Reforming the NEM to enhance end-user participation and demand response

20 August 2014 — Centre for Energy & Environmental Markets, UNSW
Outline

• What is DR?
• What can DR do?
• Why do customers participate?
• What market features are important for DR?
• What NEM reforms are being contemplated?
Who are EnerNOC?
EnerNOC’s Energy Intelligence Software
Our solutions focus on the three energy cost drivers

How you buy it

Supply management
• Develop accurate energy budgets
• Track costs against budget
• Conduct budget scenario planning

Utility bill management
• Collect historical utility bills
• Track trends in utility usage & cost
• Discover & report billing errors
• Streamline accounts payable

How much you use

Visibility and reporting
• Track trends in energy usage & carbon impact
• Visualise real-time energy data to understand consumption patterns
• Automate environmental reporting

Facility optimisation
• Benchmark & compare facilities
• Analyse meter data to identify cost saving opportunities
• Prioritise actions across a portfolio

Project management
• Track the impact of measures

When you use it

Demand response
• Earn revenue to fund your energy projects
• Measure & manage DR event performance
• Track payment history

Demand management
• Alert on demand thresholds
• Quantify cost impact of demand peaks
• Forecast new facility & system peaks
EnerNOC’s world-wide demand response footprint

Countries with active EnerNOC DR programmes
Successful demand response at scale

8,500 MW available for dispatch

15,000 commercial and industrial sites

331 dispatches per annum

106% average performance

Annual figures are for 2012 calendar year.
What is DR?
What does a power system look like without DR?

Data: AEMO “total demand” for all NEM regions, year ending 31 March 2014
It’s wasteful to build power stations you’ll hardly use

Data: AEMO “total demand” for all NEM regions, year ending 31 March 2014
Methods for involving the demand side

Moving away from treating demand as something simply to be predicted

Administrative approaches
- Controlled loads
- Time-of-use tariffs
- Critical peak pricing

Market-based approaches
- Real-time pricing
- Aggregated demand response

Photo: Zellweger ZE 22-3 Ripple receiver relay 1050 Hz by RODALCO. CC BY-SA 3.0 licensed.
Aggregated demand response
Risk management through portfolio aggregation

Aggregators protect customers and the utility from non-performance
Dependable performance from varied providers

Aggregators find the right combination of customers to meet the utility’s needs

Diagram from Kristin Brief & Brad Davids, C&I Customers Get Smart, Public Utilities Fortnightly, January 2011.
Real-time visibility is vital

We install telemetry on every participating site, so customers can see how they’re doing, and so can we.
Network Operations Centre
Triage

We have developed sophisticated tools to manage dispatches in real time

- This tree-map allows us to focus attention on customers having the most impact
- Each patch represents a customer site
- The area indicates the expected DR quantity
- The colour shows how they are performing relative to expectations
Effect of coaching

Typically 30% better performance on average, and much lower variability
What can DR do?
DR is huge in PJM

14 GW of DR in a 160 GW market
DR is bringing huge benefits to PJM

Capacity
• 2013/14 BRA: Impact of DSM
• $11.8 billion saved

Energy
• DSM price impact during 1-week heatwave
• $650 million saved

PJM letter to Transmission Expansion Advisory Committee, 28 August 2012.
PJM Demand Response Fact Sheet, 2008.
Decreasing peakiness avoids network capex
In PJM, long-planned $3.5 billion PATH & MAPP transmission projects not needed

“increasing participation in demand response programs” cited as key trend leading to the cancellation of the projects.

PJM letter to Transmission Expansion Advisory Committee, 28 August 2012.
Demand response in Western Australia

- Over 700 commercial and industrial sites participate
- Total capacity of 500 MW
Dispatch during WA gas crisis

“Assessment of the aggregated performance of DSM facilities shows that the required curtailment was delivered successfully in all intervals of dispatch.” — IMO

Sources: IMO 2011 Statement of Opportunities, p.14; Presentation by Allan Dawson, 7 April 2011.
Ancillary services in New Zealand

- Over 100 MW of capacity
- Over 150 separate facilities
- All fully automated
- Shut down in <1 second
- Notification by SMS and email
Under-frequency event in New Zealand

Data: 20 millisecond frequency samples recorded in Wellington during North Island UFE on 9 Dec 2011.
Under-frequency event in New Zealand

Data: 1 second meter data from 79 devices which responded to North Island UFE on 9 Dec 2011.
**DR can help with intermittent renewables**

Wind integration pilot at Bonneville Power Administration

Pacific Northwest is great for wind
- 3.5 GW online
- 6 GW more “in process”
- 15 GW further “in discussion”

Problem: It’s only a 40 GW system
- Approaching a 60% wind penetration factor

Solution: DR to **increase** load, as well as decreasing it
- Time-shifting heating/cooling/pumping loads
- Sub 10 minute response, fully automated
Demand response can do regulation, too

Load resources can respond more quickly and accurately than typical generators

Regulation by generator

Regulation by demand response

Gen data: Beacon Power, Smart Grid Rulemaking and Integration of Renewables & Energy Storage; DR data: Alcoa, Demand Response in the A/S Market, Jan 2009.
<table>
<thead>
<tr>
<th>What can DR do?</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale capacity</td>
<td>Lower cost</td>
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<tr>
<td>Network capacity</td>
<td>Lower cost</td>
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<tr>
<td>Contingency ancillary services</td>
<td>Better, Lower cost</td>
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<tr>
<td>Frequency regulation</td>
<td>Better</td>
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</tbody>
</table>
What makes participation attractive?
What makes participation attractive to customers?

In theory:

- The existence of appropriate price signals
What makes participation attractive to customers?

In theory:
• The existence of appropriate price signals

In practice:
• No disproportionate overheads or risks
• Actionable price signals
• Certainty of sufficient reward to be worthwhile
• Active competition between aggregators to procure DR
What market features are important for DR?
“Since demand response is actually — and not merely metaphorically — equivalent to supply response, economic efficiency requires that it be regarded and rewarded, equivalently, as a resource proffered to system operators, and be treated equivalently to generation in competitive power markets.”

The late Alfred E. Kahn
Professor Emeritus of Political Economy
Cornell University
Price signals should be actionable

If the customer doesn’t know the price, you can’t expect them to respond.

Data: AEMO 5-minute pre-dispatch and dispatch prices and demand for South Australia on 24 April 2013.
The importance of aggregators to successful DR

72% of DR capacity in PJM comes from third-party aggregators

Figure 2 from *PJM Demand Response Operations Markets Activity Report: November 2013*, showing percent of total nominated capacity.
Availability payments

Essential to motivate customers to remain available for rare events
What about the NEM?
## What can DR do in the NEM now?

<table>
<thead>
<tr>
<th></th>
<th>Advantage</th>
<th>Happening?</th>
<th>Problems</th>
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</thead>
<tbody>
<tr>
<td>Wholesale</td>
<td>Lower cost</td>
<td>A small amount</td>
<td>Retailers and the brave only</td>
</tr>
<tr>
<td>Network</td>
<td>Lower cost</td>
<td>A tiny amount</td>
<td>Conflicting incentives</td>
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<td>Better Lower cost</td>
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<td>Retailers only</td>
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</table>
Demand response in the NEM
## The NEM is an outlier

Markets which make provision for DR have much higher levels of participation

<table>
<thead>
<tr>
<th>Market</th>
<th>DR capacity</th>
<th>% of capacity</th>
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</thead>
<tbody>
<tr>
<td>PJM</td>
<td>14,118 MW</td>
<td>8.6%</td>
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<tr>
<td>WEM</td>
<td>499 MW</td>
<td>8.4%</td>
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<tr>
<td>ISO-NE</td>
<td>2,164 MW</td>
<td>7.4%</td>
</tr>
<tr>
<td>NYISO</td>
<td>2,248 MW</td>
<td>6.7%</td>
</tr>
<tr>
<td>NEM</td>
<td>820 MW</td>
<td>1.6%</td>
</tr>
</tbody>
</table>


NEM: AEMO 2013 NEFR estimated available DSP at MPC for summer 2013-14, compared to total registered generation, Oct 2013.
NEM reforms
**Demand response mechanism**

Allows DR to be treated like generation in the wholesale market.

Data: EnerNOC portfolio during PG&E dispatch on 9 Aug 2012, with uncapped baseline adjustment.
Demand response mechanism
A minimal reform to allow widespread DR participation

Unbundles DR procurement from retail supply
• Customers can shop around for the best deal for their DR
• Can still sell to their own retailer if they wish
• Should lead to a competitive market for DR, including specialist aggregators

Treats wholesale DR like non-scheduled generation
• Customers earn the spot price for their load reductions
• Aggregated DR is likely to be offered as hedges
• AEMO decided scheduled participation was too hard for initial implementation

Generators and retailers don’t like it
• Introduces additional competition to generators in the wholesale and hedge markets
• Breaks exclusivity of retailers’ relationships with customers
The state of play with the DRM

### Implementation

- SCER decision at its December 2012 meeting. ✔️
- AEMO to establish an advisory stakeholder working group upon SCER direction. ✔️
- AEMO to submit rule change proposal to the AEMC no later than December 2013. ✗
- AEMO develop guidelines and procedures in parallel to rule change process.
- The mechanism should commence no later than early 2015. ✔️

Now mid-2016?

Additional cost-benefit analysis first.
What will DR be able to do in the NEM?

<table>
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<th>Change</th>
<th>Timeline</th>
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<tbody>
<tr>
<td><strong>Wholesale</strong></td>
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<td>Power of Choice demand response mechanism</td>
<td>2016?</td>
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<td><strong>Network</strong></td>
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<tr>
<td>AER Better Regulation reforms</td>
<td>Regulatory resets from 2015</td>
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<td><strong>Contingency ancillary services</strong></td>
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NZ market design has not evolved

Catch-up overdue

Key components of an efficient electricity market:

- Scarcity pricing
- Day-ahead market
- Capacity market
- Transmission congestion hedges
- Market surveillance
- Nodal pricing
- Bid-based economic dispatch

US markets – started after NZ but systematically introduced the key components required

NZ Market – world leader when introduced in 1996, but no major developments since
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