Saving Ratepayers Money and Reducing Emissions
Next Frontiers

• Market-based answers are easy to conceptualize, but may be harder to implement
• Typical long-term contracts for renewables provide strong incentives to maximize output, instead of providing other services
• Vertically-integrated utilities may not have good incentives to operate renewables optimally
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