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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

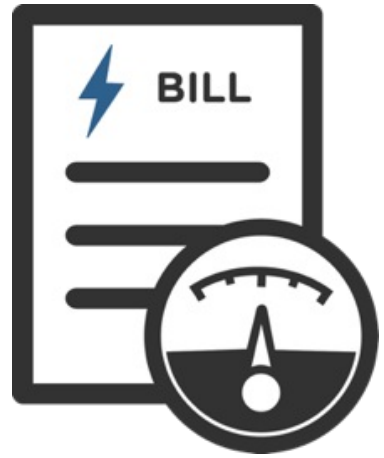
How you buy it

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

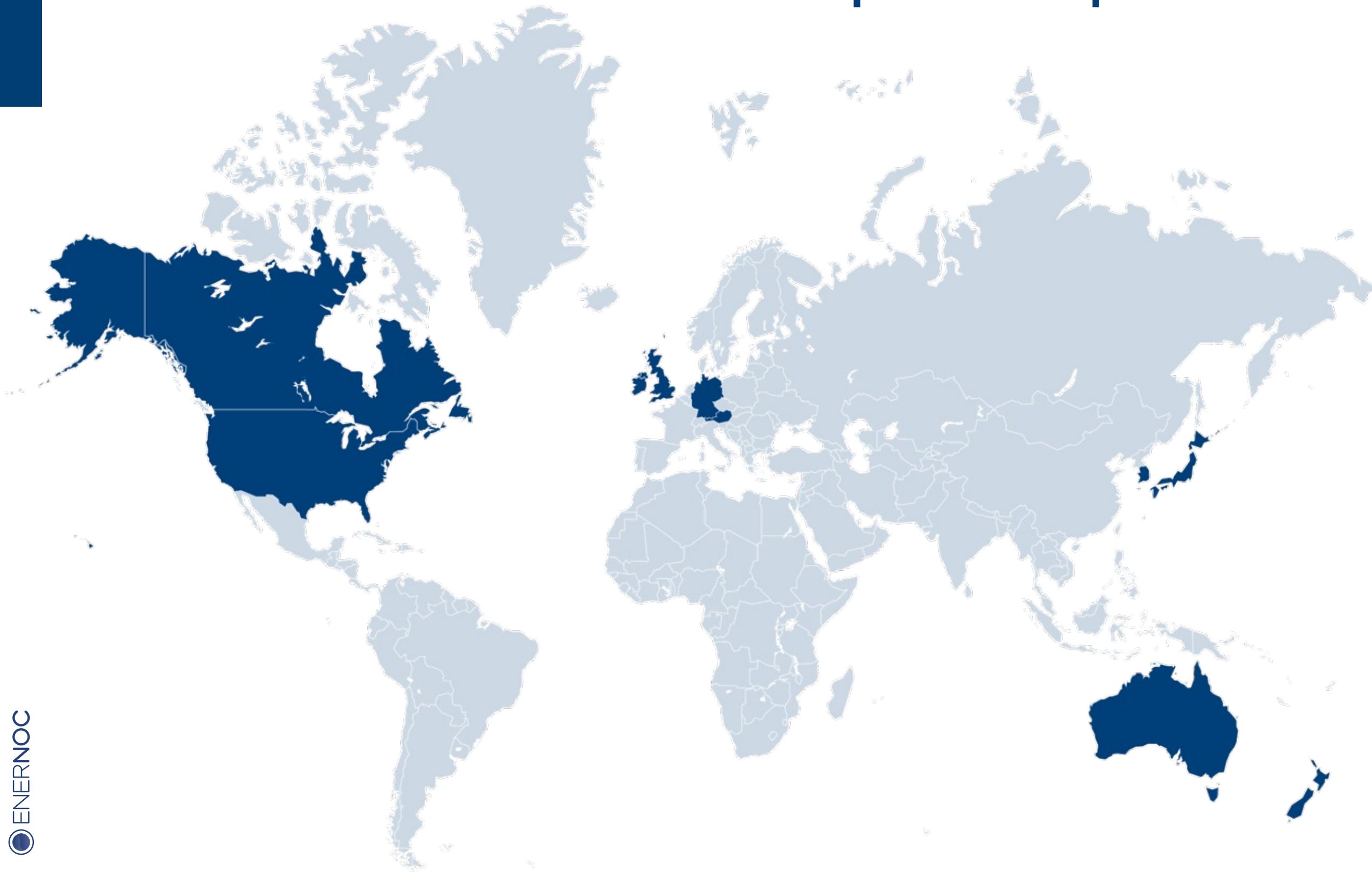
Demand response

- 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

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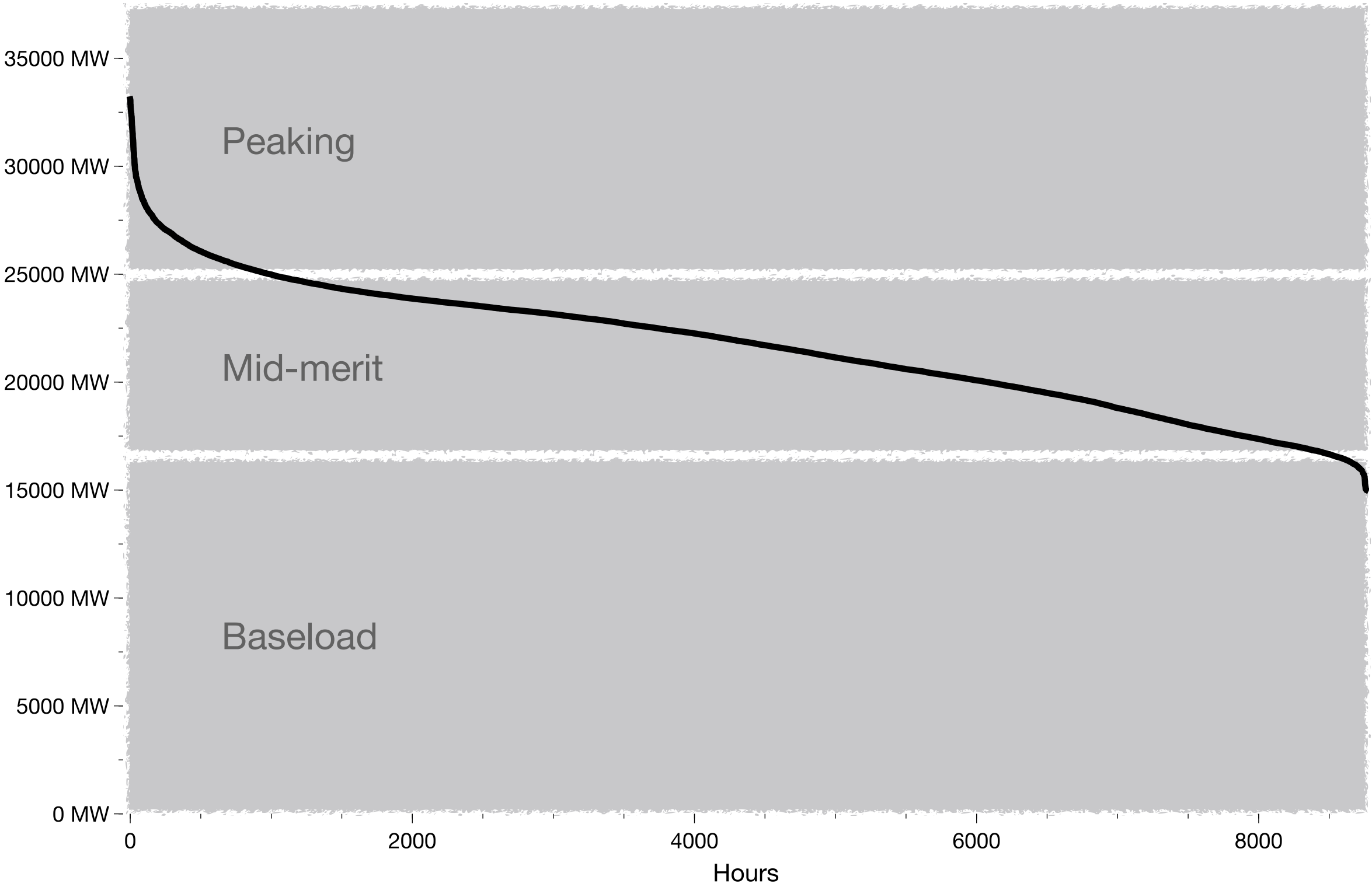
Annual figures are for 2012 calendar year.

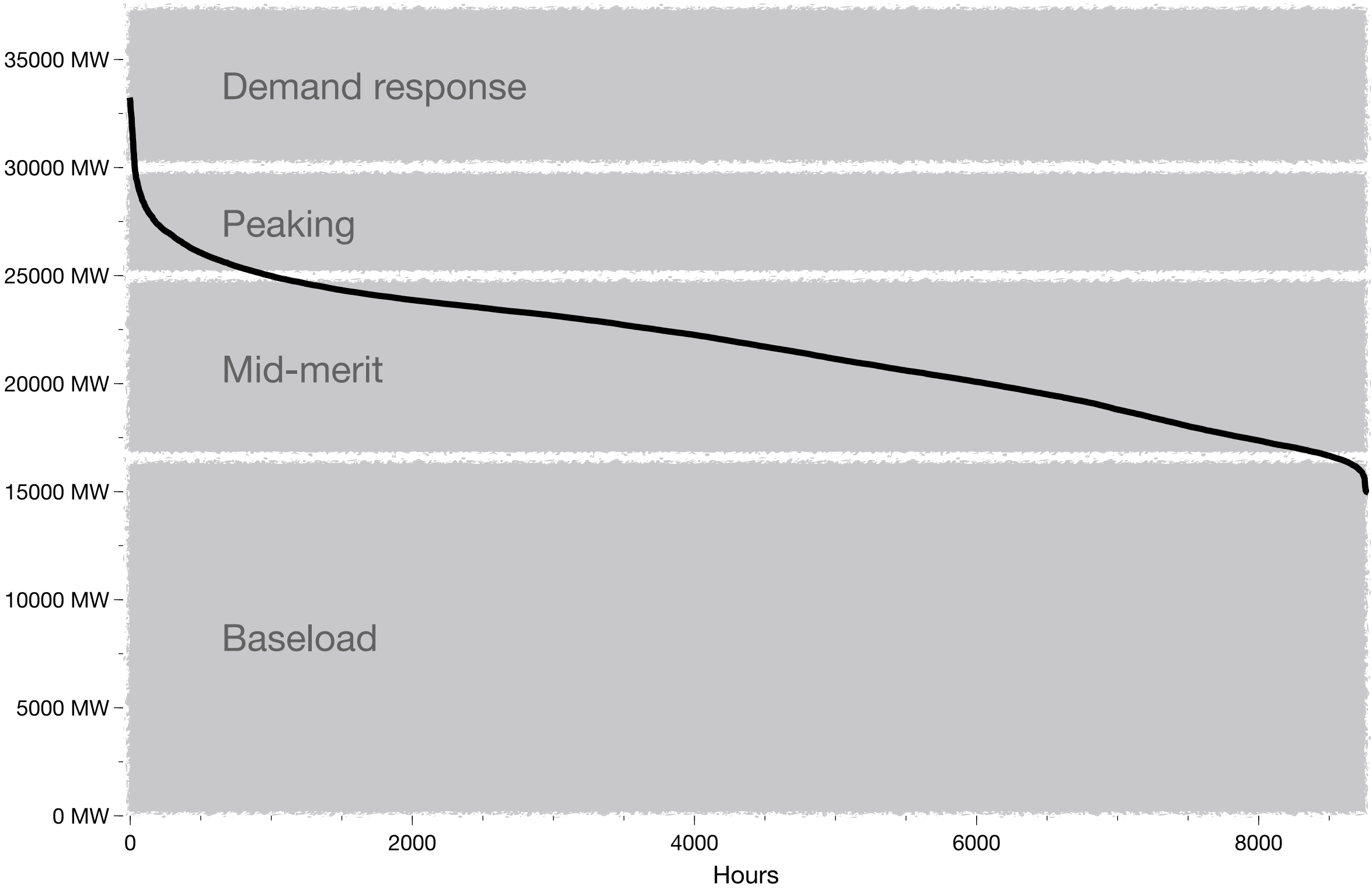
What is DR?

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

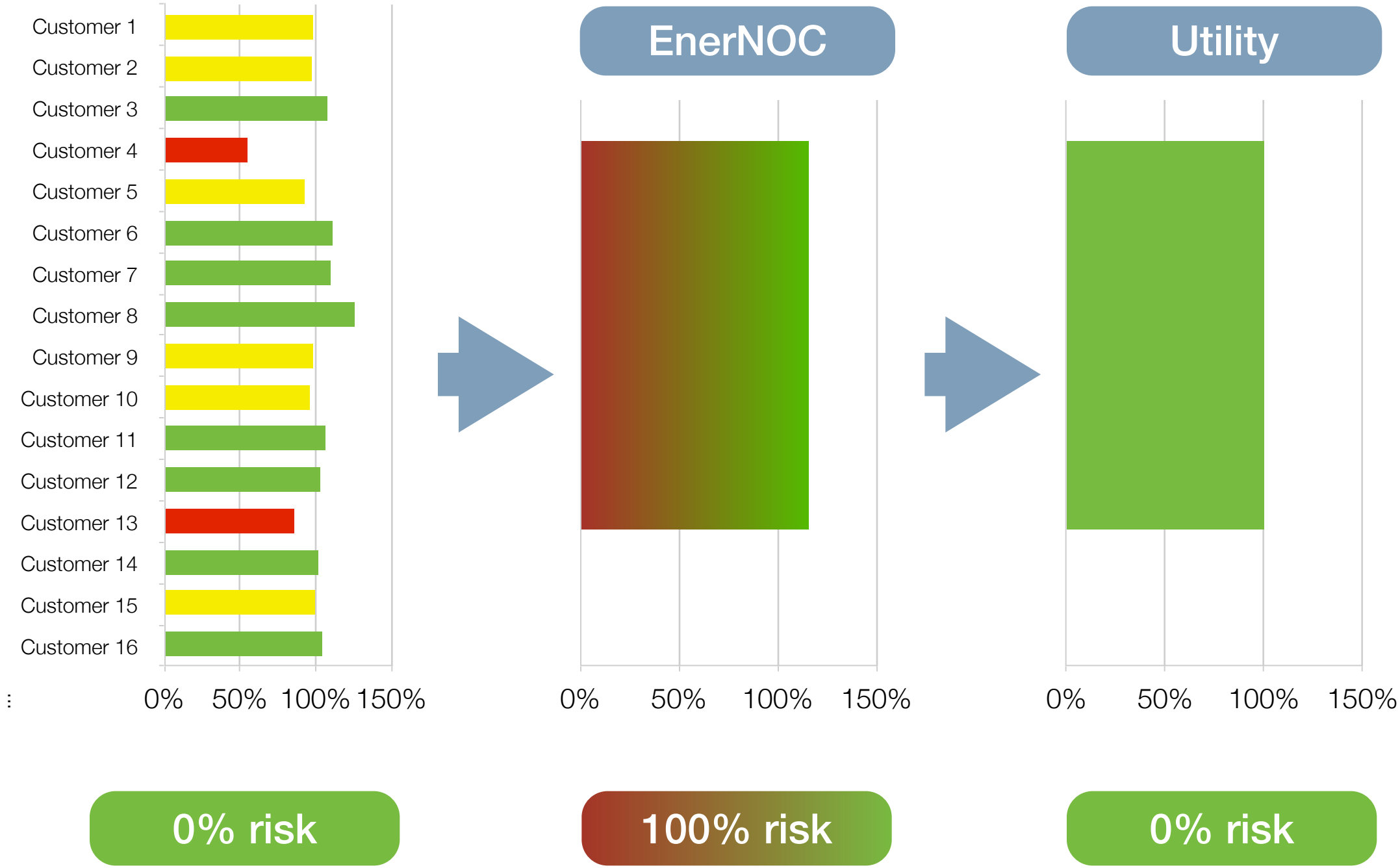
- Real-time pricing
- Aggregated demand response

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

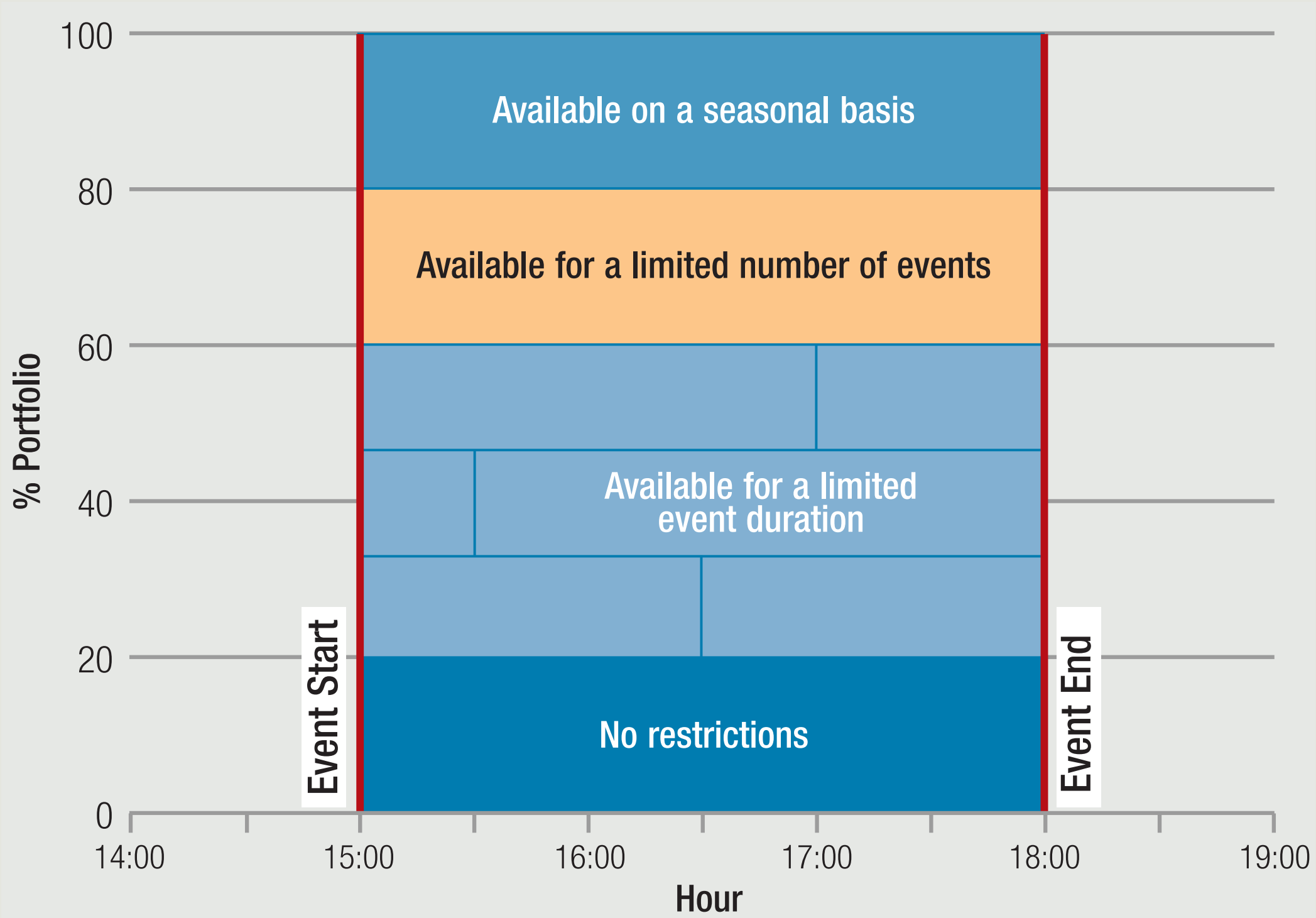
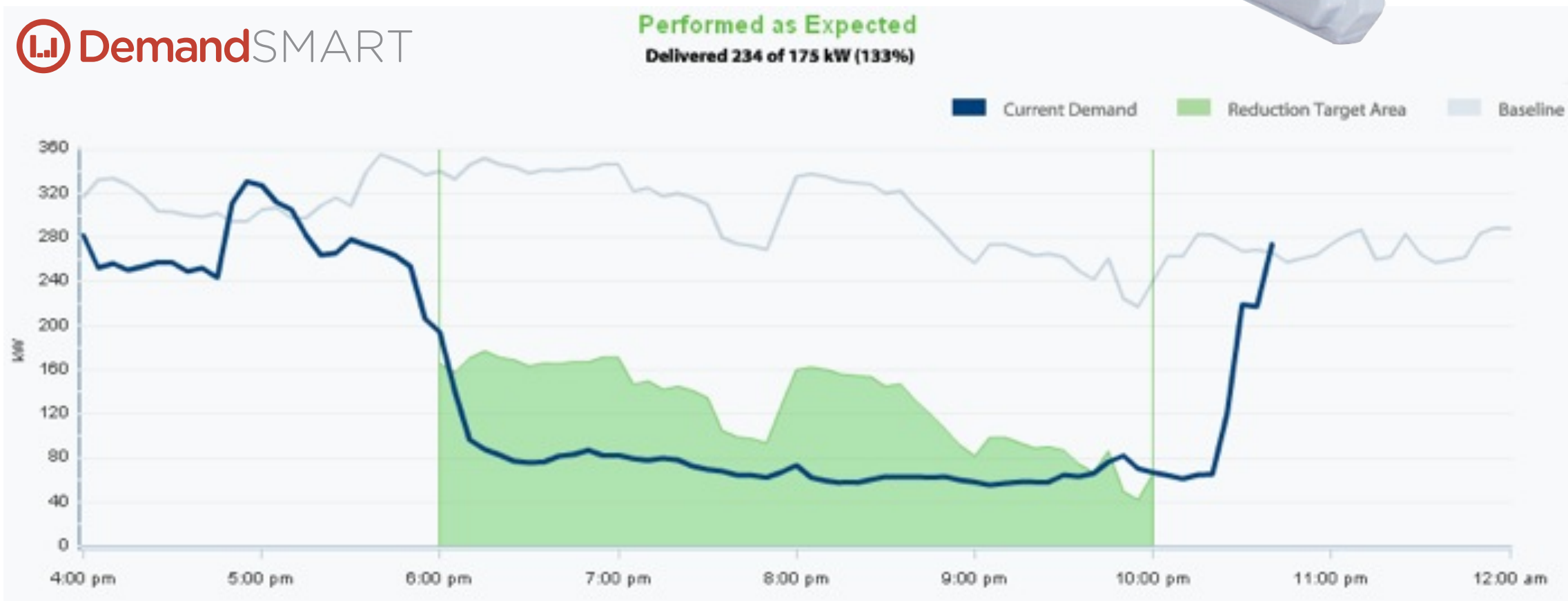


Diagram from Kristin Brief & Brad Davids, *C&I Customers Get Smart*, Public Utilities Fortnightly, January 2011.

Real-time visibility is vital

We install telemetry on every participating site, so customers can see how they're doing, and so can we

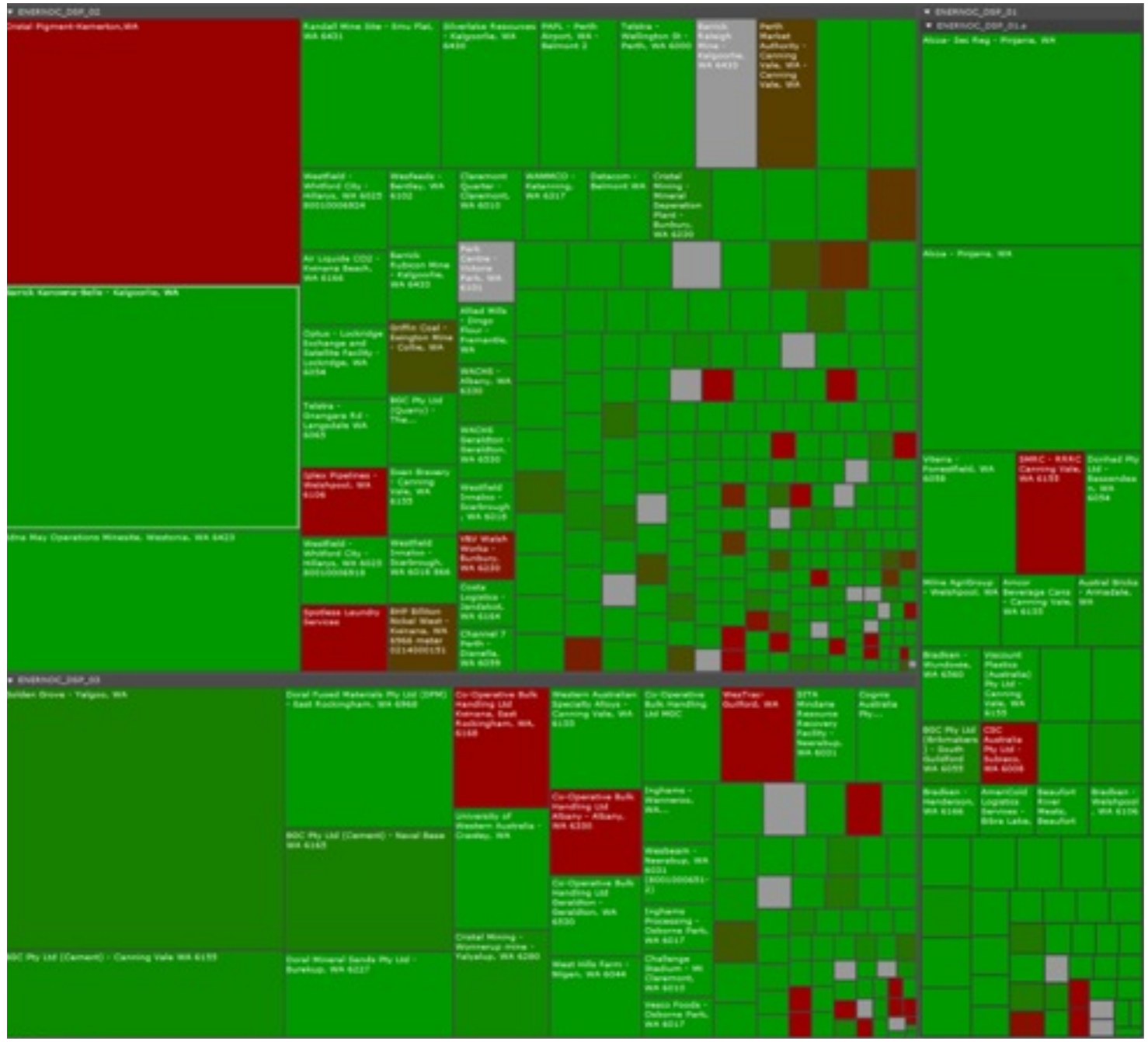


Network Operations Centre

Triage

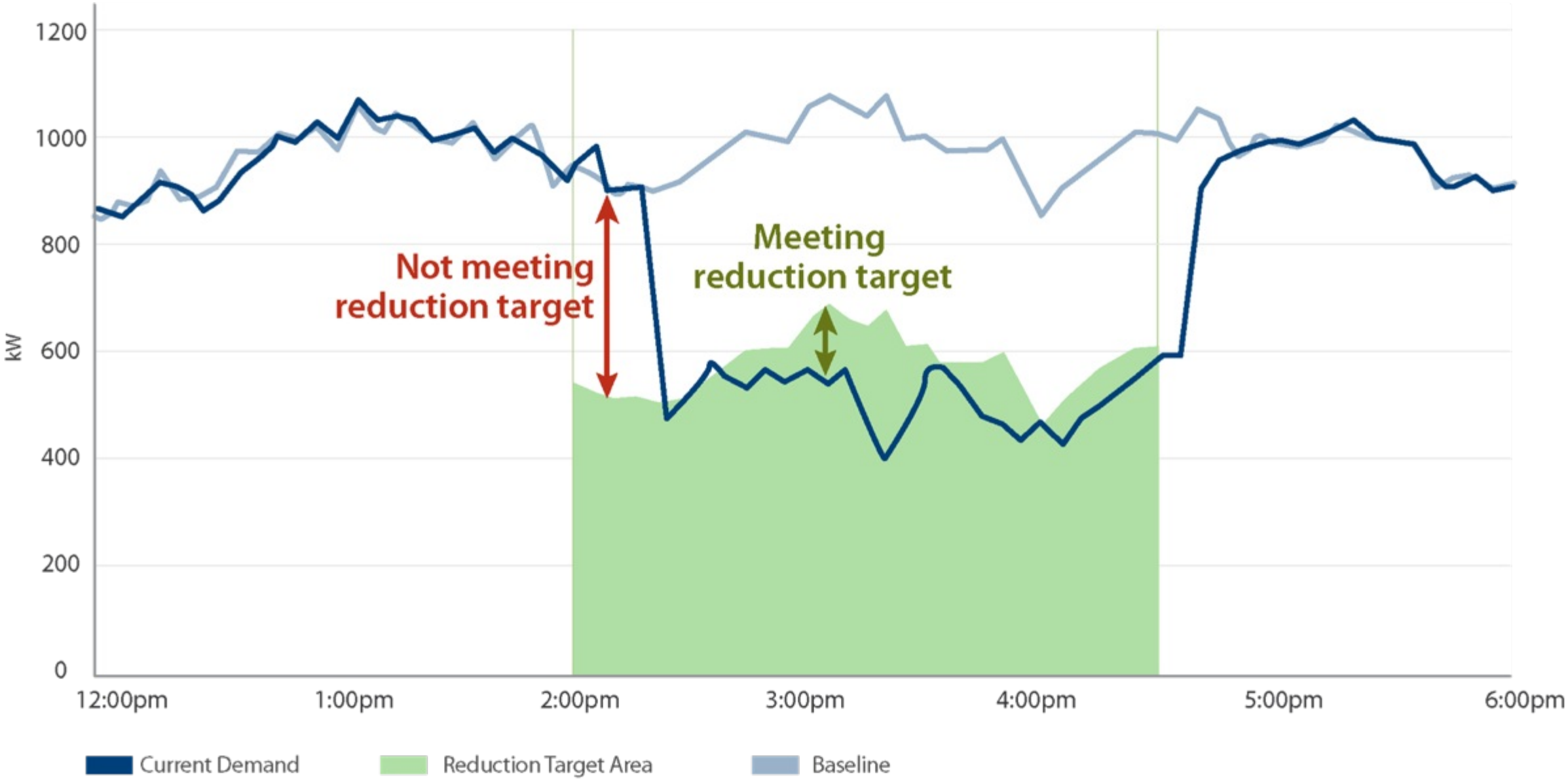
We have developed sophisticated tools to manage dispatches in real time

- 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

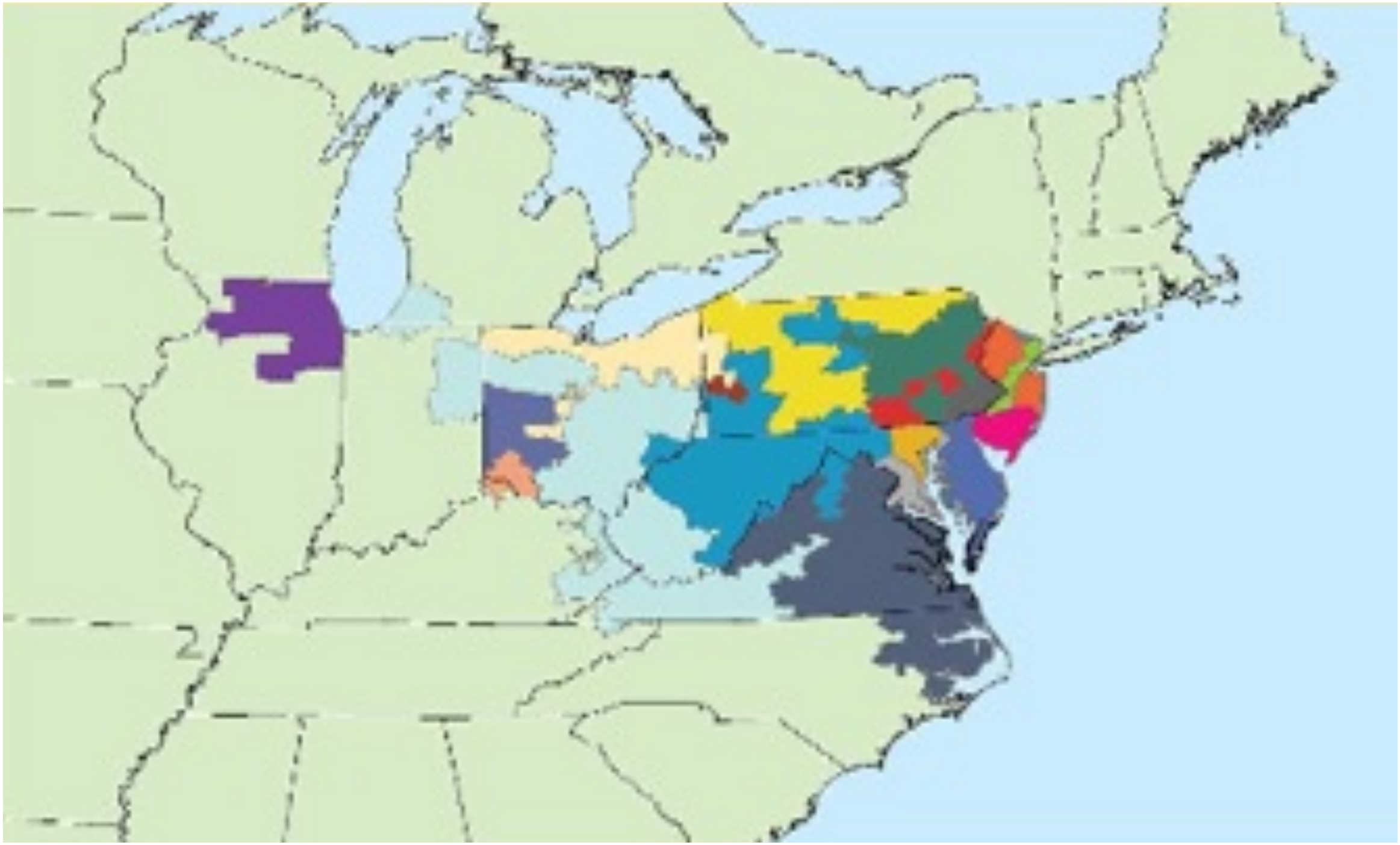
Typically 30% better performance on average, and much lower variability



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

pjm Monitoring Analytics

Based on actual auction clearing prices and quantities and make-whole MW, total RPM market revenues for the 2013/2014 delivery year were $6,708,567,045. If no DR or EE had been offered into the auction, total RPM market revenues for the 2013/2014 delivery year would have been $18,535,847,876, a difference of $11,827,280,831 compared to the total based on actual results. If all DR and EE offers had been reduced to one third of the actual offers, total RPM market revenues for the 2013/2014 delivery year would have been $12,806,812,679, a difference of $6,098,245,634 compared to the total based on actual results. If all DR and EE offers had been reduced to two thirds of the actual offers, total RPM market revenues for the 2013/2014 delivery year would have been $8,753,672,929, a difference of $2,045,105,884 compared to the total based on actual results.

Energy

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

PJM Market Monitor. Analysis of the 2013/2014 RPM Base Residual Auction Revised and Updated, September 2010.
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

pjm

955 Jefferson Avenue
Valley Forge Corporate Center
Norristown, PA 19403-2497

Steven R. Herling
Vice President - Planning

August 28, 2012

Transmission Expansion Advisory Committee

Re: PJM Board of Manager Decision on MAPP and PATH

On August 24, 2012 the PJM Board of Managers met to consider the PJM staff recommendation to remove the MAPP and PATH projects from the Regional Transmission Expansion Plan (RTEP). PJM staff reviewed results of analyses showing reliability drivers no longer exist for the project throughout the 15-year planning cycle. The analyses incorporated the continued trends of decreasing customer load growth, increasing participation in demand response programs and the recent commitment of new generating capacity in eastern PJM.

The PJM Board of Managers considered the communication received from stakeholders, and results of the reliability analyses completed by staff and decided to terminate the MAPP and PATH projects and remove them from the RTEP effective immediately.

Sincerely,

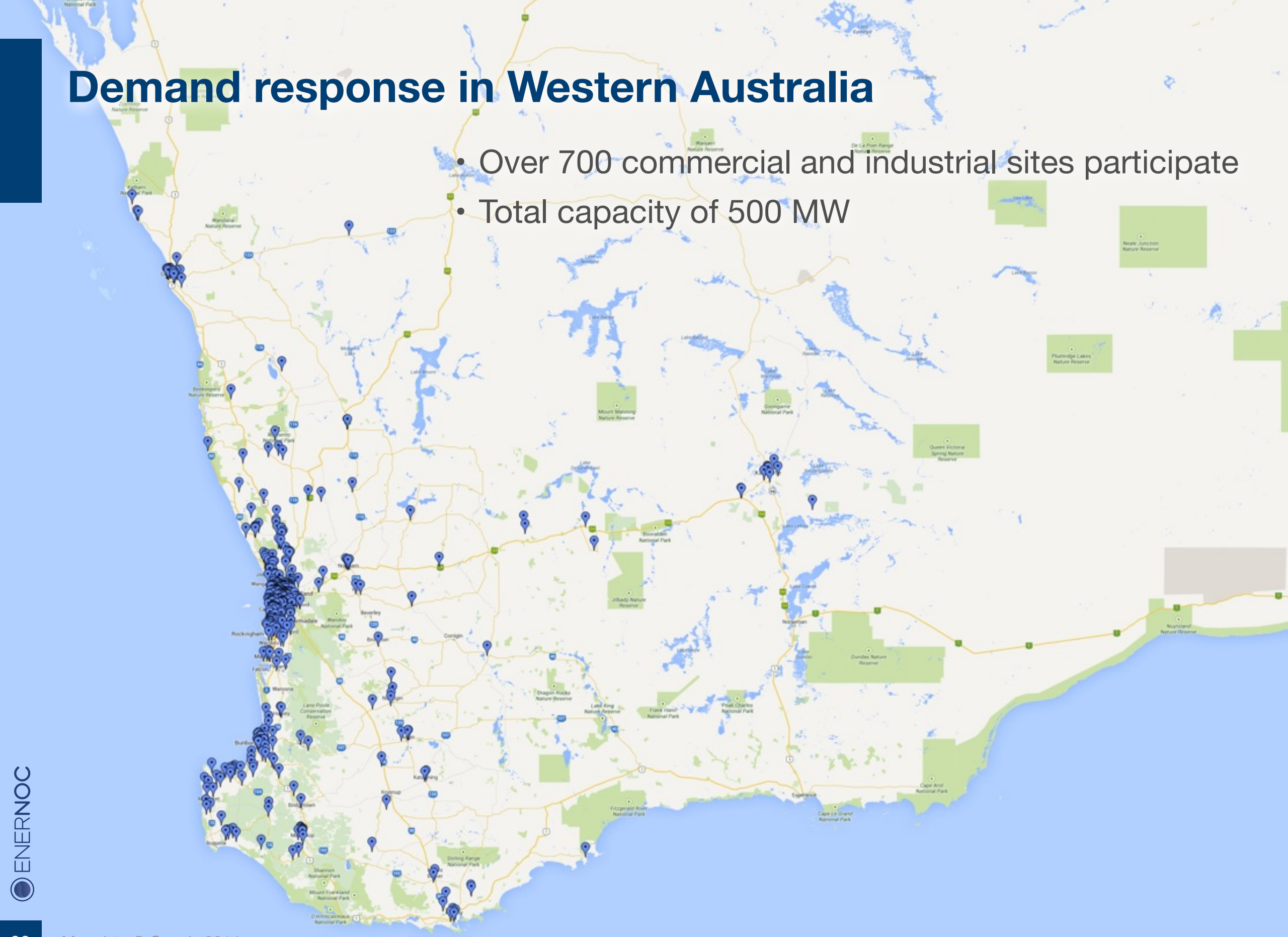
Steven R. Herling
Vice President, Planning

“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.

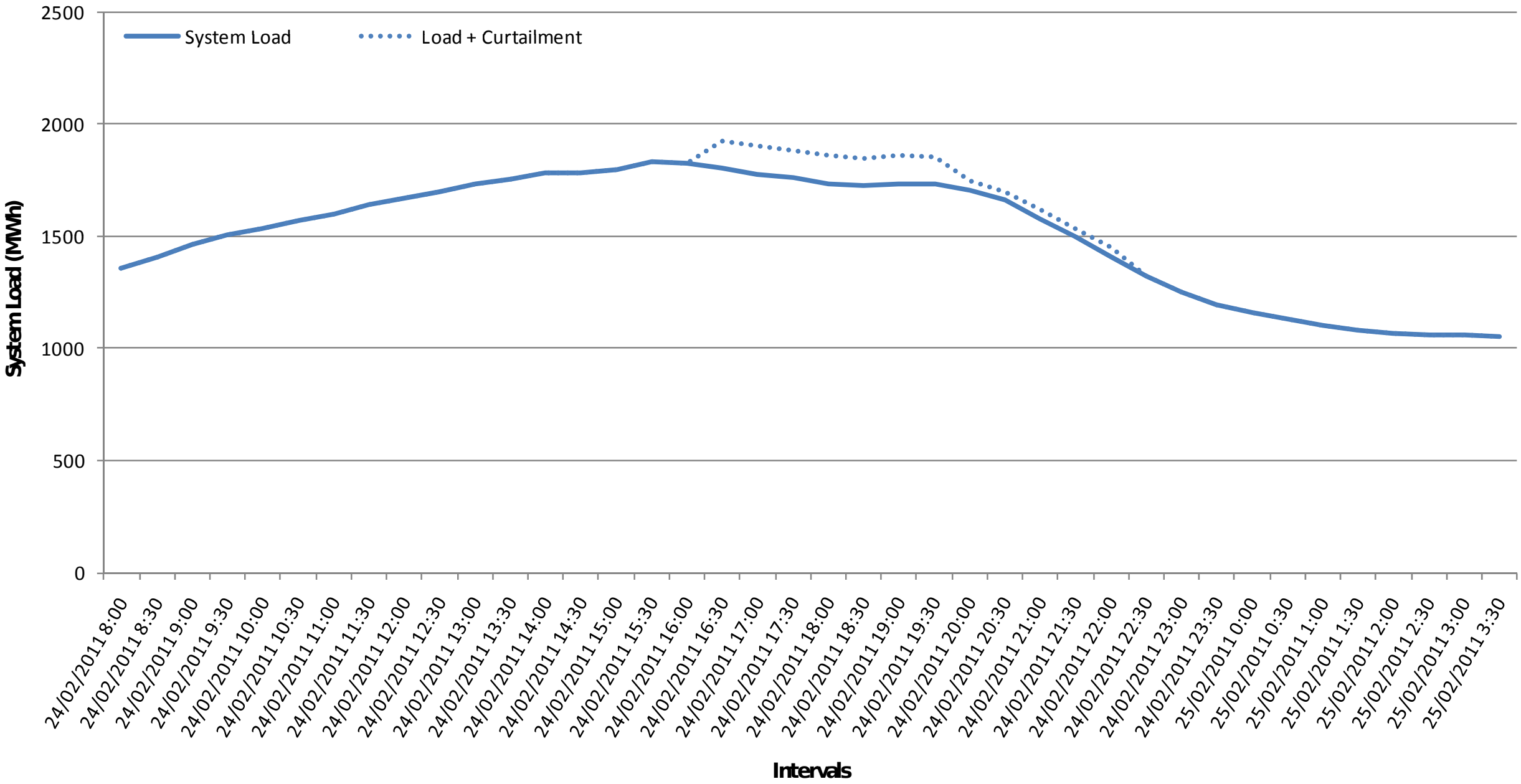
Demand response in Western Australia

- Over 700 commercial and industrial sites participate
- Total capacity of 500 MW



Dispatch during WA gas crisis

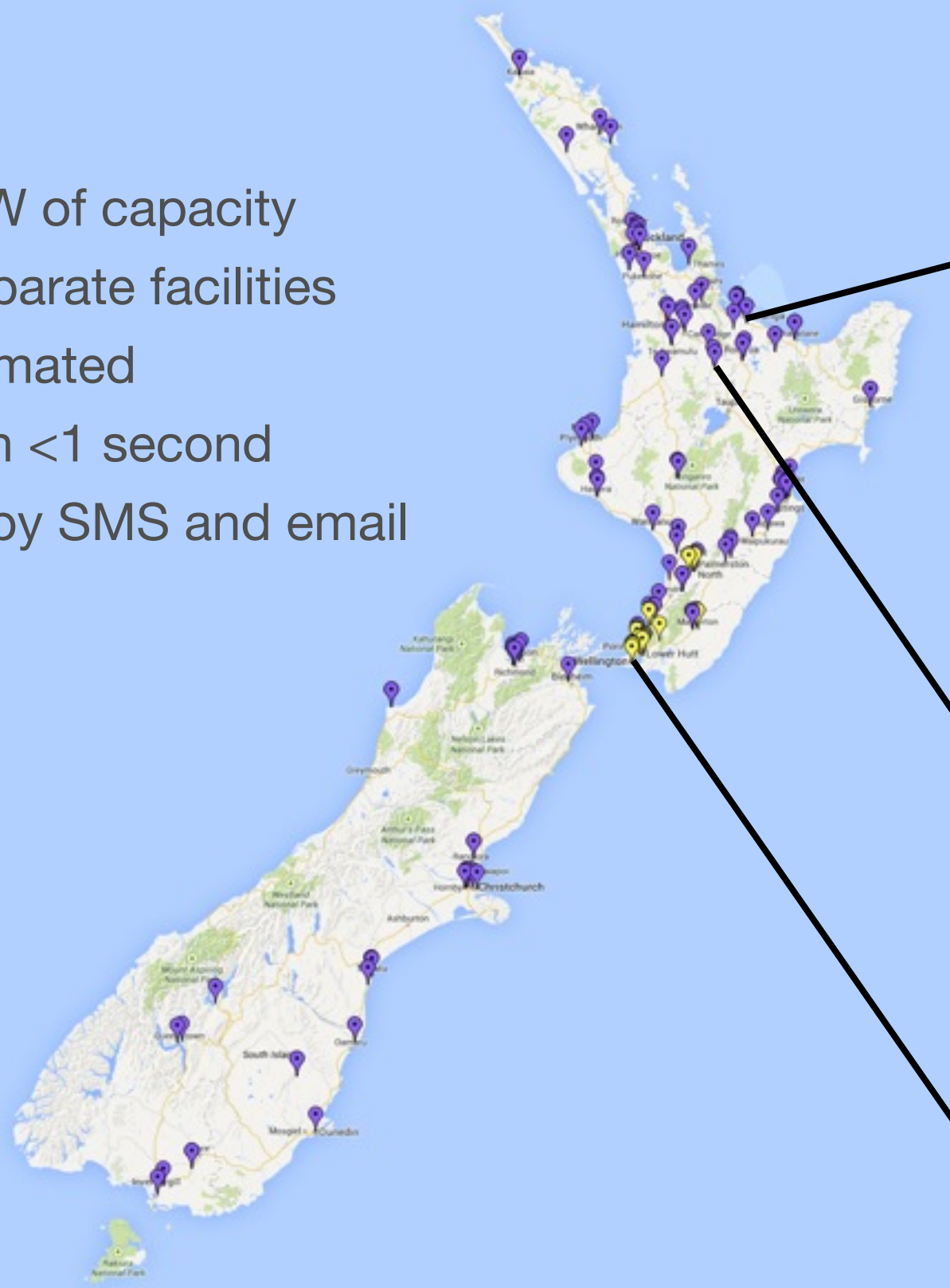
"Assessment of the aggregated performance of DSM facilities shows that the required curtailment was delivered successfully in all intervals of dispatch." — IMO



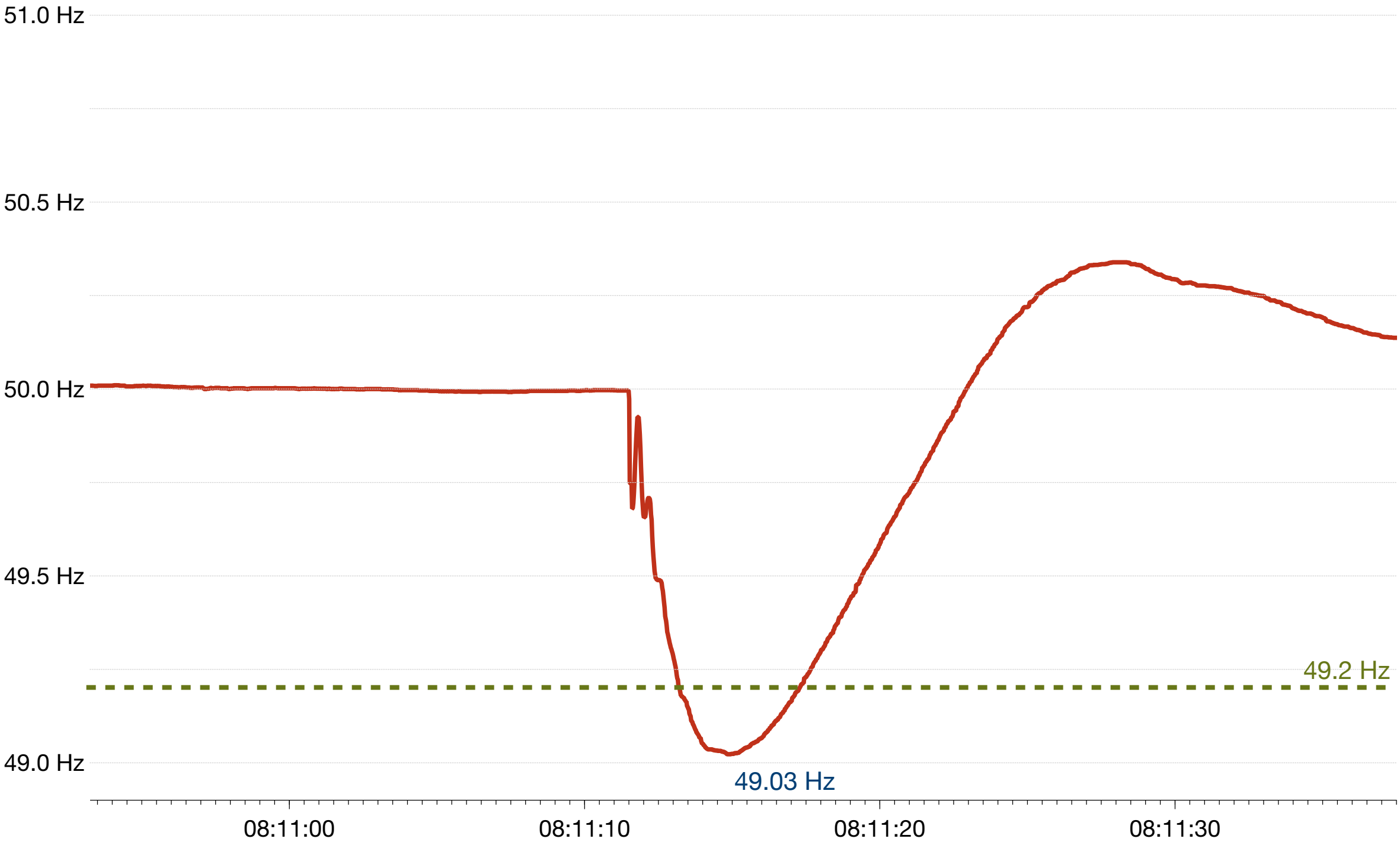
Sources: IMO 2011 Statement of Opportunities, p.14; Presentation by Allan Dawson, 7 April 2011 .

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

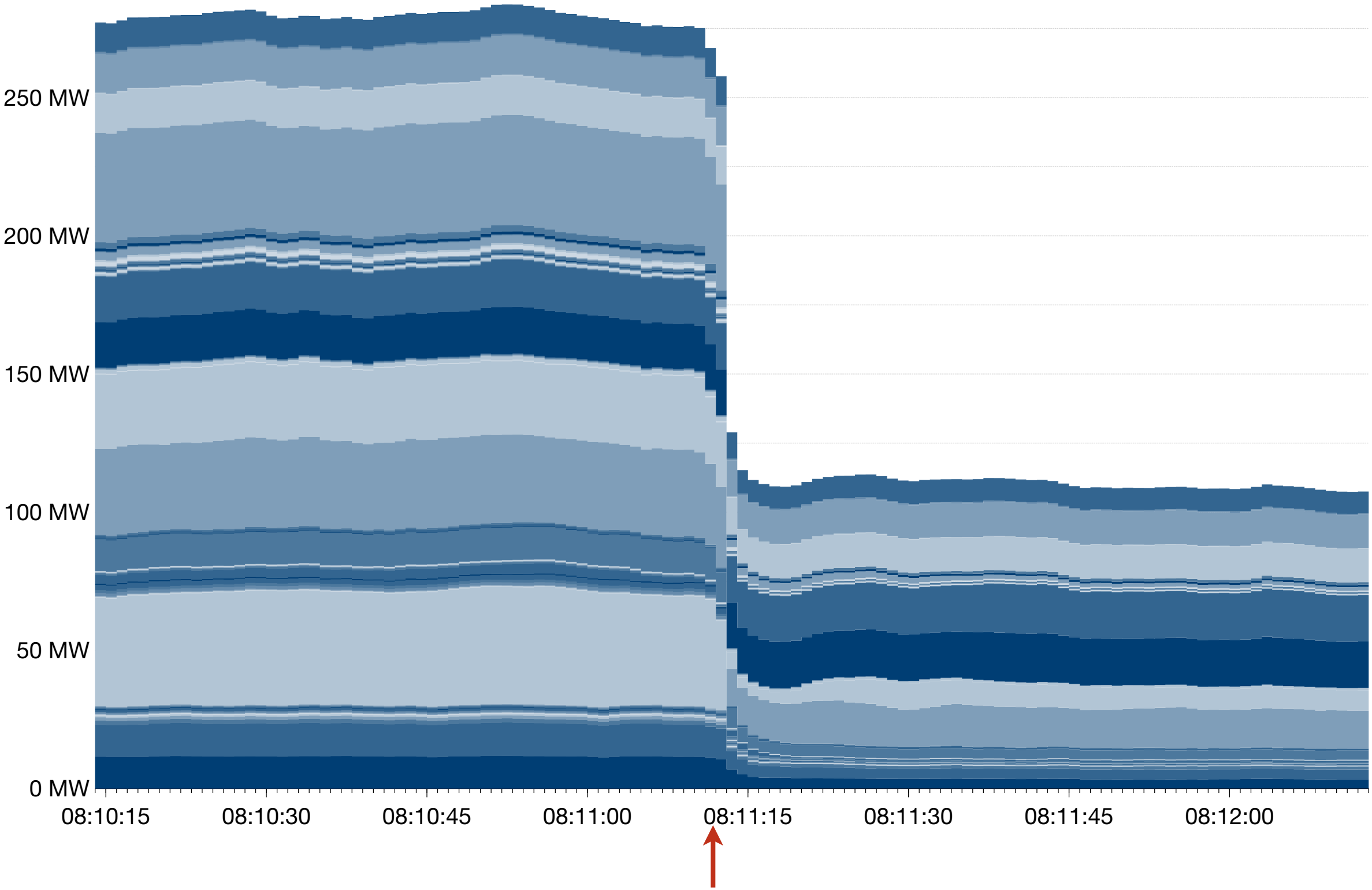


Under-frequency event in New Zealand



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.

Photo: Biglow Canyon Wind Farm, by portland general. CC BY-ND 2.0 licensed.

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

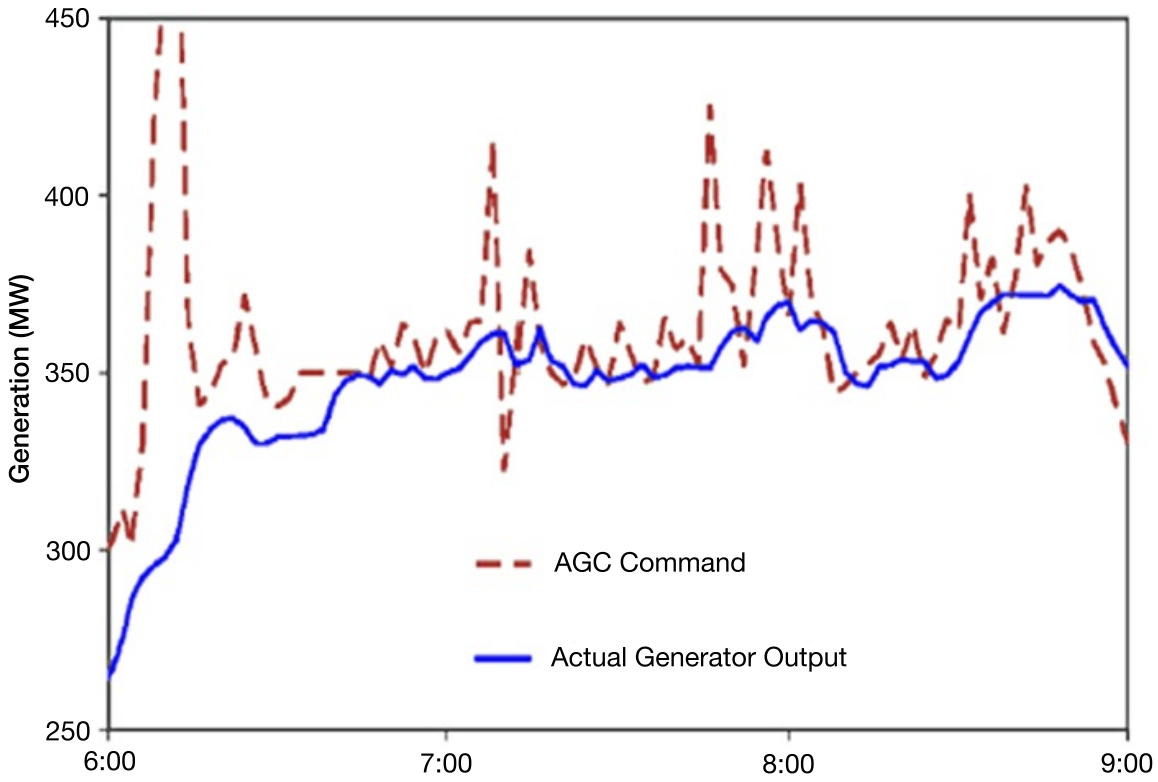
Solution: DR to **increase** load, as well as decreasing it

- Time-shifting heating/cooling/pumping loads
- Sub 10 minute response, fully automated

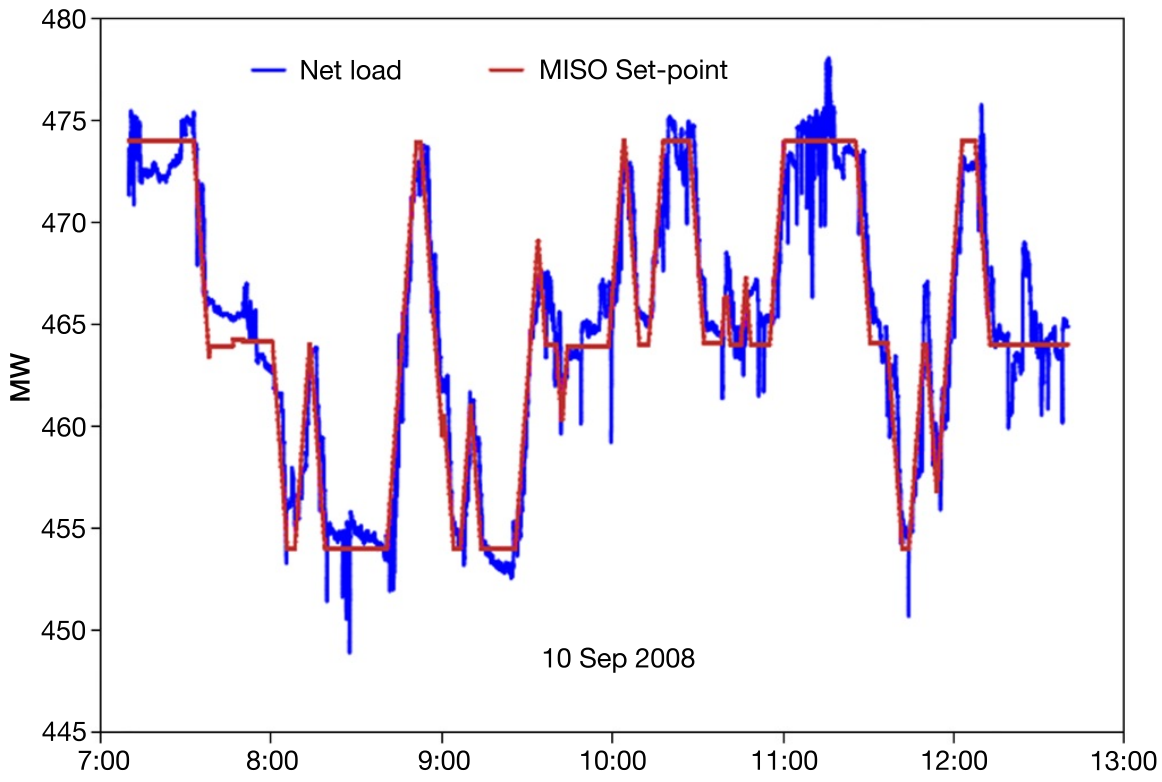
Demand response can do regulation, too

Load resources can respond more quickly and accurately than typical generators

Regulation by generator



Regulation by demand response



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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.

What can DR do?

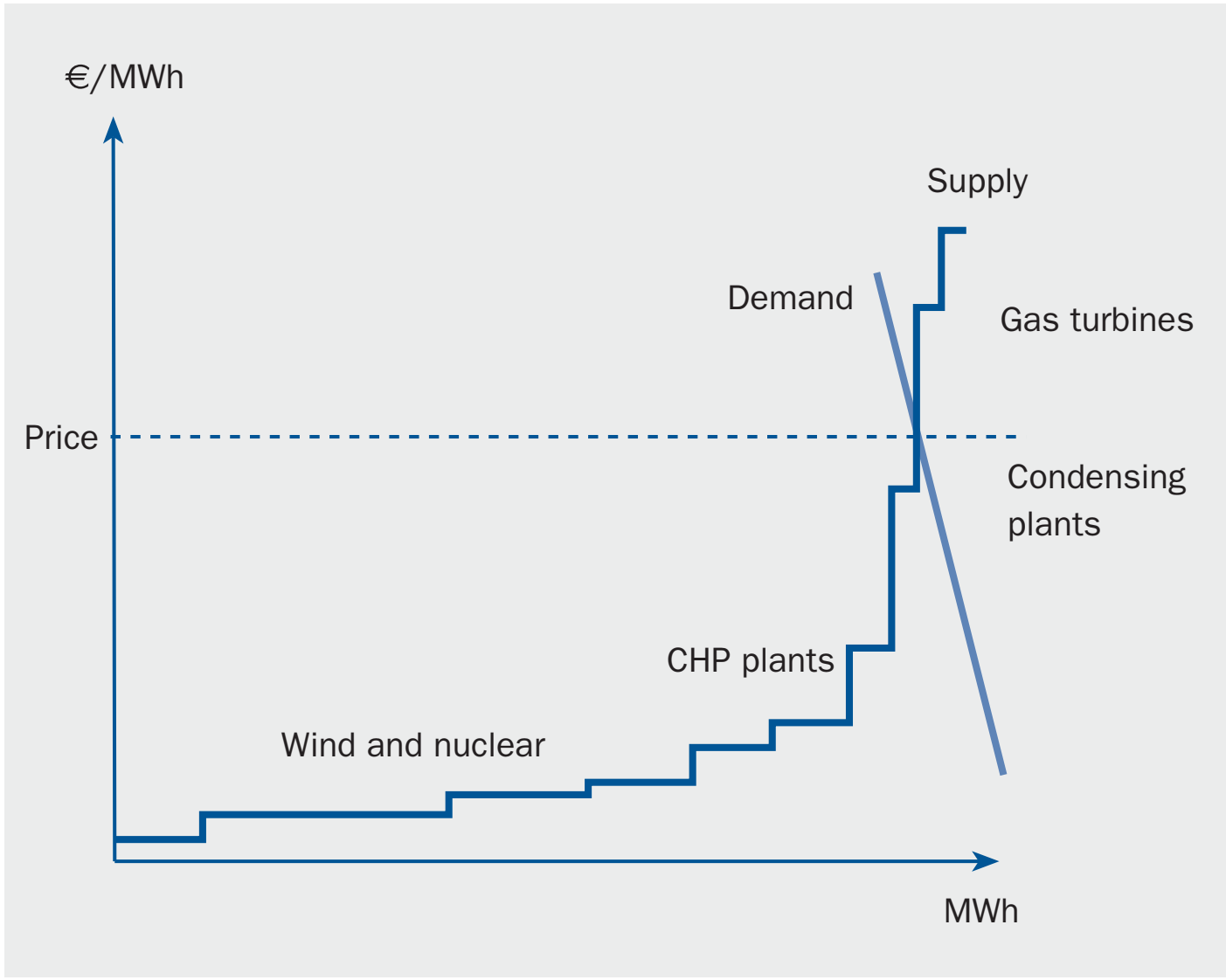
	Advantage
Wholesale capacity	Lower cost
Network capacity	Lower cost
Contingency ancillary services	Better Lower cost
Frequency regulation	Better

What makes participation attractive?

What makes participation attractive to customers?

In theory:

- The existence of appropriate price signals



Supply curve for NordPool, taken from EWEA, *The Economics of Wind Energy*, March 2009, figure 0.10

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

Demand Response Compensation in Organized Wholesale Markets, FERC Docket No. RM10-17-000.

Price signals should be actionable

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

	19:35	19:40	19:45	19:50	19:55	20:00	20:05	20:10	20:15	20:20	20:25	20:30	20:35	20:40	20:45	20:50	20:55	21:00	21:05	21:10	21:15	21:20	21:25	21:30
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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

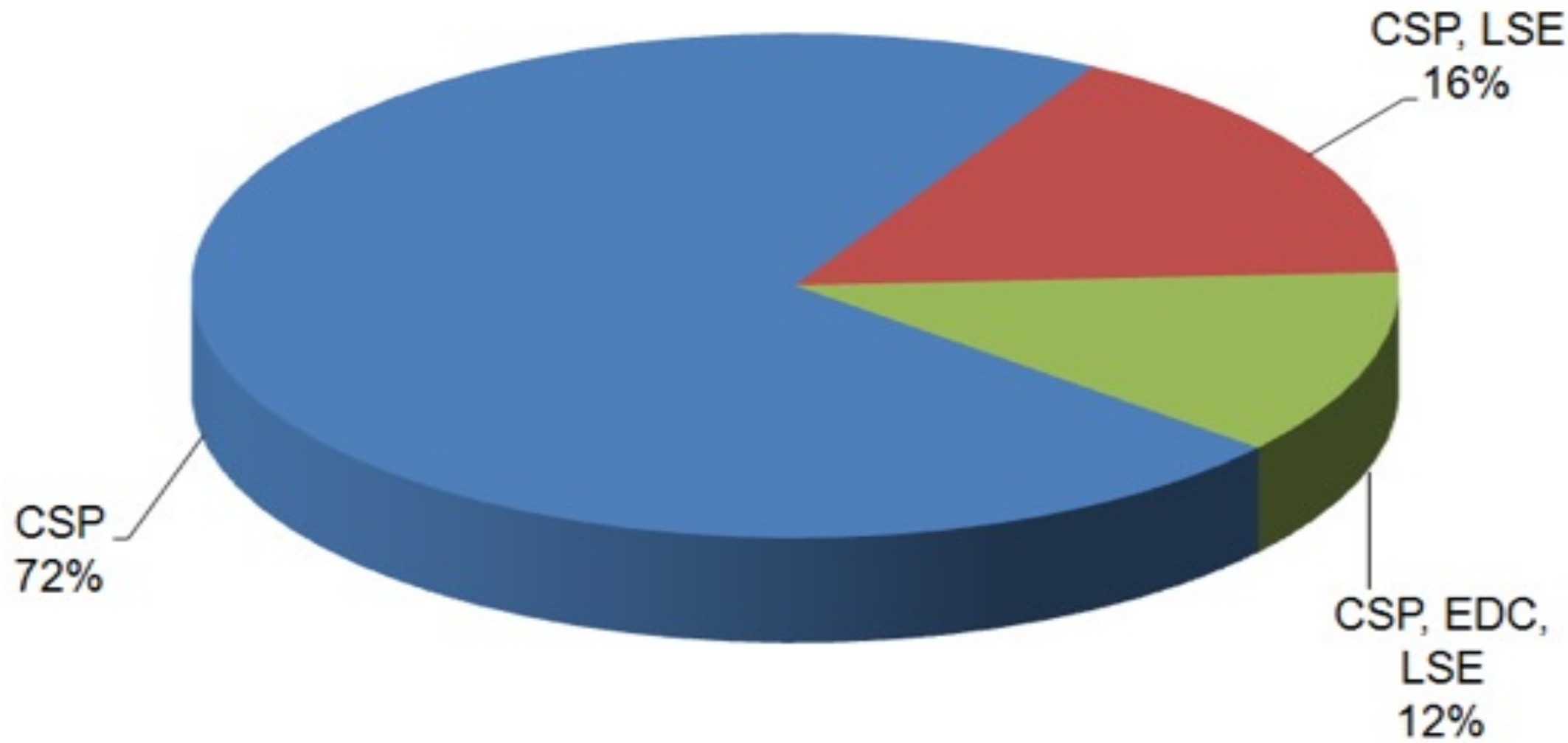
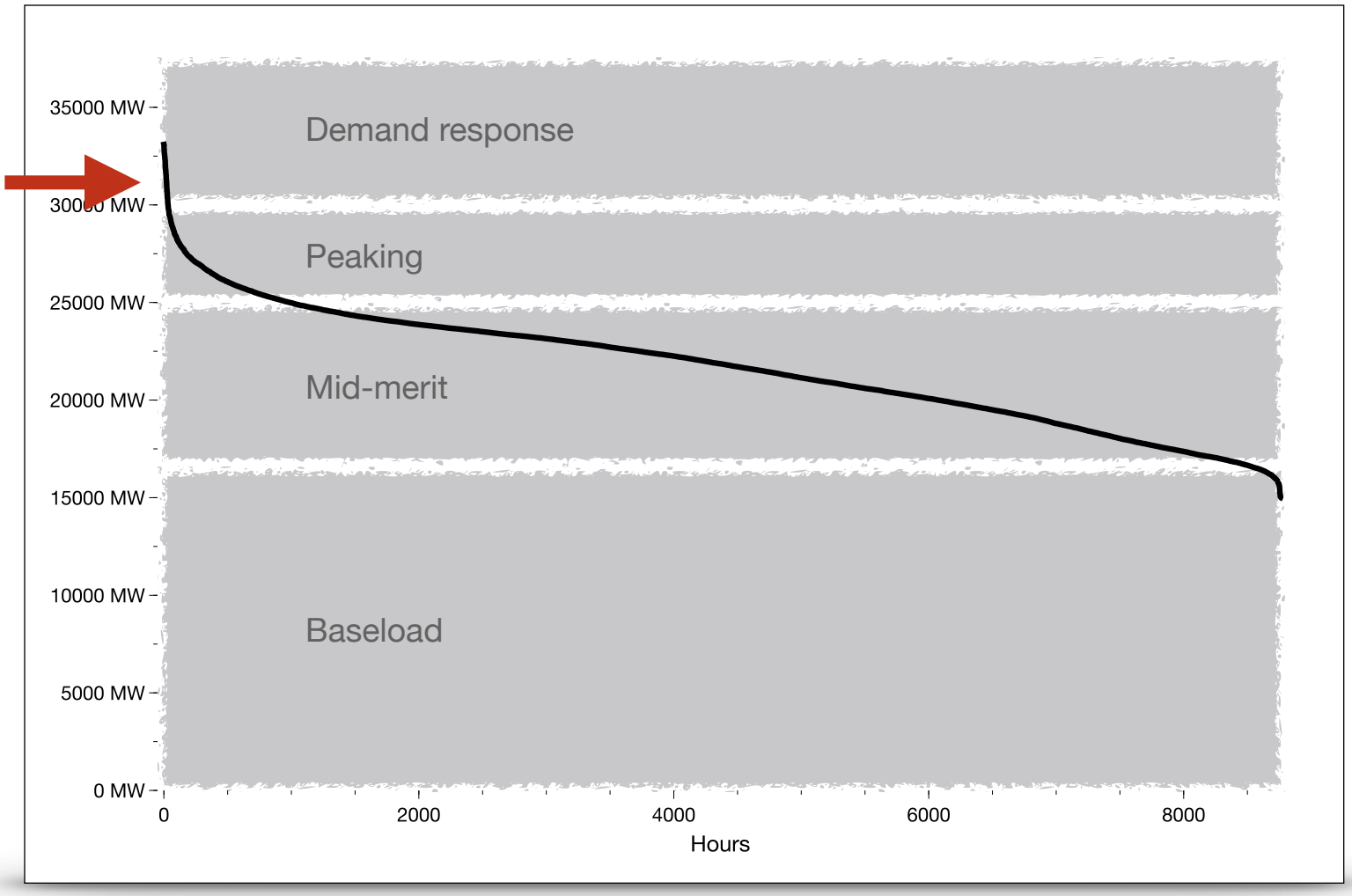
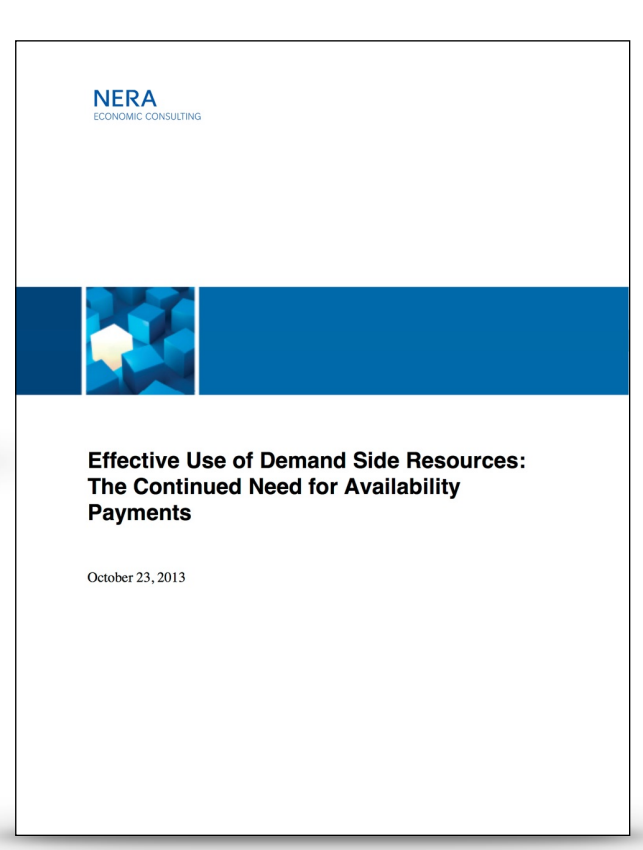


Figure 3 from *PJM Demand Response Operations Markets Activity Report: November 2013*, showing percent of total nominated capacity.

Availability payments

Essential to motivate customers to remain available for rare events





NERA
ECONOMIC CONSULTING

Effective Use of Demand Side Resources: The Continued Need for Availability Payments

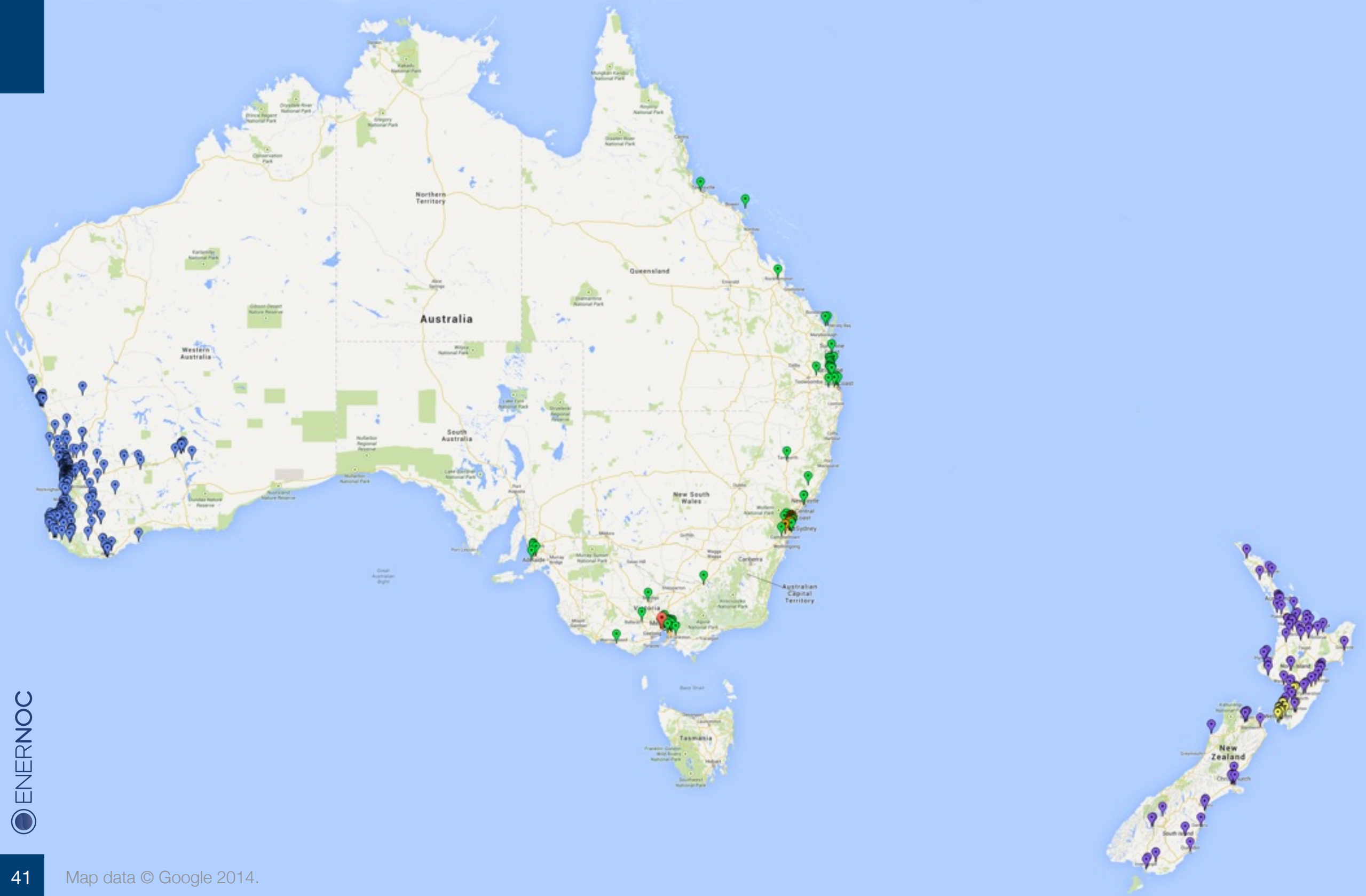
October 23, 2013

What about the NEM?

What can DR do in the NEM now?

	Advantage	Happening?	Problems
Wholesale	Lower cost	A small amount	Retailers and the brave only
Network	Lower cost	A tiny amount	Conflicting incentives
Contingency ancillary services	Better Lower cost	Vic smelter only	Retailers only
Frequency regulation	Better	No	Retailers only

Demand response in the NEM



The NEM is an outlier

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

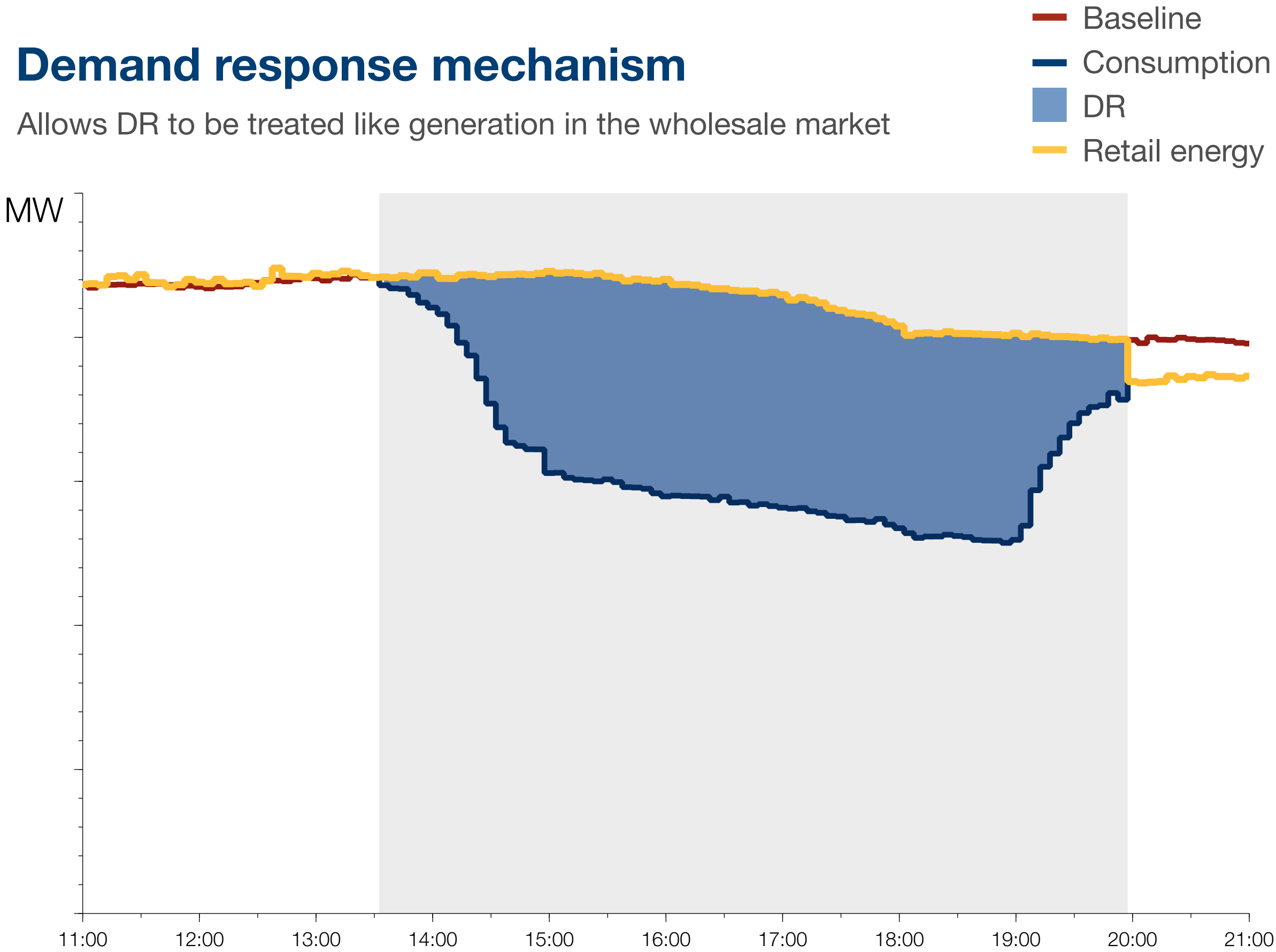
Market	DR capacity	% of capacity
PJM	14,118 MW	8.6%
WEM	499 MW	8.4%
ISO-NE	2,164 MW	7.4%
NYISO	2,248 MW	6.7%
NEM	**820 MW**	**1.6%**

PJM: 2014/15 Base Residual Auction results, Doc #645284, p. 9. 14,118.4 MW of DR cleared in the RPM; 2014/15 RPM Base Residual Auction parameters, Doc #631095, p. 2. Forecasted peak of 164,758 MW.
WEM: IMO, Summary of Capacity Credits for the 2011 Reserve Capacity Cycle (October 2013-2014).
NYISO: NYISO's Demand Response Programs. Donna Pratt, Manager Demand Response Products. May 2011; NYISO Press Release, 22 July 2011. Peak demand reached 33,454 MW on 21 July 2011.
ISO-NE: Forward Capacity Auction 5 (FCA5, 2014-15) Results Summary, 2011; ISO Installed Capacity Requirements, PAC Meeting, July 2011. Compares cleared FCA5 MW to the CELT 2011 Forecast 50/50 Peak of 29,380 MW for 2015 Capability Year.
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. ❌

Additional cost-benefit analysis first.

AEMO develop guidelines and procedures in parallel to rule change process.

The mechanism should commence no later than early 2015.

Now mid-2016?

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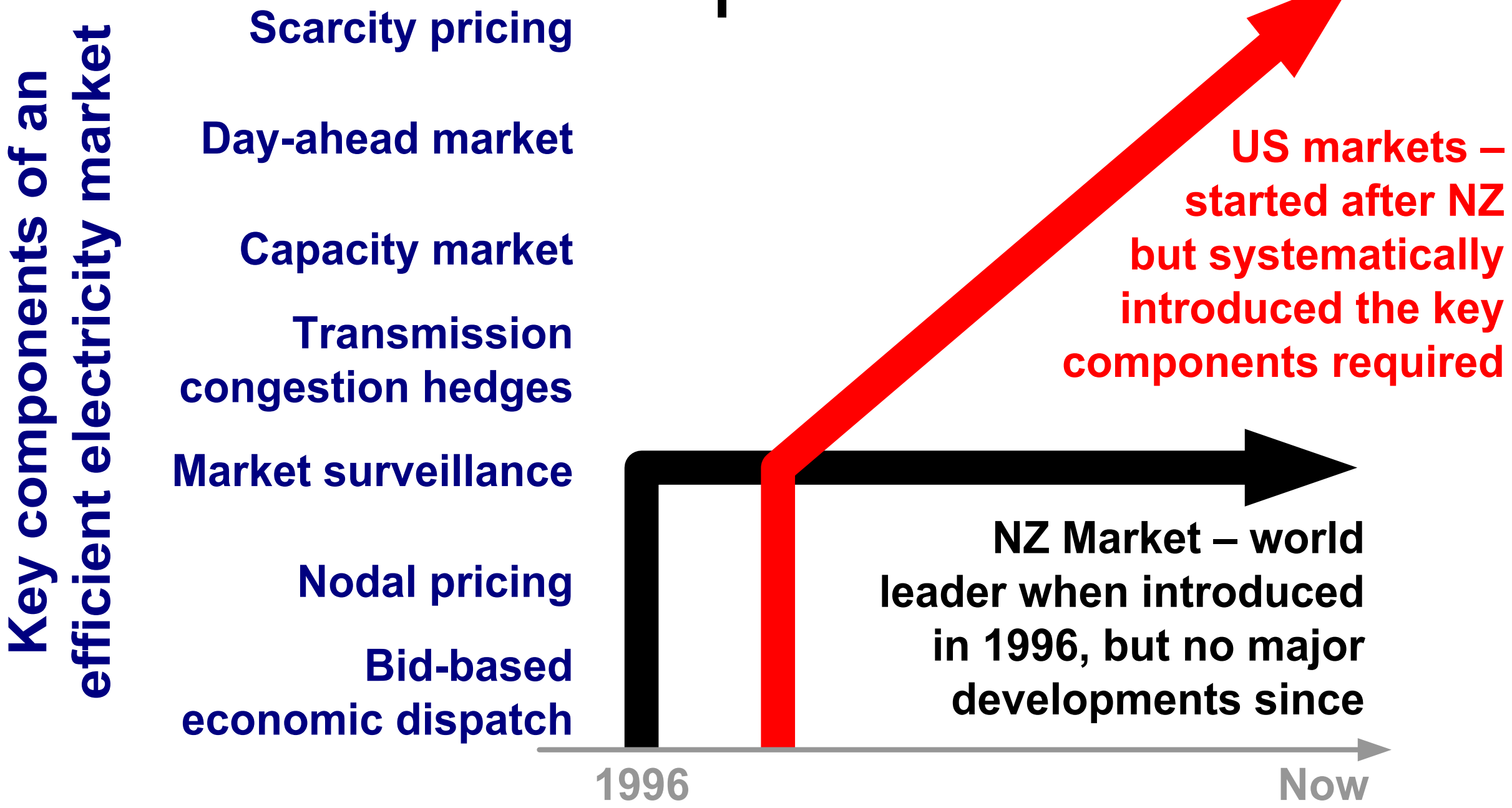
AEMC, *Power of Choice*, Final Report Implementation Plan, November 2012.

What will DR be able to do in the NEM?

	Change	Timeline
Wholesale	Power of Choice demand response mechanism	2016?
Network	AER Better Regulation reforms	Regulatory resets from 2015
Contingency ancillary services	Non-energy services market participant	2016?
Frequency regulation	Non-energy services market participant	2016?

NZ market design has not evolved
Catch-up overdue



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