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# Demand Response in Wholesale Markets

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# DELIVERING ENERGY LAW AND POLICY IN THE EU AND THE US

## A Reader

Edited by
Raphael J. Heffron and Gavin F. M. Little

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# DEMAND RESPONSE IN WHOLESALE MARKETS

Joel B. Eisen[1]

## INTRODUCTION

Demand response participation in wholesale markets is an important building block in a profound transformation of electricity systems in the United States and Europe. Technical and economic innovations, supported by governmental policies, are moving electricity systems toward smart grids[2] that integrate generation, transmission and distribution in a more networked, environmentally responsible and efficient manner, incorporating distributed energy resources and delivering benefits for utilities and consumers.[3] As one component of smart

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[2] J. B. Eisen, 'An open access distribution tariff: removing barriers to innovation on the smart grid', *UCLA Law Review* 61 (2014), 1712, 1714 (contemplating a 'multimodal grid featuring supply, demand, and network management taking place at multiple nodes on the network').

[3] The US Energy Independence and Security Act of 2007 established a national policy for grid modernisation and described the smart grid as a system capable of accomplishing over ten diverse objectives. 42 USC Sec. 17381. See J. B. Eisen, 'Smart regulation and federalism for the smart grid', *Harvard Environmental Law Review* 37 (2013), 1–56.

grids, consumers, utilities and regional grid operators may benefit from more use of demand response programmes that reduce peak power consumption and market price spikes, balance intermittency of renewables and achieve greater grid efficiency and reliability.

## DEMAND RESPONSE DEFINED

The US Federal Energy Regulatory Commission (FERC) defines demand response as: 'changes in electric use by demand-side resources from their normal consumption patterns in response to changes in the price of electricity, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized'.[4]

There are three broad categories of demand response programmes. Emergency/standby programmes, the most common, offer customers reduced rates or incentive payments if they agree to reduce their interruptible load. For decades, utilities have contracted with large industrial or commercial customers to allow curtailment when necessary to lower utilities' costs of managing peak demand. Participants typically have little control: once enrolled, they generally must reduce load when 'called'. A residential sector example is a programme in which customers agree to allow their utility to directly control air conditioners to reduce demand at peak hours.

Price response bidding programmes allow customers to bid demand reductions into wholesale markets, often through the use of intermediaries (see below). Unlike emergency programmes, these allow customers to choose when and how much energy use they are willing to curtail. Customers can respond to real-time or day-ahead price signals, depending on the market.

The third category is price-responsive demand. In these programmes, customers have variable retail electricity rates, and can reduce consumption when rates are high, or shift consumption to off-peak hours.

In general, customers may handle curtailments in a variety of ways, including shifting electricity use to non-peak hours. At present, most demand response comes from large commercial and industrial users that can stagger equipment start-up, use electricity stored in batteries or produce power from on-site generators to replace power not purchased. These customers usually can provide demand reductions meeting grid operators' minimum size requirements, and can afford to invest in necessary smart meters and communications systems. However, demand response opportunities in the residential sector are growing substantially with increased deployment of smart meters and related technologies.[5]

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[4] CFR 18, Sec. 35.28(b)(4).

[5] Bipartisan Policy Center, 'Policies for a modern and reliable U.S. electric grid' (February 2013), available at http://bipartisanpolicy.org/wp-content/uploads/sites/default/files/Energy Grid_Report[1].pdf, 50.

## DEMAND RESPONSE PARTICIPATION IN WHOLESALE MARKETS

Demand response participation in organised wholesale markets is substantial in the US,[6] and emerging in Europe and elsewhere.[7] In the US, FERC-approved 'regional transmission organisations' (RTOs) administer regional transmission grids and oversee multistate wholesale electricity markets.[8] More than half the electricity sold in the US trades on these markets, while some regions oppose the RTO model and rely on individual utilities to govern transmission.

RTOs typically administer three types of markets:

1. Energy – in an energy market, utilities and other load-serving entities purchase electricity for delivery within the next hour or a day ahead.
2. Capacity – a capacity market is a forward-looking market, in which participants commit to serve future demand with new generating capacity.[9]
3. Ancillary services – these markets compensate providers of 'regulation' (an industry term of art for keeping grid frequency in balance) and reserve services that enable the reliable transmission of electricity.[10]

At first, the wholesale markets involved only electricity generators.[11] Today, demand response resources can participate in energy markets to substitute for electricity sold at the market price. In capacity markets, demand response curtailments substitute for new power plants. Ancillary service markets have

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6 US Federal Energy Regulatory Commission, '2014 assessment of demand response and advanced metering' (December 2014), available at www.ferc.gov/legal/staff-reports/2014/demand-response.pdf, at 11, Table 3-3 (demand response programs in organised wholesale markets had a potential of 6.1 per cent of peak demand in 2014).

7 Smart Energy Demand Coalition, 'Mapping demand response in Europe today: tracking compliance with Article 15.8 of the Energy Efficiency Directive' (April 2014), available at http://sedc-coalition.eu/wp-content/uploads/2014/04/SEDC-Mapping_DR_In_Europe-2014-04111.pdf

8 US Federal Energy Regulatory Commission, 'Regional transmission organizations (RTO)/independent system operators (ISO)', available at www.ferc.gov/industries/electric/indus-act/rto.asp. One RTO with substantial demand response is PJM Interconnection, LLC (PJM), which administers a large regional grid that includes thirteen states (mostly in the mid-Atlantic region) and the District of Columbia.

9 A principal difference between the US and Europe is that in Europe, 'few countries currently allow DSR providers [aggregators] to participate in their energy market or a capacity mechanism', so demand response does not yet have the same opportunities to participate in markets as in the US. Linklaters, 'Capacity mechanisms: Reigniting Europe's energy markets' (2014), available at www.linklaters.com/pdfs/mkt/london/6883_LIN_Capacity_Markets_Global_Web_Single_Final_1.pdf>, at 18 (contrasting the European experience with that of PJM).

10 J. B. Eisen, 'Distributed energy resources, virtual power plants, and the smart grid', *University of Houston Environmental and Energy Law and Policy Journal* 7 (2012), 191–213, at 198.

11 J. B. Eisen, 'Who regulates the smart grid?: FERC's authority over demand response compensation in wholesale electricity markets', *San Diego Journal of Climate and Energy Law* 4 (2012–2013), 69–103, at 80.

comparatively little demand response participation,[12] but demand response can increasingly help with frequency regulation.[13]

Intermediaries known as 'curtailment service providers' (CSPs) or 'aggregators' bid demand response into the markets. For example, CSPs in the PJM RTO in the US Mid-Atlantic region offer demand response in energy, capacity, day-ahead scheduling reserve, synchronised reserve and frequency regulation markets.[14] Aggregators can also combine demand reductions from a number of customers, enabling smaller customers to participate in markets when they otherwise could not do so. By grouping customers into a block resource, aggregators give RTOs a more reliable and controllable volume of resources for a longer time period, spreading out the risk of customers not curtailing demand when called.[15] Aggregators have begun to market to the residential sector, although this market is still small.

## DEMAND RESPONSE BENEFITS FOR REGIONAL GRIDS, UTILITIES AND CONSUMERS

Demand response resources can achieve a variety of financial and operational benefits in wholesale markets. At present, demand on the grid peaks noticeably at a small number of hours each year. This can make the marginal cost of generating electricity highly variable, with prices spiking at peak hours. Unanticipated outages or unusually high demand exacerbate this problem. At peaks that stress the grid to its limits, grid operators traditionally responded by calling on available generation capacity. Yet reducing grid stress through demand response could cut marginal costs as much or more than generating additional power. A 2009 FERC report estimated potential reductions in peak demand of up to 20 per cent.[16] Demand response programmes may also lead to increased conservation if usage at peak periods is eliminated rather than shifted.

Demand response can help meet future anticipated demand and avoid unnecessary expenses of building new power plants. Demand 'peakedness' requires grid operators to have power plants on hand to meet peak demand, which leads to oversupply of generating capacity. Many peaking plants operate fewer than 100 hours per year, and demand response could eliminate the need to build them. Demand response can also lower the need for spinning reserves: power

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[12] J. MacDonald, P. Cappers, D. S. Callaway and S. Kiliccote, Lawrence Berkeley National Laboratory, 'Demand response providing ancillary services: a comparison of opportunities and challenges in the US wholesale markets' (2012), available at www.gridwiseac.org/pdfs/forum papers12/macdonald_paper_gi12.pdf (noting that 'organized electricity and ancillary services markets are just beginning to support DR resources for ancillary services').

[13] US demand response providers may take advantage of FERC's Order 755, which changed the policies for pricing of frequency regulation service. 'Frequency regulation compensation in the organized wholesale power markets', *Federal Register* 76 (20 October 2011), 67,260.

[14] PJM Interconnection, LLC, 'Demand response, markets & operations', available at www.pjm.com/markets-and-operations/demand-response.aspx

[15] Eisen, 'Distributed energy resources', 203–5.

[16] US Federal Energy Regulatory Commission, 'A national assessment of demand response potential' (June 2009), available at www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf, x, Figure ES-1.

plants that run offline, burning fossil fuels continuously, to supply power on short notice. RTOs increasingly rely on regional planning processes and capacity mechanisms[17] to decide whether new power plants are needed. Factoring demand response into these models can lead to less new construction.

Also, demand response increases grid reliability when used as a balancing resource for wind and solar power.[18] As more distributed energy resources are integrated to the grid, demand response will be more useful in stabilising the grid. Finally, by providing incentives for CSPs and other third party providers, it encourages market competition.

## NEW TECHNOLOGIES AND PROGRAMME DESIGNS ARE NEEDED

Because demand response gives consumers incentives to lower or adjust their consumption at strategic times, they can benefit directly. These benefits depend on availability of smart meters and communications systems[19] needed for measuring and verifying demand reductions. Smart meters are digital versions of traditional analogue meters that measure electricity consumption at short time intervals and generate near real-time data. By 2014, nearly one-third of US consumers had them,[20] but less than 1 per cent had devices to work with them and help manage energy usage.[21] Eventually, 'smart' devices will give consumers more flexibility to monitor and control electricity usage, with assistance from energy service companies.[22]

Achieving these benefits requires more use of 'dynamic pricing': real-time pricing or other variable electricity pricing structures that more closely match supply and demand. Currently, most US consumers pay a fixed price that does not conform to the cost of providing electricity. Less than 1 per cent of US consumers have any form of variable pricing, with the most common form being time-of-use pricing.[23] Dynamic pricing gives consumers incentives to cut back on consumption, and is important to the success of demand response programmes.[24] A 2012 survey of twenty-four utility pilot programmes in

[17] An example of a capacity market is PJM's 'reliability pricing model'. PJM Interconnection, LLC, 'Capacity market (RPM)', available at www.pjm.com/markets-and-operations/rpm.aspx

[18] Eisen, 'Distributed energy resources', 201–5.

[19] US Department of Energy, 'The smart grid: an introduction' (2009), available at http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf, 12 (listing remote sensors and monitors, switches and controllers with embedded intelligence, and digital relays).

[20] US Federal Energy Regulatory Commission, '2014 assessment of demand response and advanced metering', 3, Table 2-1 (31.5 per cent deployment).

[21] US Department of Energy, 'Advanced metering infrastructure and customer systems', available at www.smartgrid.gov/recovery_act/deployment_status/ami_and_customer_systems##CustomerDevicesDeployed

[22] US Department of Energy, 'The smart grid: an introduction', 11.

[23] US Federal Energy Regulatory Commission, '2014 assessment of demand response and advanced metering', 30.

[24] A. Faruqui, R. Hledik and J. Palmer, 'Time-varying and dynamic rate design' (2012), available at www.ksg.harvard.edu/hepg/Papers/2012/RAP_FaruquiHledikPalmer_TimeVaryingDynamicRateDesign_2012_JUL_23.pdf, 39.

North America, Europe and Australia found that dynamic pricing programmes yielded both cost savings and demand reductions.[25]

Besides taking advantage of smarter technologies, demand response programmes must be designed to respond to customers' needs and wants, to prompt them to take part. Communication tailored appropriately to consumers is essential, as is proper design of the payments and incentives, the level of complexity and amount of customer control over the nature and duration of curtailments. For example, the Maryland-based utility Baltimore Gas & Electric (BGE), which serves 1.2 million electricity customers, has worked with the firm Opower, sending pricing signals to residential customers the night before an 'energy savings day' and asking them to take action. By summer 2015, BGE aims to roll out the programme to all of its residential customers.[26]

## STRONGER AND MORE CONSISTENT GOVERNMENTAL POLICIES ARE NEEDED TO SUPPORT DEMAND RESPONSE

New laws, regulations and market structures must be in place to promote effective demand response participation in wholesale markets in the US and Europe.[27]

An example of US federal policy is FERC Order 745, which required demand response bid into a wholesale energy market to be compensated at the 'locational marginal price', the price generators receive for selling electricity.[28] In 2014, however, a US federal appeals court's decision in *Electric Power Supply Association* v. *FERC* (*EPSA*) invalidated Order 745, putting the future of more widespread demand response in the wholesale markets in doubt.[29] In the US, states control retail electricity sales and the federal government regulates wholesale transactions. The court held that demand response is exclusively a retail-level matter beyond FERC's jurisdiction.

Given demand response's benefits, its severely reduced role in US wholesale markets after the *EPSA* decision would have widespread negative effects. Immediately after the decision, two petitions were filed with FERC to invalidate regional capacity auctions that included demand response resources. The PJM RTO removed demand response from bidding into its capacity auctions,[30]

[25] Ibid., 27–8.

[26] US Federal Energy Regulatory Commission, '2014 assessment of demand response and advanced metering', 24.

[27] Policies needed in Europe are discussed in Smart Energy Demand Coalition, 'Mapping demand response in europe today: tracking compliance with Article 15.8 of the Energy Efficiency Directive'.

[28] US Federal Energy Regulatory Commission, 'Demand response compensation in organized wholesale energy markets', *Federal Register* 76 (24 March 2011), 16,658 (to be codified at CFR 18, pt. 35).

[29] No. 11-1486 (2014) (DC Circuit Court of Appeals).

[30] PJM Interconnection, LLC, 'Revisions to the reliability pricing market ('RPM') and related rules in the PJM open access transmission tariff ('tariff') and reliability assurance agreement among load serving entities ('RAA')' (14 January 2015), Docket No. ER15-852-000, available at www.pjm.com/documents/ferc-manuals/ferc-filings.aspx

providing instead that load-serving entities controlling demand response could put their obligation to procure capacity. This is controversial because it leaves out industrial customers and CSPs that bid substantial amounts of demand response into PJM's markets.

Concerned about impacts on wholesale markets, the federal government, demand response providers and others petitioned the US Supreme Court to reverse the *EPSA* decision. In May 2015, the Court granted the petition, which may well lead to a conclusion that 'FERC has authority to regulate wholesale rates and activities that have a direct impact on rates, such as demand response'.[31] The petitioners' argument to this effect is supported in part by two recent decisions of US appellate courts. These decisions rejected state laws offering subsidies to new power plants above PJM capacity market prices, and affirmed FERC's exclusive authority to regulate capacity markets.[32] In a related case (*ONEOK, Inc.* v. *Learjet, Inc.*), the Supreme Court held in April 2015 that FERC's statutory authority to regulate practices affecting wholesale market rates did not pre-empt state antitrust laws.[33] However, the Court may distinguish this decision on the basis that demand response – like capacity market rules – has a more direct impact on rates than state antitrust laws, which the *ONEOK* court believed aim more broadly at businesses' anti-competitive conduct.[34]

Efforts by grid operators controlling single-state grids in California[35] and New York[36] are also underway to design new legal structures to promote distributed energy resources and expand demand response programmes in wholesale markets. In Europe, Article 15.8 of the Energy Efficiency Directive outlined specific requirements to promote demand response programs, although progress lags behind the US.[37]

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31 J. B. Eisen, 'Supreme Court to hear major energy law federalism case', CPR Blog, Center For Progressive Reform, available at www.progressivereform.org/CPRBlog.cfm?idBlog=9D7551F2-DE35-1637-D13A016B799BBCC0.

32 *PPL EnergyPlus, LLC* v. *Nazarian* (2014) 753 F.3d 467 (4th Circuit), petition for cert. filed, No. 14-614, No. 14-623 (25 and 26 November 2014); and *PPL EnergyPlus, LLC* v. *Solomon* (2014) 766 F.3d 241 (3rd Circuit), petition for cert. filed, No. 14-634, No. 14-694 (26 November 2014 and 10 December 2014).

33 *ONEOK, Inc.* v. *Learjet, Inc.* (2015) 575 U.S. __ (2015); decided 21 April 2015.

34 Eisen, 'Supreme Court to hear major energy law federalism case'. For further discussion of this and other energy law issues raised by the *ONEOK* decision, see E. Hammond, 'ONEOK v. Learjet, energy law's jurisdictional boundaries: a call for course correction', George Washington Law Review Docket, available at www.gwlr.org/oneok-v-learjet

35 California Public Utilities Commission decisions promoting demand response are described in Jeff St. John, greentechgrid, 'California's demand response 2.0 creates new competitive markets' (11 March 2015), available at www.greentechmedia.com/articles/read/Californias-Demand-Response-2.0-Creates-New-Competitive-Markets

36 New York's ambitious framework called 'Reforming the energy vision' was adopted by the state's Department of Public Service in 2015. New York Department of Public Service, 'Order adopting regulatory policy framework and implementation plan' (26 February 2015), available at www3.dps.ny.gov/W/PSCWeb.nsf/All/26BE8A93967E604785257CC40066B91A?OpenDocument

37 Smart Energy Demand Coalition, 'Mapping demand response in Europe today: tracking compliance with Article 15.8 of the Energy Efficiency Directive'.

## CONCLUSION

Demand response offers considerable energy saving and management capabilities, with further success depending on development and deployment of the right technologies required for participation, continued evolution of regulatory initiatives (particularly rules that promote participation in wholesale markets administered by regional grid operators), and encouragement of CSPs and other market participants. Even with these numerous challenges to full deployment, demand response is likely to be an increasing and important component of electricity wholesale markets.