

EXAMPLES OF DISPATCHABLE DEMAND RESPONSE CLEARING THE ISO-NEW ENGLAND AND PJM FORWARD CAPACITY MARKETS

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There is growing interest in electricity market reforms that can tap the potential of dispatchable demand response to balance an increasing percentage of renewables in the power system. In the two “forward” capacity markets in the US, dispatchable demand response has been growing impressively, along with other demand-side resources.² This paper provides examples of the types of businesses and demand response projects that have successfully participated in these markets.

Participation is primarily through an intermediary, called a curtailment service provider (CSP). The intermediary offers a megawatt (MW) amount of demand response into the capacity market and then assembles a portfolio of individual customers capable of providing demand response at the level of that offer. In addition, some large customers participate directly and offer demand response MWs into the capacity market.

The following is a sampling of the companies who currently participate in the forward capacity markets operating in six New England states (ISO New England) and a large portion of the mid-west and mid-atlantic states (PJM).³ All the information here is based on publicly available data and/or information obtained from direct communications with CSPs, and provided here with their permission.

PJM Examples:

Participation in the PJM demand -side portion of the capacity market has shown rapid growth in the years since 2007 and accounts for more than \$500 million per year in revenue to the participants in this program. The total revenues from demand response participation are a function of the prices in the PJM capacity market and revenue sharing agreements between customers and CSPs. As an example, a 1.0 MW demand response resource in the Eastern Mid-

¹ Research and examples compiled by Elizabeth Watson, RAP Energy and Environment Fellow and Joseph Bowring, Monitoring Analytics Inc.

² For additional information about forward capacity markets and how the demand-side participates, see The Role of Forward Capacity Markets in Increasing Demand-Side and Other Low-Carbon Resources: Experience and Prospects, The Regulatory Assistance Project (May 2010) available at: <http://www.raonline.org/document/download/id/91>.

³ *Ibid*, Figure 1.



Atlantic Area Council zone would be paid \$89,425 per year in the delivery year 2013/2014 at the clearing price of \$245 per MW-day. As another example, a 1.0 MW demand response resource in the same zone would have been paid \$40,150 per year in the delivery year 2011/2012 at the clearing price of \$110 per MW-day.⁴

Examples of participants include:

1. WalMart Stores⁵ (Retail merchant with multiple sites)
 - Multiple stores in VA, WV, and OH
 - CSP is not public
 - Size: Typical store size between 0.1 and 0.3 MW
 - Method: Automatic energy management system responds to pre-programmed strategy. Advanced metering system used to shut down or lower store loads in order to comply with emergency events.
2. General Services Administration Buildings⁶ (Agency of the U.S. government)
 - Buildings located in Washington, D.C.
 - CSP is not public
 - Size: 5.916 MW
 - Method: Building management. Lowers lights in all buildings and use natural lights, turn off any unnecessary equipment, lower air conditioning use, pre-cooling of building (during off-peak), raised chilled water temperature, reduce outside air infiltration.
3. Kendal-Crossroads Communities (Two building retirement community)
 - Located in Philadelphia, PA
 - CSP: [Enerwise Global Technologies/ Comverge](#)
 - Size: 1.15 MW
 - Method: Two 1.5-megawatt generators with automatic paralleling switchgear. This behind the meter generation used to reduce load during emergencies when called on by PJM.

⁴ All payment information is provided in US dollars. For more information on PJM capacity markets and the role of demand side resources in those markets, see *2010 State of the Market Report for PJM*, Section 5, "Capacity Market" and detailed reports on each auction which can be found at: <http://www.monitoringanalytics.com/reports/Reports/>

⁵ Giberson, M. (September 18, 2009). *Walmart says ISO power markets offer best programs for supporting demand response*. <http://knowledgeproblem.com/2009/09/18/walmart-says-iso-power-markets-offer-best-programs-for-supporting-demand-response/>

⁶ Dawson, P. (July 12, 2011). *Federal Buildings Shedding Load*. [http://www.demandresponsesmartgrid.org/Resources/Documents/NTM%20Presentations/Pat%20Dawson%20\(GSA\)%20-%20NAP%20Tech.pdf](http://www.demandresponsesmartgrid.org/Resources/Documents/NTM%20Presentations/Pat%20Dawson%20(GSA)%20-%20NAP%20Tech.pdf)

- Payment: Since June 2005, KCC has received \$522,944 from participation in PJM's demand response programs (Real Time Energy Market, Capacity Market, and Synchronized Reserve Market).
4. Severstal Sparrows Point⁷ (Large steel plant)
 - Sparrows Point, MD
 - CSP is not public
 - Size: 230 MW peak load
 - Method: Curtail operations at plant, such as shutting down blast furnace, or use behind the meter generation.
 5. Praxair⁸ (Industrial gas manufacturer)
 - Located in VA, WV, and OH
 - CSP: not public
 - Size: not public
 - Method: Auto-DR controls to shut down equipment during emergency.
 6. [Bridesburg Foundry](#) (Heavy industrial)
 - Whitehall, PA
 - CSP: EnerNOC
 - Size: 0.9 MW
 - Method: Controls to shut down foundry, shifting production to earlier in the day to avoid production during on-peak period. Majority of furnaces are shut down during DR emergency.
 7. [Four Seasons Produce](#) (Warehouse for agricultural produce)
 - Size: 1.0 MW.
 - Ephrata, PA
 - CSP: EnerNOC
 - Program – PJM Emergency Load Response, PJM Synchronized Reserves Market
 - Method: Remote or in-person shut down of refrigeration systems for short periods. For longer periods, a behind the meter back-up generator is used.
 - Payment from EnerNOC: \$25,000 annually
 8. Defense Logistics Agency Energy⁹

⁷ Belbot, R. (January 26, 2010). *RPM: A Large Industrial View*.

<http://www.pjm.com/~media/committees-groups/stakeholder-meetings/lrci/20100126/20100126-panel-1-ron-belbot-severstal.ashx>

⁸ EPS. *EPS Demand Response Success Stories*. <http://www.epsway.com/products-solutions/demand-response/eps-demand-response-success-stories/>

⁹ Viridity Energy (April 19, 2011). *Press Release: Defense Logistics Agency Energy (DLA Energy) Selects Viridity Energy as Demand Response Provider*. <http://viridityenergy.com/press-release-defense-logistics-agency-energy-dla-energy-selects-viridity-energy-as-demand-response-provider/>

Viridity Energy (June 8, 2011). *US Army Base Fort George G. Meade Selects Viridity Energy for Demand Optimization*. <http://viridityenergy.com/us-army-base-fort-george-g-meade-selects-viridity-energy-for-demand-optimization/>

- Federal and military sites across US. (Fort Meade, in BGE zone is highlighted)
 - CSP: Viridity
 - Size: Combined capacity of 160 MW
 - Program: Demand response / load curtailment
 - Method: Building management systems, HVAC optimization, generator dispatch and leveraging ice storage
 - DR payments: \$2.4 million in credits generated
9. [Northwest Hospital](#)
- Northwest Baltimore, MD
 - Size: 2.2 MW of generation and 600 kW load shed
 - CSP: Comverge
 - Method: curtailment and backup generation. Two 1.5 MW diesel-run emergency generators were retrofitted with natural gas. The retrofit process also added two 750-ton chillers, two primary chilled water pumps, two secondary chilled water pumps, two condenser pumps, two cooling towers, and one fan coil pump to the load of the generators.
10. [Sinai Hospital](#)
- Baltimore County, MD
 - Size: 2.2 MW
 - CSP: Comverge
 - Method: curtailment and backup generation. Four existing diesel-run emergency generators were retrofit to a bi-fuel configuration incorporating natural gas
 - Payment: Through May 2009, Sinai has realized a cash flow of \$510,000 through the program
11. [U.S. Department of Agriculture](#)
- Washington, DC
 - CSP: EnergyConnect
 - Size: 1 MW
 - Method: curtailment
 - Payment: \$300,000 over two years of participation in PJM's capacity and other markets
12. [Bryn Mawr College](#)
- Campus of over 50 buildings spread over 120 acres in PA
 - Size: 1 MW
 - CSP: EnergyConnect
 - Method: curtailment. Building automation systems randomly turn off fans in many buildings, causing chillers to back off and pumps to ramp down. As building temperatures rise, fans and AC units are reactivated to maintain a 77°F maximum.
 - Payment: \$300,000 over three years of participation in PJM markets

13. [Seabrook Brothers](#) (Agriculture)
 - Seabrook, NJ
 - Size: 3 MW
 - CSP: EnergyConnect
 - Method: curtailment. Seabrook curbs or shifts vegetable processing activity on production lines; and reduces use of the Individually Quick Frozen freezer.
 - Payment: Seabrook earns \$210,000 annually in PJM markets, 7% of its annual electricity bill
14. [Delaware Valley College](#)
 - Bucks County, PA
 - Size: 400 kW
 - CSP: EnergyConnect
 - Method: curtailment. Delaware Valley uses automated temperature controls and sends out campus-wide emails requesting that students and faculty turn off all unneeded equipment such as lighting, copying machines, and coffee pots.
 - Payment: \$25,000 in first few months of participation in PJM markets plus cost savings of over \$250,000

Examples in ISO New England:

In ISO-NE's fifth Forward Capacity Auction (for the 2014/2015 commitment period), 1,384 MW of active real-time demand response resources cleared the auction, accounting for \$47 million per year in revenue to these participants.¹⁰ Real-time demand response resources filled 4% of the auction's net installed capacity requirement of 33,200 MW.¹¹

CSP—EnerNOC:

1. [Berkshire Health Systems](#) (Health Care)
 - Includes three interrelated facilities located in Berkshire County, MA
 - Size: approximately 1.3 MW during peak periods
 - Method: curtailment and backup generation. BHS reduces energy use via a mix of energy reductions (lighting reductions, HVAC adjustments, shut-down of selected elevators) and short-term backup generation. BHS retains control over its generators and chooses which combination to start up.

¹⁰ ISO-NE. *Forward Capacity Auction 2014-2015 Results*. http://www.iso-ne.com/markets/othrmkts_data/fcm/cal_results/ccp15/fca15/fca_5_results_report.pdf

¹¹ ISO-NE. *Forward Capacity Auction 2014-2015*. http://www.iso-ne.com/markets/othrmkts_data/fcm/cal_results/ccp15/fca15/index.html

- Payment from EnerNOC: approximately \$25,000 annually
2. [Cabot Creamery](#) (Agriculture/Food Manufacturing)
 - Facilities including 50,000 sq ft manufacturing facility and 95,000 sq ft cut-and-wrap facility for processing and packaging in Cabot, VT
 - Size: 1 MW
 - Method: curtailment. Cabot shuts down large refrigeration and ice-making machinery within its manufacturing facilities.
 - Payment from EnerNOC: \$20,000 annually
 3. [Durgin and Crowell Lumber](#) (Manufacturing of lumber and wood products)
 - New London, NH
 - Size: 2 MW
 - Method: curtailment. Durgin and Crowell shut down major equipment including the sawmill, planer, and kilns.
 - Receive a 30-minute advanced notice of DR even which can last up to eight hours.
 - Payment from EnerNOC: \$40,000 annually
 4. [Gunstock Mountain Resort](#) (Resort/Recreation)
 - Gilford, NH
 - Size: 3 MW
 - Method: curtailment. Gunstock shuts down snowmaking operations.
 - 30 minute response time
 - Payment from EnerNOC: \$16,500 annually
 5. [Harpoon Brewery](#) (Brewing)
 - Boston, MA and Windsor, VT
 - Size: 350 kW
 - Method: curtailment. Harpoon reschedules bottling processes, modifies settings on their chillers, and makes lighting and HVAC adjustments.
 - Payment from EnerNOC: \$8,000 annually
 6. [High Liner Foods](#) (Food Processing)
 - 100,000 sq ft processing facility in Danvers, MA; 130,000 sq ft cold storage and distribution center in Peabody, MA; 180,000 sq ft processing facility in Portsmouth, NH
 - Size: 1.6 MW at processing plant and 450 kW at cold storage facility
 - Method: curtailment. High Liner temporarily shuts down processing equipment like blast freezers and makes lighting and HVAC adjustments.
 - Receives notification 30 minutes before dispatch.
 - Payment from EnerNOC: \$45,000 annually
 7. [Millipore](#) (Life Sciences/Biomanufacturing)

- Nine mixed-use facilities in Eastern MA. Facilities include offices buildings as well as research and development facilities.
 - Size: 1.3 MW
 - Method: curtailment and backup generation. Millipore reduces lighting, adjusts HVAC settings, and activates backup generation.
 - Payment from EnerNOC: \$25,000 annually
8. [Red Blazer Restaurant](#) (Food Service)
- Concord, NH
 - Size: 1 kW
 - Method: back up generation. Red Blazer starts its 100 kW backup generator, run solely on waste vegetable oil.
 - Payment from EnerNOC: \$3,000 annually
9. [Seaport Hotel](#) (Hospitality)
- 330,000 sq ft mixed-used facility in Boston, MA
 - Size: 300 kW
 - Method: curtailment. The hotel adjusts its air conditioning, reduced its laundry activities, and shuts off or reduces non-essential lighting. All changes are controlled centrally via the building management system.
 - Payment from EnerNOC: \$7,500 annually

As indicated from the above examples, a wide range of customers providing dispatchable demand response have successfully participated in these US capacity markets. Experience in these markets also indicates that good measurement and verification is critical from the inception of these programs. For additional case studies of dispatchable demand response programs, please see:

EnerNOC: <http://www.enernoc.com/resources/>

EnergyConnect: <http://www.energyconnectinc.com/services/case-studies/>

Comverge: <http://www.comverge.com/resources>