EnerNOC

24–27GW of Peak Load under management
~9GW of Dispatchable Demand Response (DR)
10 Countries with DR operations
100+ Utilities / System Operator relationships
14,000+ C&I Facilities in our network
~1.5 Billion Data Points / Month into our NOC
~1,000 Employees worldwide
DR is a flexible system resource
The same participant is often capable of providing multiple grid services

**Emergency DR Resource (100 MW)**
- *Typical dispatch*: 6 hours duration; 1-2x/year; Day-ahead notice
- *Load reduction only*

**Peak-shaving DR Resource (50 MW)**
- *Typical dispatch*: 4 hours duration; 10-15x/year; 30 minutes – 4-hour notice.
- *Load reduction only*

**Non-Spinning Reserves DR (25 MW)**
- *Typical dispatch*: 30-minute to 2 hours duration; 10-50x per year; 10-minute notice
- *Load reduction only*

**Load-following DR Resource (15 MW)**
- *Typical dispatch*: 1-2x/day; 30-minute duration; 5-minute notice
- *Load reduction or increase*
DR in Global Capacity Markets
Given market access, DR has proven to be an important resource in capacity markets

<table>
<thead>
<tr>
<th>Market</th>
<th>DR capacity</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>14,118 MW</td>
<td>8.6%</td>
</tr>
<tr>
<td>NYISO</td>
<td>2,248 MW</td>
<td>6.7%</td>
</tr>
<tr>
<td>ISO-NE</td>
<td>2,164 MW</td>
<td>7.4%</td>
</tr>
<tr>
<td>WEM</td>
<td>499 MW</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

$11.8 Billion Saved
2013/14 BRA: Impact of DSM

PJM Market Monitor. Analysis of the 2013/2014 RPM Base Residual Auction Revised and Updated, September 2010
PJM 2014/15 Base Residual Auction Results, Doc #645284, page 9. 14,118.4 MW of DR Cleared in the RPM.
PJM 2014/15 RPM Base Residual Auction Parameters, Doc #631095, pg 2. Forecasted peak of 164,758 MW
WA: Summary of Capacity Credits for the 2011 Reserve Capacity Cycle (October 2012-2013). IMO, Sep 2011
WA: Ibid. Compares cleared DSM capacity to the Reserve Capacity Requirement of 5,312 MW.
**DR in Ancillary Services Markets**

Given market access, DR has proven to be an important A/S resource

**New Zealand Instantaneous Reserves**

DR now provides 20%+ of the reserve, increasing competition, reducing costs

DR responds faster than generation, potentially reducing reserve requirement

(Data: 1 second meter data from 79 devices which responded to North Island UFE on 9 Dec 2011.)
Markets need to be open to 3rd parties for DR to thrive

In existing DR markets, 3rd parties provide the majority of DR resources

- Open access enables a variety of business models
- Specialists find DR more efficiently than utilities
- DR is not a utility’s core business focus
- Retailers are limited by contractual churn (and potentially trading considerations)
- DSOs are limited by their regulatory construct, organizational inertia
- Competition leads to a better deal for participants
- Allowing customers to do DR independently of their retailer while ensuring retailers are unaffected is a solved (and solvable) problem

Registered DR by Company Type for PJM DY 2013/14

- CSP (Aggregator)
- LSE (Retail Supplier)
- LSE, EDC (Utility)
Markets need to be open to 3rd parties for DR to thrive
Reconciling 3rd party access with the BRP regime is the #1 issue for DR in Europe

Building DR Resources as a 3rd-party in Germany’s Balancing Markets

- TSO
  - Balance group agreement
  - Prequalification (PQ), supply of reserve energy
  - Grid connection
  - Agreement, report of non-availability, and § 19 (2) StromNEV, Confirmation for PQ

- DR provider role
  - Agreement on participation
  - Power Consumer Flexibility Supplier
  - Grid connection
  - Grid usage

- BRP
  - Agreement on schedule exchange, BRP-approval for PQ
  - Balance group responsibility
  - Agreement on payments

- DSO
  - Grid connection

- Retailer
  - Power delivery
Availability payments are crucial for DR success

Availability payments help overcome many real-world issues with decision-making

Decisions are hard. It is generally easier to do what you did yesterday

Electricity is typically a relatively small cost of doing business

DR participation requires significant up-front investment

• Technology
• Decision-making

The benefits that accrue from DR are both in the future and uncertain

• Customers have very high discount rates for energy investments (see: EE)
• Customers want an asymmetric risk equation

Availability payments guarantee that participants start out ahead, and they guarantee an ongoing return to those participants
Availability payments are crucial for DR success
Market data confirms that availability payments are key to customer participation

**Estimated Maximum % of System Peak from C&I DR Resources**

- **PJM**
- **ISO-NE**
- **NYISO**

Source: Reports to FERC and/or stakeholder meetings
### Designing a Demand Response Program

Each program design element needs to be carefully chosen to balance system needs with the need to incent customer program participation.

<table>
<thead>
<tr>
<th>Low</th>
<th>Program Compensation</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short/ Uncertain</td>
<td>Program Life</td>
<td>Long/ Certain</td>
</tr>
<tr>
<td>24/7</td>
<td>Event Window, Frequency, and Duration</td>
<td>Limited Hours</td>
</tr>
<tr>
<td>Instant</td>
<td>Event Notification</td>
<td>Hours</td>
</tr>
<tr>
<td>Usury</td>
<td>Performance Penalties</td>
<td>Reasonable</td>
</tr>
<tr>
<td>Curtailment Only</td>
<td>Allowable Response Type</td>
<td>Curtailment/ Generation</td>
</tr>
<tr>
<td>Self/ Manual</td>
<td>Performance Measurement</td>
<td>Clear Rules</td>
</tr>
</tbody>
</table>

- Design DR for system needs, not exact equivalence with supply-side resources
- DR should be valued based on the avoided costs it delivers to the system
Thank You

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