

Demand Response in PJM

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PJM, the regional transmission organization (RTO) for the Mid-Atlantic region and Chicago, has been a world leader on demand response (DR). Demand response has been an integral part of their forward capacity markets since 2007, with greater activity than any other region.

Demand response is a set of measures that reduce load or increase demand-side generation as needed. Some examples are turning up the temperature on the thermostat to reduce air conditioning load, slowing down or temporarily stopping production at an industrial facility, or running generation on the customer side of the meter, such as CHP facilities and “emergency” back up generators.

While DR was originally used only in emergencies, it is evolving to become a general system resource,

able to cut down peak prices, smooth grid operations, and reduce the risk of outages.

Demand response is executed by Curtailment Service Providers (CSPs), companies that aggregate the demand of willing customers, register that demand with PJM, submit the verification of demand reductions for payment by PJM, and receive the payment from PJM. CSPs then compensate their customers according to their contracts. CSPs can be both utilities and independent companies.

DR facts

The IT revolution has enabled grid operators to control demand in the same way they control supply, to balance the system.

Demand side resources now account for almost 10% of peak demand in PJM.

DR can be used to increase flexibility in a system with more wind and solar power.



The EnerNOC demand response operations center in Boston.

PJM procures two categories of demand response: emergency and economic.

Emergency demand response is when customers reduce demand in emergency situations, when called upon by PJM operators. Customers can commit in advance as part of the capacity market; their participation is then mandatory and they are paid through the capacity market. Or they can volunteer when an emergency is called, and be paid through the energy market.

Economic demand response allows customers to respond to prices to reduce demand in the real-time and day-ahead markets. Prices vary according to time and place, as determined by the locational marginal price (LMP).

Economic demand response can compete equally with generation in all of PJM's markets:

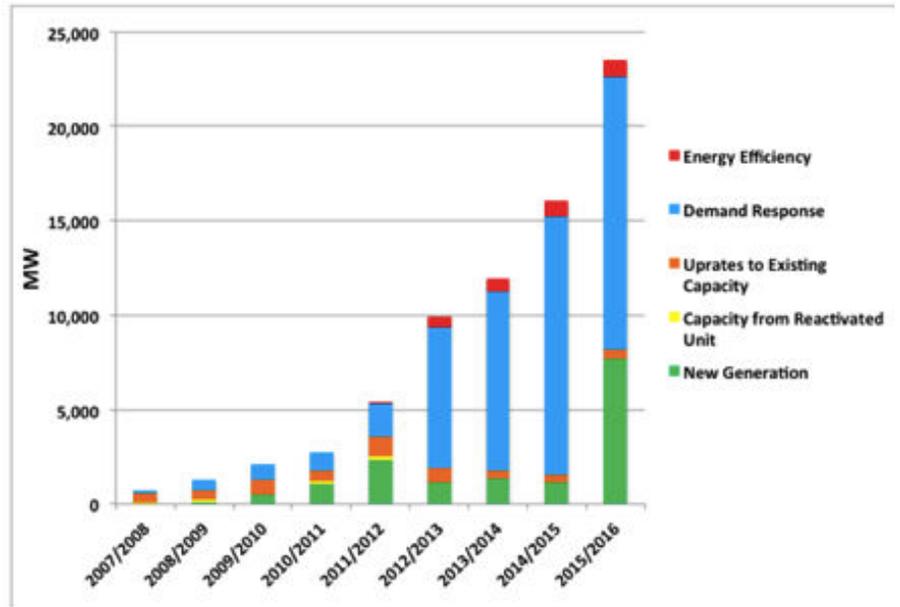
- **Energy:** sales of megawatt-hours of electricity, in both real-time and day-ahead time frames.
- **Capacity:** the ability to provide energy services in advance, as determined by the Reliability Pricing Model (RPM)
- **Synchronized Reserves:** the ability to reduce electricity consumption within 10 minutes of PJM dispatch
- **Day Ahead Scheduling Reserves:** the ability to reduce electricity consumption within 30 minutes of PJM dispatch
- **Regulation:** the ability to follow PJM's regulation and frequency response signal

The capacity market (RPM) has been a significant driver of demand response in PJM. The RPM is administered through auctions to buy new capacity three years ahead of time, for one year. Starting in 2007, PJM allowed efficiency and demand response to compete in the auctions with new power plants. DR currently (in the 2014-15 RPM year) accounts

for 9.4 percent of the total capacity that clears in the PJM auction. DR dominates the procurement of new resources in the capacity auction, as shown in the graph, with as much as 14,833 MW in a single year, equal to 50 average power plants.

PJM has a substantial amount of capacity now, with reserve margins of 25 percent.

New Capacity in PJM, 2007-2016



PJM continues to evolve their demand response offerings in the RPM. In 2011, PJM designated two [new types of DR products](#), Extended Summer DR and Annual DR. These joined the existing, but renamed, Limited DR. Limited DR refers to resources interrupted only during summer weekdays from noon to 8:00 pm. Extended Summer DR can be tapped from May through October during most hours of the day. Annual DR are products available throughout the year for a defined number of hours within a defined time window.

The next likely evolution of demand response will be greater application during winter peaks. The 2011 "polar vortex" winter storm caused significant disruptions of the power systems, with 22 percent of capacity not available during the January 7 peak. While some demand response was tapped, it was clear that DR still reflects its origin as a summer-peaking resource. PJM staff have proposed

creating a new “[capacity performance](#)” product to incentivize Annual DR resources that can be curtailed for 72 hours, or for 16 peak hours over three consecutive days.

Because DR has declined from its 2011 peak year (for 2014-15 deployment), some observers are concerned that it may be hitting its maximum potential. Navigant, for example, said recent PJM auction results show “it is clear that DR is [in a structural decline](#).”

Demand response is especially valuable because it displaces power at peak times, when electricity prices can be two or three times the average. PJM customers have [saved as much as \\$650 million](#) in a month due to demand response, including \$230 million on one day.

More recently, PJM expanded their demand-side offerings with a “price responsive demand” product (PRD). With PRD, customers see actual wholesale market prices for energy and capacity at the nodal level, rather than receiving side payments through the economic or emergency DR programs. In contrast, PJM’s economic DR program provides payments based on zonal prices and on declared reductions as measured against customer baseline consumption levels that have significant measurement issues. PRD is also faster responding than emergency DR, and the exact nodal location of the response is known to market participants.

However, according to the official [PJM Market Monitor](#), PRD participation is minimal, due to flaws in the rules. They recommend requiring that PRD customers use real-time prices (rather than time of use bins), at five-minute intervals, and that electric retailers (load serving entities, or LSE’s) pass through the full savings from the program to PRD customers.

A related problem is that very few retail customers are currently on real-time or time-of-use rates, especially residential or smaller customers. Widespread deployment of smart meters is making

participation by more customers possible, though dynamic pricing policies are lagging behind. Nest, with their “smart thermostat,” have a [pilot project](#) in Austin, Texas testing residential demand response. Their customers have reduced air conditioning demand by 50 percent on hot afternoons. The thermostat pre-cools the homes in the morning, then shuts it off in the afternoon, so customers don’t notice the temperature creeping back up late in the day, when power demand is peaking.

Demand response rules in PJM were [recently tightened](#) to make them more responsive. PJM complained that DR resources couldn’t be triggered unless they called an emergency and gave two hours notice. PJM changed the rules by creating a new category of “pre-emergency” DR resources. These DR entities (with few exceptions) must respond within 30 minutes, can have a minimum run time of one hour instead of two, and have revised price caps. In approving the changes FERC said they “will allow PJM to dispatch demand response resources in a cost-effective and efficient manner, resulting in just and reasonable market outcomes.”

A further issue with DR is a recent court decision that overturned the Federal Energy Regulatory Commission’s (FERC) Order 745 on Demand Response Compensation. [FERC Order 745](#), finalized in 2011, said that DR payments should be the same as those to generators in the wholesale energy markets. This was challenged by a number of generator and utility groups. In May, the court determined that DR in the energy markets is a retail product rather than a wholesale one, meaning that FERC had overstepped its jurisdiction to regulate only wholesale markets. FERC has appealed the ruling.

It is not clear how the ruling, if upheld, will affect demand response. It could mean that DR would have to be a retail market product, regulated by individual states, rather than a wholesale product managed by a regional market like PJM. This would require individual states to develop their own DR rules, which would be a time-consuming prospect though could lead to a broader and more refined use of DR.

The Power Markets Project studies and promotes market policies that align with clean energy goals. It is a project of PaulosAnalysis, with financial support from the Heinrich Böll Foundation, the Cynthia and George Mitchell Foundation, and the Rockefeller Brothers Fund. For more information on the project and on power market issues, see www.powermarkets.org.