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Report to Congressional Requesters

March 2014

ELECTRICITY MARKETS

Demand-Response Activities Have Increased, but FERC Could Improve Data Collection and Reporting Efforts

GAO-14-73

GAO Highlights

Highlights of GAO-14-73, a report to congressional requesters

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Why GAO Did This Study

Electricity demand fluctuates throughout the day and year and, as GAO has reported, electricity is generated first at U.S. power plants with the lowest operating costs, and, as demand rises, at more costly plants. Prior to being sold to retail consumers such as households and businesses, electricity is traded in wholesale markets. Regulation of electricity markets is divided; states oversee retail markets, and FERC oversees wholesale markets. In 2004, GAO reported on the benefits of encouraging consumers to reduce demand when the cost to generate electricity is high. These activities are known as "demand-response activities," which can reduce the costs of producing electricity, improve market functions, and enhance reliability.

GAO was asked to examine demand-response activities. This report provides an update since 2004 and discusses: (1) federal efforts to facilitate demand-response activities, (2) FERC efforts to collect and report data on demand-response activities, (3) changes in the extent of demand-response activities, and (4) key benefits and challenges of current efforts. GAO reviewed documents and conducted interviews with government officials and industry stakeholders with demand-response expertise.

What GAO Recommends

GAO recommends FERC review the scope of its data collection and improve the transparency of its reporting efforts. In commenting on a draft of this report, FERC stated that it would take the report's recommendations and findings under advisement. GAO believes in the importance of fully implementing these recommendations.

View GAO-14-73 For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

Since 2004, the federal government has made efforts to facilitate demand-response activities, including expanding their use in wholesale electricity markets. Among these efforts, the Federal Energy Regulatory Commission (FERC) issued regulatory orders affecting Regional Transmission Organizations (RTO)—entities that operate the transmission system and administer wholesale markets in some parts of the country. For example, FERC issued orders approving RTO rules for quantifying the extent of demand-response activities and compensating consumers for their demand-response activities.

FERC collects and reports data on demand-response activities in accordance with the Energy Policy Act of 2005, but these efforts have limitations. Electricity markets and demand-response activities have changed since FERC began collecting and reporting this data in 2006, but FERC has not reviewed the scope of its efforts to determine whether they could better reflect changes in electricity markets and demand-response activities. For example, FERC has reported that the limited number of retail consumers paying rates that vary with the cost of serving them is a barrier to expanding demand-response activities, but its report provides limited data on the number of consumers doing so. GAO has reported that evaluation of programs or efforts with a specific focus—such as FERC's demand-response data collection efforts—can play a key role in management and oversight. FERC, in some cases, adjusts the data it collects before making them available to the public—using its judgment to improve the data's consistency, for example—but does not fully document these adjustments. Best practices for data management advise that data modifications be documented. By not addressing these limitations, FERC is missing opportunities to make its data more informative and transparent to users for analysis of trends in demand-response activities and the extent to which progress has been made in addressing barriers.

Since GAO's 2004 report, FERC data show that the extent of demand-response activities has increased, with demand-response activities in wholesale and retail markets more than doubling from a total of 29,653 megawatts (MW) of potential reduction in peak demand in 2005 to more than 66,350 MW in 2011—about 8.5 percent of total peak demand. Demand-response activities in retail markets have increased 81 percent from a reported 20,754 MW of potential reduction in 2005 to a reported 37,543 MW in 2011. In wholesale markets, demand-response activities more than tripled from 2005 through 2011—increasing from 8,899 MW of potential reduction in 2005 to 28,807 MW of potential reduction in 2011—but the extent of demand-response activities has varied by RTO region.

According to stakeholders, current demand-response efforts provide benefits for consumers, including increasing reliability and lowering prices, but these efforts also pose a number of challenges for wholesale markets. For example, FERC's efforts to encourage demand-response activities in the markets it oversees have made these markets more complex by introducing administrative functions that, according to stakeholders, have led to challenges. Challenges include the need to develop estimates of the amount of electricity a consumer would have used in order to quantify the reduction in electricity use from demand-response activities. FERC has taken some steps to address these challenges, but it is too soon to tell whether these steps will be effective.

Contents

Abbreviations

DOE	Department of Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
GW	gigawatt
ISO	Independent System Operator
MW	megawatt
NERC	North American Electric Reliability Corporation
PURPA	Public Utility Regulatory Policies Act of 1978
RTO	Regional Transmission Organization

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March 27, 2014

The Honorable Thomas R. Carper
Chairman
Committee on Homeland Security and Governmental Affairs
United States Senate

The Honorable Susan M. Collins
United States Senate

The Honorable Peter Welch
House of Representatives

Electricity is vital to the nation's economy and central to the lives of all Americans. Businesses—from large industrial manufacturers to small businesses—rely on electricity to produce trillions of dollars in products and services. Residential consumers rely on electricity to power household appliances and other devices important to their daily lives.[1] Given its importance, the price and reliability of electricity can have substantial impacts on consumers and the broader economy.

Electricity is supplied through a complex network of power plants and power lines—the electricity grid—managed by utility companies and other operators. Since electricity cannot be easily stored, power plants' electricity output must be matched precisely with demand, which varies significantly depending on the time of day and year. To maintain a reliable supply of electricity, operators of the electricity grid take steps to ensure that power plants will be available to generate electricity when needed. In doing so, they typically ensure availability exceeds estimated demand so that any unexpected increases in demand or power plant outages can be

[1]Electricity consumers are divided into four groups: industrial, commercial, residential, and other. According to the Energy Information Administration (EIA), the industrial sector encompasses manufacturing, agriculture, mining, and construction—and a wide range of activities, such as processing and assembly, space conditioning, and lighting. According to the EIA, the commercial sector consists of businesses, institutions, and organizations that provide services, encompassing many different types of buildings and a wide range of activities. Examples of commercial sector facilities include schools, stores, office buildings, and sports arenas. According to EIA, the residential sector includes households and excludes transportation. In the residential sector, energy is used for heating, cooling, lighting, water heating, and many other appliances and equipment. Other includes uses not captured in the other three categories, including transportation.

accommodated without consumers losing access to electricity. As demand for electricity varies throughout the day and year, grid operators respond by continually increasing or decreasing the amount of electricity that they call upon power plants to generate. As we have previously reported, the cost of generating electricity varies, and grid operators generally rely on plants that are the least costly to operate first and most often and plants that are the most costly to operate last and least often.[2] Because the plants used to meet the highest levels of demand are generally much more expensive to operate, there is significant variation in the costs of serving consumers throughout the day and year.

Responsibility for regulating electricity is divided between states and the federal government. Most electricity consumers are served by retail markets that are regulated by the states, generally through state public utility commissions or equivalent organizations. As the primary regulator of retail markets, state commissions approve many aspects of utility operations, such as the siting and construction of new power plants, as well as the prices consumers pay and how those prices are set.[3] In 2004, we reported that most retail consumers paid electricity prices that reflected the average cost of serving them for an extended period.[4] Such extended periods could be a year or longer. Prior to being sold to these retail consumers, such as households and businesses, electricity is bought, sold, and traded in wholesale electricity markets by companies that own power plants, as well as utilities and other companies that sell electricity directly to retail consumers. Wholesale buyers may purchase electricity at prices that vary throughout the day and year and are largely determined by the interaction of supply and demand. Wholesale electricity markets are regulated by the federal government. The Federal Energy Regulatory Commission (FERC), which oversees wholesale electricity sales, among other things, has statutory responsibility to ensure that wholesale electricity rates are “just and reasonable” and not “unduly

[2] GAO, *Electricity Markets: Consumers Could Benefit from Demand Programs, but Challenges Remain*, GAO-04-844 (Washington, D.C.: Aug. 13, 2004).

[3] The price consumers pay for electricity is often a combination of rates determined by regulators and prices determined by markets. Rates are generally approved by regulators and set to recover the cost of providing a service plus a rate-of-return. Prices are market-based, determined based on the interaction of supply and demand. For the purposes of this report, we generally use “prices” to refer to both rates and prices, except when specifically discussing FERC’s oversight authority.

[4] GAO-04-844.

discriminatory or preferential."[5] Historically, FERC met this responsibility by approving electricity rates based on utilities' costs of production plus a rate-of-return that it determined to be reasonable. Beginning in the late 1990s, FERC took a series of significant steps to restructure the wholesale electricity markets to increase the role of competition—market forces of supply and demand—in setting prices.[6]

We previously reported that, while regulation of retail and wholesale markets is divided, these markets are interconnected and operationally joined, with generation and consumption of electricity separated by milliseconds.[7] We also reported that encouraging consumers to change their demand for electricity in response to changes in varying prices and the availability of other incentives can offer cost savings and operating advantages over relying solely upon increases in the production of electricity to meet demand. These activities are collectively known as "demand-response activities," and they can be integrated into both retail and wholesale markets. For example, to encourage retail consumers to reduce demand when costs are high, such as on summer afternoons, utilities may charge prices that vary throughout the day and year to reflect the costs of serving consumers. Alternatively, utilities may provide consumers with financial or other incentives to install technologies on certain equipment—such as pool pumps, air conditioners, and water heaters—that allow the utility to directly lower electricity consumption of these devices during times of high demand. Similarly, in wholesale markets, grid operators may provide compensation to consumers for

[5]FERC is also responsible for regulating transmission of electricity in interstate commerce by privately owned utilities. FERC does not regulate transmission or wholesale electricity sales in most of the state of Texas because Texas' grid is separate from the two other U.S. grids. In addition, FERC does not regulate transmission or wholesale electricity sales in Alaska or Hawaii because of their geographical isolation.

[6]These steps included the development of the following two orders: (1) Order 888, *Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities.* Apr. 24, 1996, and (2) Order 2000, *Regional Transmission Organizations*. Dec. 20, 1999.

[7]GAO-04-844. GAO, *Electricity Restructuring: 2003 Blackout Identifies Crisis and Opportunity for the Electricity Sector,* GAO-04-204 (Washington, D.C.: Nov. 18, 2003).

actions they take to use less electricity than expected during periods of peak demand.[8]

Our August 2004 report found that demand-response activities could benefit consumers by improving market functions and enhancing the reliability of the electricity system (e.g., the ability to meet consumers' electricity demand).[9] We also found that such demand-response activities could encourage consumers to reduce demand when the cost to generate electricity is high. However, we highlighted three main barriers to expanding demand-response activities: (1) state regulations that shield consumers from short-term variations in the cost of producing electricity or wholesale prices; (2) the absence of equipment required for participation in demand-response programs at consumers' sites, such as advanced meters that can measure electricity consumption on a more frequent basis;[10] and (3) consumers' limited awareness of demand-response programs and their potential benefits. In 2005, through the Energy Policy Act, Congress encouraged time-based pricing of electricity—prices that vary with the cost of serving electricity consumers—and other forms of demand-response activities.[11] The act also provides that it is the policy of the United States that the deployment of technology and devices that enable electricity consumers to participate in such pricing and demand-response programs are to be facilitated, and that unnecessary barriers to expanding demand-response activities in electricity markets are to be eliminated. In addition, the act required that FERC prepare and publish an annual report that assesses demand-response resources in the United States. Additionally, we reported in 2012 that 2 to 12 percent of coal-fueled capacity may be retired and other plants may be modified to reduce environmental impacts and that

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[8] Grid operators may provide compensation for demand-response activities to a wide range of market participants, including consumers and others. Throughout this report, we use the term "consumers" to capture the range of market participants including the consumers that reduce demand, as well as others.

[9] GAO-04-844.

[10] In general, traditional electric meters measure electricity consumption on an ongoing basis, but the measurements may only be captured monthly to calculate bills for consumers. Advanced meters are capable of measuring and recording consumption on a more frequent basis, hourly or less.

[11] Pub. L. No. 109-58, § 1252(f), 119 Stat. 594, 966 (Aug. 8, 2005).

demand-response could provide a way to mitigate potential reliability impacts of these actions.[12]

In this context, you asked us to examine U.S. efforts to expand demand-response activities. This report provides an update on the status of demand-response activities since we reported on them in 2004 and assesses: (1) the federal government's efforts to facilitate demand-response activities; (2) FERC efforts to collect and report data on demand-response activities; (3) changes, if any, in the extent of demand-response activities in retail and wholesale markets; and (4) key benefits and challenges, if any, of current demand-response efforts.

To do this work, we reviewed federal demand-response policies and interviewed officials from FERC, the Environmental Protection Agency (EPA), and the Department of Energy (DOE). In addition, we reviewed FERC demand-response data about how overall levels of demand-response activities have changed over time. We also analyzed data from a 2012 FERC survey of utility demand-response activities to identify the primary demand-response approaches in use at the retail level. To assess the reliability of these data, we interviewed FERC officials and performed electronic testing of the data. We found some elements of the data to be sufficiently reliable for our purposes. In other cases, we were unable to determine the quality of the data and, therefore, did not include related analyses in our report. In addition, we reviewed current literature, including reports about demand-response activities. We also interviewed a nonprobability sample of 37 electricity stakeholders with expertise on demand-response activities from trade associations and public interest organizations, academics and consultants, state government officials, industry representatives, and grid operators. We selected these five types of stakeholders to represent different perspectives on demand-response activities. Within each stakeholder group, we spoke with a diverse set of stakeholders to maintain balance on key issues—for example, their views on how to compensate those who participate in demand-response activities. Because this was a nonprobability sample, the information and perspectives that we obtained from the interviews are not generalizable to similar groups of stakeholders. We also interviewed an additional 5 stakeholders who had specialized knowledge about certain aspects of the

[12] GAO, *EPA Regulations and Electricity: Better Monitoring by Agencies Could Strengthen Efforts to Address Potential Challenges,* GAO-12-635 (Washington, D.C.: July 17, 2012).

electricity industry relevant to our study—for example, experience evaluating the competitiveness of the FERC-regulated wholesale markets. A more complete discussion of our objectives, scope, and methodology is provided in appendix I of this report.

We conducted this performance audit from September 2012 to March 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

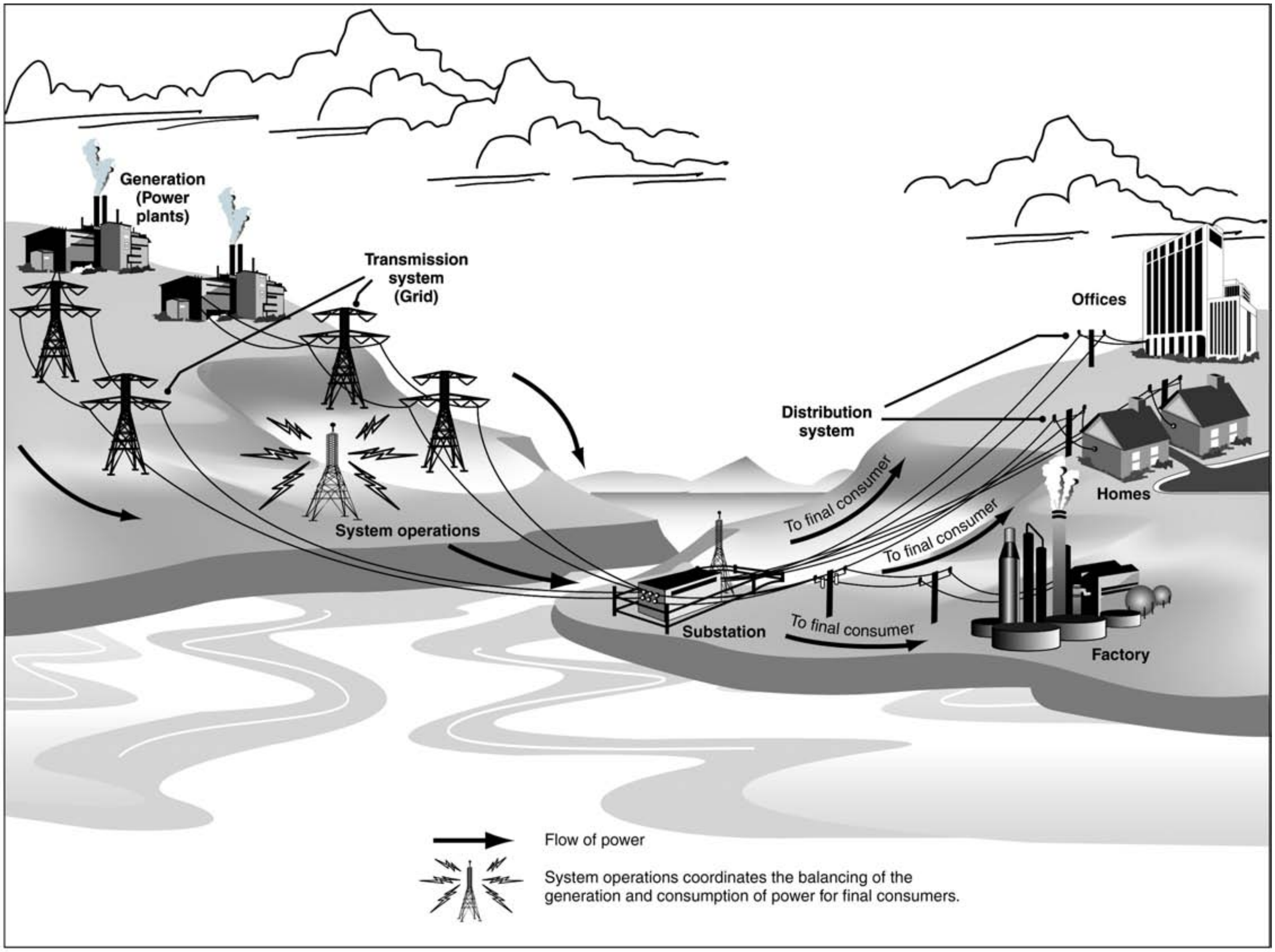
Background

This section describes (1) the balancing of supply and demand in regional electricity systems, (2) restructuring of the electricity sector and the expanding role of competition in markets, and (3) two key demand-response approaches.

Balancing Supply and Demand in Regional Electricity Systems

The electricity industry includes four distinct functions: generation, transmission, distribution, and system operations (see fig. 1). Electricity may be generated at power plants by burning fossil fuels; through nuclear fission; or by harnessing wind, solar, geothermal, or hydroenergy. Once electricity is generated, it is sent through the electricity grid, which consists of high-voltage, high-capacity transmission systems to areas where it is transformed to a lower voltage and sent through the local distribution system for use by business and residential consumers. Throughout this process, a grid operator, such as a local utility, must constantly balance the generation and consumption of electricity. To do so, grid operators monitor electricity consumption from a centralized location using computerized systems and send minute-by-minute signals to power plants to adjust their output to match changes in the demand for electricity.

Figure 1: Functions of the Electricity Industry



Source: GAO.

Balancing the generation and consumption of electricity is challenging for grid operators because consumers use sharply different amounts of electricity through the course of the day and year. Although there are regional variations, demand typically rises through the day and reaches its highest point—called the peak—in late afternoon or early evening. In some parts of the country, average hourly demand can be up to twice as high during late afternoon and early evening as it is during the middle of the night and early morning hours. In addition to these daily variations in demand, electricity demand varies seasonally, mainly because air-conditioning during the summer accounts for a large share of overall electricity usage in many parts of the country. In some areas, peak usage can be twice as high during the summer as it is during the winter.

The power plants that grid operators use to meet this varying demand include baseload plants and peakers. Baseload plants are generally the most costly to build but have the lowest hourly operating costs.[13] In general, grid operators maximize the amount of electricity supplied by the baseload plants, which are often used continuously for long periods of time. As demand rises through the day and through the year and exceeds the amount of electricity generation that can be delivered from baseload power plants, grid operators increasingly rely on electricity supplied by peakers. Peakers are usually less costly to build but more costly to operate.[14] As grid operators' reliance on peakers rises, the cost of meeting demand can increase considerably. For example, the wholesale price of electricity can rise almost 10-fold in the late afternoon and early evening, when demand is at its highest and more peakers are being utilized, compared to nighttime and early morning, when demand is at its lowest and few, if any, peakers are being utilized. Peak periods are generally short and account for only a few hours per day and, overall, a small percentage of the hours during a year, but can significantly contribute to the overall costs of serving consumers. According to a 2012 report by DOE's Lawrence Berkeley National Laboratory, spikes in demand during peak periods have a significant economic impact.[15] This report estimates that, in many electricity systems, 10 percent or more of the costs of generating electricity are incurred to meet levels of demand that occur less than 1 percent of the time.

[13]The types of technologies used by baseload power plants can vary by region but often include plants using coal, nuclear, hydroelectric, or combined-cycle natural gas technologies—units that utilize a combustion turbine in conjunction with a steam turbine to produce electricity.

[14]The types of technologies used by peaker power plants can vary by region but often include plants using natural gas combustion turbines.

[15]DOE, Ernest Orlando Lawrence Berkeley National Laboratory, and EnerNOC, *Addressing Energy Demand through Demand Response: International Experiences and Practices* (June 2012). This work was also supported by two authors from EnerNOC, a company in the demand-response industry.

Maintaining a reliable supply of electricity is a complex process requiring the grid operator to coordinate three broad types of services as follows:

- **Energy**. Operators schedule which power plants will produce electricity—referred to as energy scheduling—to maintain the balance of electricity generation and consumption. As a general rule, grid operators will schedule the least costly baseload power plants first and run them longest, and schedule the most costly peaker plants last and run them less often.

- **Capacity**. Operators procure capacity—long-term commitments to provide specific amounts of electricity generation to ensure that there will be sufficient electricity to reliably meet consumers' expected future electricity needs. Procuring capacity may involve operators of power plants committing that existing or new power plants will be available to generate electricity, if needed, at a particular future date. To provide for potential unexpected increases in demand or any problems that prevent some power plants from providing electricity or transmission lines from delivering electricity as expected, the commitments to provide electricity may exceed expected demand by a specified percentage or safety margin.

- **Ancillary services**. Operators procure several ancillary services to maintain a reliable electricity supply. Ancillary services encompass several highly technical functions required for grid operators to ensure that electricity produced can be delivered and used by consumers. Some ancillary services help ensure that electricity can be delivered within technical standards—for example, at the right voltage and frequency—to keep the grid stable and be useful for consumers who may have equipment that needs to operate at specific voltage and frequency levels.

Restructuring of the Electricity Sector and the Expanding Role of Competition and Markets

Over the last 2 decades, some states and the federal government have taken steps to restructure the regulation of their electric systems with the goals of increasing the roles of competition in markets, lowering prices, and giving consumers access to a wider array of services. The electricity industry was historically characterized by integrated utilities that oversaw the four functions of electricity service—generation, transmission, distribution, and system operations—in a monopoly service territory in exchange for providing consumers with electricity at regulated retail prices. In certain parts of the country, states and the federal government restructured the electricity industry to one in which the wholesale price for electricity generation is determined largely by supply and demand in competitive markets. More specifically, historically, at the retail level, integrated monopoly utilities provided consumers with electricity at regulated prices, and state regulators generally set retail electricity prices based on a utility's cost of production plus a fair rate of return on the utility's investment in its infrastructure, including power plants and power lines. However, beginning in the late 1990s, some states chose to restructure the retail markets they oversee to allow the price of electricity to be determined largely by supply and demand in competitive markets. In parts of the country where electricity markets have restructured, new entities called retail service providers compete with existing utilities to provide electricity to consumers by offering electricity plans with differing prices, terms, and incentives.

At the wholesale level, FERC is required by law to ensure that the rates it oversees are "just and reasonable" and not "unduly discriminatory or preferential," among other things.[16] Prior to restructuring the wholesale electricity markets in the late 1990s, FERC met this requirement by approving rates for transmission and wholesale sales of electricity in interstate commerce based on the utilities' costs of production plus a fair rate of return on the utilities' investment.[17] After restructuring wholesale electricity markets, FERC continued to develop transmission rates in this same way. In addition, FERC provided authority for many entities—for example, independent owners of power plants—to sell electricity at prices determined by supply and demand where FERC determined that the markets were sufficiently competitive or that adequate procedures were in place to mitigate the effect of companies with a large market share and the ability to significantly control or affect prices in the markets. As a result, these entities can now compete with existing utilities and one another to sell electricity in wholesale markets.

As part of this restructuring process, FERC also encouraged the voluntary creation of new entities called Regional Transmission Organizations (RTO) to manage regional networks of electric transmission lines as grid operators—functions that, in these areas, had traditionally been carried

[16]Sections 205 and 206 of the Federal Power Act, 16 U.S.C. §§ 824d -824e.

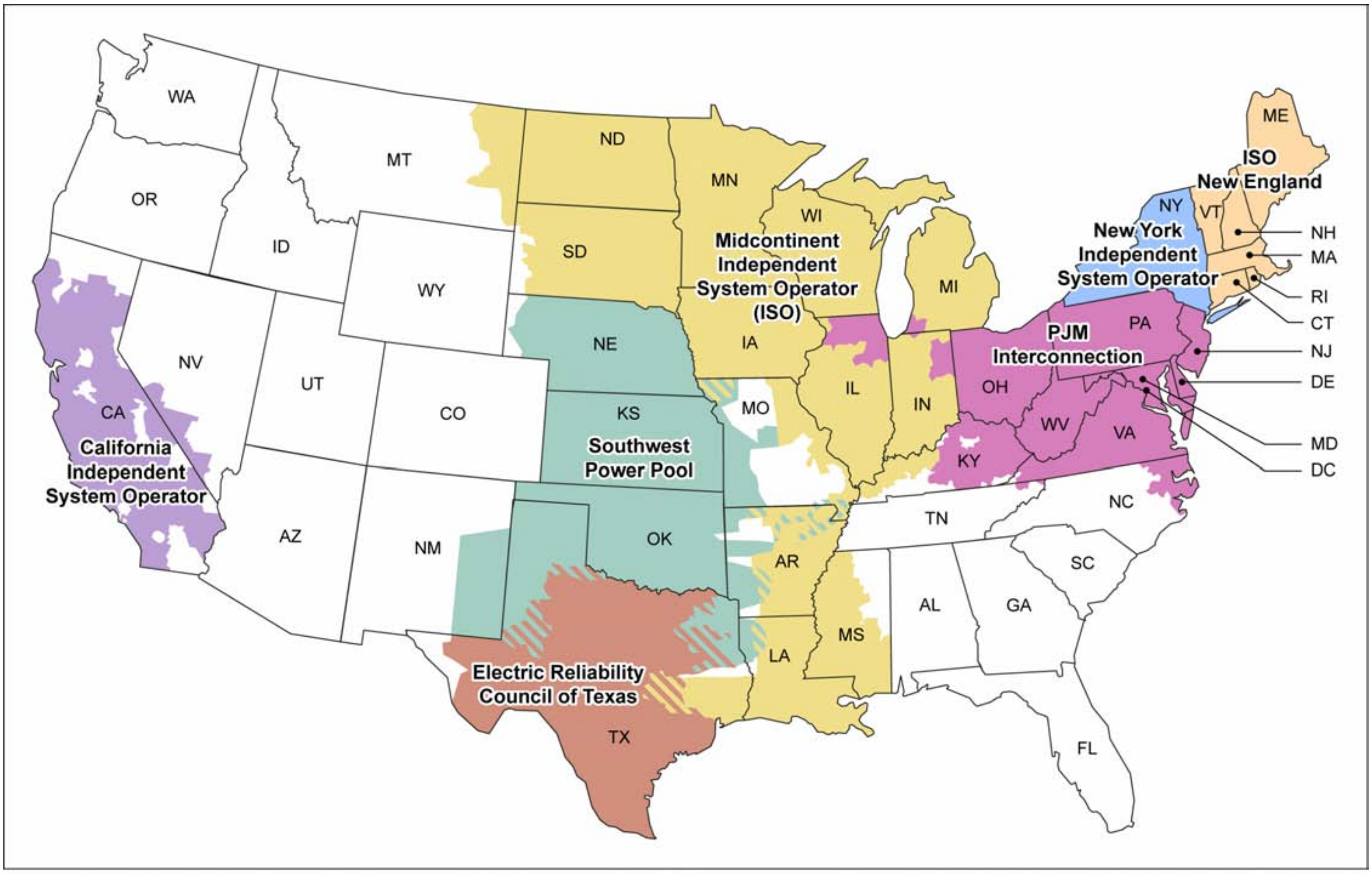
[17]Under section 205 of the Federal Power Act, FERC oversees rates for the transmission of electric energy in interstate commerce and the sale of electric energy at wholesale in interstate commerce. 16 U.S.C. § 824.

out by local utilities.[18] Figure 2 indicates the location of major RTOs that have developed in certain regions of the United States. As grid operators, RTOs are responsible for managing transmission in their regions, which includes establishing and implementing rules and pricing related to transmission, as well as considering factors, such as weather conditions and equipment outages, that could affect the reliability of electricity supply and demand.[19]

[18]Prior to the creation of RTOs, FERC approved the creation of entities called Independent System Operators (ISO). ISOs perform many similar functions to RTOs and for the purposes of this report, we refer to all ISOs and RTOs as “RTOs”. However, many RTOs that originally took on names that include “ISO” have maintained them.

[19]The North American Electric Reliability Corporation (NERC), which has been designated by FERC as the principal reliability authority for the United States, oversees the reliability of key parts of the U.S. electricity grid, including establishing mandatory standards of reliability. RTOs, utility grid operators, and other participants in the electricity markets must take various actions to comply with these standards.

Figure 2: United States Regional Transmission Organizations (RTO)



Sources: ISO/Regional Transmission Organization Council (data); Map Resources (map).

Note: This graphic reflects RTO borders based on available information as of February 2014, but these borders may change as territory is added or subtracted from RTO regions. The transmission grid that the Electric Reliability Council of Texas (ERCOT) administers is located solely within the state of Texas and constitutes a separate grid from the two other main grids in the continental United States. As a result, ERCOT is largely unregulated by FERC and is instead subject to oversight by the Public Utility Commission of Texas. ERCOT performs similar functions as the RTOs in this map, including managing Texas' transmission system and overseeing wholesale sales of electricity.

Like other grid operators, such as utilities, RTOs take steps to schedule and procure energy, capacity, and ancillary services. RTOs often do so using the three broad types of markets they manage—energy markets; capacity markets; and markets for several different ancillary services, including voltage support and frequency support. In the energy markets, for example, sellers—such as owners of power plants—place offers with RTOs to supply an amount of electricity at a specific price. Potential buyers of this electricity, such as retail service providers, also place bids with RTOs defining their willingness to pay for it. RTOs periodically—hourly, for example—"stack" the offers to supply electricity from lowest offered price to highest until the RTO estimates that it has sufficient electricity to meet the total demand. The market clearing price, or the highest supply bid needed to satisfy the last unit of demand, is paid for each unit of electricity produced for that time period. Regions with RTOs are referred to as having "organized wholesale markets," because the RTOs centrally coordinate these transactions between buyers and sellers according to rules the RTOs have established and FERC has approved.

In regions of the country without RTOs, electric utilities generally continue to serve the role of grid operator. In these regions, the local utility often integrates the delivery of electricity services—energy to maintain the balance of electricity generation and consumption, capacity to meet demand and provide a safety margin, and a range of ancillary services. Utilities in these regions may build and operate power plants to provide electricity to serve their retail customers. These utilities may also buy electricity from other power plant owners.

Two Key Demand-Response Approaches

According to a 2006 FERC report on utilities' demand-response activities, programs focused on reducing consumer demand for electricity as part of grid operators' and utilities' efforts to balance supply and demand have been in place for decades.[20] FERC reported that demand-response activities—known as load management or demand-side management—increased markedly in the 1980s and early 1990s. This increase was driven by a combination of a directive in the Public Utility Regulatory Policies Act of 1978 (PURPA) to examine standards for time-based pricing and by state and federal policy focused on managing consumer demand and planning future resource availability for providing electricity.[21] However, according to data from NERC, estimates of certain demand-response activities generally declined between 1998 and 2003, just as FERC was beginning to restructure wholesale electricity markets.

[20]FERC, *Assessment of Demand Response and Advanced Metering. Staff Report. Docket Number: AD-06-2-000,* August 2006(revised 2008).

[21]Public Utility Regulatory Policies Act of 1978, Pub. L. No. 95-617, 92 Stat. 3121 (1978) (codified at 16 U.S.C. § 2621).

Demand-response activities may occur within both retail and wholesale markets. The actions taken by retail and wholesale demand-response program participants are often not substantially different and typically involve consumers reducing their electricity consumption by delaying or stopping the use of electricity-consuming appliances, processes, or machinery during periods of high demand. As with electricity prices, FERC and state regulators each have interest in and responsibility for overseeing aspects of these demand-response activities, at the wholesale and retail levels, respectively.

There are two broad approaches to demand-response: (1) consumer-initiated and (2) operator-initiated. Specifically, these approaches are as follows:

- **Consumer-initiated approaches**. With consumer-initiated demand-response approaches, consumers determine when they will take specific actions to reduce the amount of electricity they consume. There are various types of consumer-initiated demand-response approaches. For example, retail consumers may pay time-based prices that vary with the cost of serving them with the goal of encouraging them to choose to reduce their use of electricity when prices are high.[22] Time-based prices include time-of-use prices, which vary at broad intervals, such as peak and off-peak times, and real-time prices, which vary at least hourly in response to changes in market conditions such as the cost of producing electricity at that time. Consumers' actions to reduce demand may be manual—such as turning off lights or delaying use of the clothes dryer—or automatic—such as using thermostats or other automated systems that are preprogrammed to reduce air conditioning use when prices reach a certain level. To participate in programs that use consumer-initiated approaches, consumers may need access to certain technology, such as the internet or a home display that provides information about changing prices. In addition, they may need a type of electric meter known as an advanced meter, which measures and records data on consumers' electricity use at closer intervals than standard electricity meter—typically at least hourly—and provides these data to both consumers and electricity suppliers.

[22]The cost of serving consumers depends on the cost of producing electricity, which is based on the costs associated with the last generating plant needed to meet consumer demand. In restructured regions, the cost of serving consumers varies with the wholesale price of electricity.

- **Operator-initiated approaches**. Operator-initiated approaches allow grid operators to call on participating consumers to reduce demand—for example, by shutting down equipment—during periods of tight supply in exchange for a payment or other financial incentive. These approaches can minimize the number of consumers losing access to electricity during periods of extremely high demand, reduce stress on a distribution network, or help accommodate the unexpected shut down of a power plant or transmission line. Incentives for participation in these approaches may include a payment, a bill credit, or a lower electricity price. Although participation in programs that use these approaches is typically voluntary, participating consumers may incur financial penalties if they do not reduce demand as they agreed to.

The Federal Government Has Made Efforts to Facilitate Demand-Response Activities, Including Expanding Their Use in Wholesale Markets

Since 2004, the federal government has undertaken efforts to facilitate demand-response activities. These efforts include actions to address barriers to expanding demand-response activities by funding the installation of advanced meters and facilitating coordination between FERC and state regulators. In addition, FERC has undertaken efforts to remove barriers to expanding, as well as encouraging consideration of demand-response activities in wholesale markets by approving the use of various demand-response approaches in individual RTO markets it regulates and, more recently, taking steps to establish more consistent rules for all RTOs.

DOE and FERC Have Taken Certain Actions to Help Address Barriers to Expanding Demand-Response Activities

DOE, which formulates national energy policy and funds research and development on various energy-related technologies, among other things, has taken a key step to address one barrier we identified in our 2004 report—the lack of advanced meters.[23] Specifically, in 2010, DOE began providing $3.4 billion in funds appropriated under the 2009 American Recovery and Reinvestment Act to install, among other things, advanced meters, communications systems, and programmable thermostats in homes, businesses, and other locations where electricity is used. Recipients of these DOE funds, such as utilities, provided additional funding to total $7.9 billion of investment. In recent years, the installation of advanced meters has grown substantially. Data from FERC indicate

[23] GAO-04-844.

that the installation of advanced meters as a percentage of total meters installed has grown from 0.7 percent in 2005 to 22.9 percent in 2011.[24]

FERC has also taken action to collaborate with state regulators on demand-response policies, best practices, and other issues. In 2004, we noted the importance of FERC continuing to work with grid operators, RTOs, and interested state commissions, among others, to develop compatible policies regarding demand-response activities.[25] In 2006, FERC and the state public utility commissions—through the National Association of Regulatory Utility Commissioners[26]—took steps to coordinate their regulatory activities through a joint collaborative. This collaborative explored how federal and state regulators can better coordinate their respective approaches to demand-response policies and practices. In 2013, the focus of this collaborative was broadened to include additional topics that cut across the retail and wholesale electricity sectors to build more understanding between and amongst regulators.

In addition to their steps to address these barriers, FERC and DOE also took a series of steps to study how the federal government could encourage demand-response activities. The Energy Independence and Security Act of 2007 directed FERC to conduct a national assessment of demand-response potential, develop a national action plan on demand-response activities, and with DOE, develop a proposal to implement the National Action Plan.[27] FERC completed *A National Assessment of Demand Response Potential* in 2009 and identified significant potential for demand-response activities to reduce peak energy demand under several different scenarios. Under one scenario, called the "full participation scenario," FERC estimated that peak demand could be reduced by 188 gigawatts (GW)[28] compared with a scenario with no

[24]FERC, *Assessment of Demand Response and Advanced Metering*, 2012.

[25]GAO-04-844.

[26]The National Association of Regulatory Utility Commissioners represents state public service commissions that regulate the utilities that provide energy, telecommunications, water, and transportation services.

[27]Energy Independence and Security Act of 2007, Pub. L. No. 110-140, §529, 121 Stat. 1492, 1664-65 (codified at 42 U.S.C. § 8279).

[28]One gigawatt is equal to 1,000 megawatts, 1,000,000 kilowatts, and 1,000,000,000 watts. One traditional incandescent light bulb consumes about 60 watts, and a comparable compact fluorescent light bulb consumes approximately 15 watts.

demand-response activities within 10 years.[29] This reduction is equal to approximately 2,500 peaking power plants.[30] The national assessment also identified remaining barriers to the adoption of demand-response approaches—such as the divided federal and state oversight responsibilities and the absence of a direct connection between wholesale and retail prices. In 2010, FERC completed its *National Action Plan on Demand Response*, which identified proposed activities and strategies for demand-response approaches across three broad areas: assistance to the states, national communications, and providing tools and materials.[31] One proposed action—the national communications program—has objectives focused on increasing consumer awareness and understanding of energy-consuming behavior and demand-response activities. FERC and DOE jointly completed the *Implementation Proposal for the National Action Plan on Demand Response*, identifying specific roles for DOE, FERC, and other entities. For example, DOE and FERC agreed to provide support for informational and educational sessions for regulators and policymakers.

[29]This scenario estimates the extent of cost-effective demand-response activities if advanced metering infrastructure were universally deployed; if consumers, by default, paid prices that vary with the cost of serving them; and if consumers were offered and used enabling technologies where it is cost-effective.

[30]In its 2009 assessment, FERC compared the size of potential reductions in peak demand from demand-response activities with the size of a peaking power plant, which it estimated to be about 75 MW in size.

[31]According to FERC officials, when developing the National Action Plan, FERC undertook a multiyear, collaborative process. FERC and DOE then worked with a diverse group of state officials, industry representatives, members of a National Action Plan Coalition, and experts from research organizations to develop tools and suggested approaches to implement recommendations made in the National Action Plan.

FERC Has Approved the Use of More Demand-Response Activities in RTO Markets

Since we last reported in 2004, FERC has formally acknowledged that demand-response activities are important in electricity markets in general and in particular, in wholesale markets overseen by RTOs.[32] FERC has also reported that electricity markets are more effective when retail rates vary with the cost of serving consumers.[33] However, as retail markets are generally outside the scope of its authority, FERC historically focused its efforts on remaining barriers to participation of demand-response and encouraging RTOs to identify how demand-response activities could be incorporated into the wholesale markets they operate.[34] FERC has found that demand-response activities directly affect wholesale electricity prices; therefore, facilitating demand-response activities is essential to FERC fulfilling its responsibility for ensuring wholesale prices are just and reasonable.[35]

Since 2004, FERC has taken steps to remove barriers to further expand demand-response activities in RTO markets. Prior to our 2004 report, FERC had approved a few demand-response programs coordinated by the RTOs, but, as we reported, demand-response activities were in

[32]Specifically, in a 2007 FERC Advance Notice of Proposed Rulemaking addressing *Wholesale Competition in Regions with Organized Electric Markets,* FERC highlighted the importance of demand-response activities in organized wholesale markets by describing potential benefits such as reduced wholesale prices. More broadly, in FERC's 2009 *National Assessment of Demand Response Potential,* FERC stated that demand-response resources can play an important role in operational and long-term planning, as well as providing emergency response and ancillary services.

[33]FERC, *Advance Notice of Proposed Rulemaking. Wholesale Competition in Regions with Organized Electric Markets,* RM07-19-000 and AD07-7-000, 72 Fed. Reg. 36276 (Jun. 22, 2007).

[34]Though FERC officials told us FERC efforts to promote demand-response activities have largely been in RTO regions, they also told us that FERC took some steps to address demand-response activities in orders that apply to both RTO and non-RTO regions. For example, in two orders related to transmission, FERC required entities providing access to transmission lines—for example, RTOs and utilities—to consider transmission and nontransmission alternatives, including demand-response activities, on a comparable basis when identifying transmission needs as part of their local and regional transmission planning processes. Order 890, *Preventing Undue Discrimination and Preference in Transmission Service*, 72 Fed. Reg. 12266 (Mar. 15, 2007); Order 1000, *Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities*, 76 Fed. Reg. 49,842 (Aug. 11, 2011). State regulators, utilities, and others have also taken steps to promote demand-response activities both in and out of RTO regions.

[35]FERC, Order 745-A, *Demand Response Compensation in Organized Markets; Order on Rehearing and Clarification*, RM10-17-001 (Dec. 15, 2011).

limited use.[36] Since our report was issued in 2004, individual RTOs have continued to develop opportunities for demand-response resources to provide specific services (e.g., energy, capacity, and ancillary services) through the markets they operate. According to FERC officials, FERC has reviewed these proposals on a case-by-case basis and, when FERC believed it to be appropriate, approved them. FERC has also addressed demand-response activities in broad orders related to other electricity regulation topics.[37]

As a result of FERC's approval of changes to individual RTOs' market rules, RTOs have utilized demand-response resources provided by various entities including both large electricity consumers and intermediaries. For example, demand-response resources may be provided directly by large consumers such as steel mills or other manufacturing facilities that purchase electricity directly from wholesale markets. These large consumers may delay the use of highly electricity intensive equipment, such as an electric arc furnace used to melt steel, until later in the day than they had planned in exchange for payments or other incentives. Demand-response resources may also be provided by intermediaries that combine the demand-response activities—for example, reductions in use of air-conditioning or household appliances at peak times—of multiple retail consumers to provide the quantity of demand-response resources required to participate in wholesale markets.[38] These intermediaries may include retail service providers or utilities that have made arrangements with their customers through retail demand-response programs they administer to reduce demand in exchange for compensation or lower prices. It may also include third–party entities referred to as "aggregators" that perform similar functions by

[36]GAO-04-844.

[37]For example, FERC addressed demand-response activities in Order 890 related to transmission planning by, among other things, allowing qualified demand-response resources to participate in regional transmission planning processes. In Order 693, FERC required that the North American Electric Reliability Corporation—the U.S. electric reliability organization—revise reliability standards so that all technically feasible resource options, including demand-response resources, be employed in the management of grid operations and emergencies.

[38]For example, in PJM Interconnection's energy markets, which operate in the Mid-Atlantic and parts of the Midwestern United States, the minimum amount of demand-response activities needed to participate is 100 kilowatts. Intermediaries may combine the demand-response activities of retail consumers in order to meet the offer minimum of 100 kilowatts.

combining the demand-response activities of independent retail consumers. In some cases, these intermediaries combine a large number of small reductions made by many consumers. In other cases, they seek out medium and larger businesses to identify profitable opportunities to reduce larger amounts of demand when needed. Collectively, we refer to these entities as “demand-response providers”.

In addition, demand-response resources can be used in wholesale markets to provide a wide range of services. Specifically, individual RTOs have allowed demand-response resources to be used to provide energy, capacity, and ancillary services to varying degrees. For example, according to documentation from PJM Interconnection,[39] demand-response resources are used to provide each of the three services within PJM Interconnection. Specifically, these services are as follows:

- **Energy**. Demand-response activities can help ensure that the generation and consumption of electricity remain in balance, with demand-response resources providing an alternative to energy scheduled from power plants. In RTO markets, demand-response providers can place offers to provide specified amounts of electricity during specific hours at specific prices. They provide this electricity by reducing their or their customers’ demand from levels they had expected to consume. Unlike the generators that are also bidding in these markets, which produce additional electricity by increasing the electricity generation of a power plant, demand-response providers make electricity available to the market by not consuming it. Demand-response resources may be scheduled if they are among the least costly options for addressing energy needs at a particular location.

- **Capacity**. Demand-response resources can act as an alternative to power plant operators agreeing to be available to generate electricity at a future time. Demand-response providers agree to reduce their own or their customers’ electricity consumption at a future time when the grid operator determines such actions are needed.

[39]PJM Interconnection is an RTO that coordinates markets and the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

- **Ancillary services**. Demand-response resources can act as an alternative to using changes in the amount of electricity generated to stabilize the grid. Grid operators may use demand-response resources for a short period of time to help stabilize the grid and ensure that electricity generated matches demand on a moment-to-moment basis.

FERC Has Taken Recent Steps to Make Demand-Response Rules More Consistent

Beginning in 2008, FERC issued a series of regulatory orders that establish more consistent rules related to demand-response activities for all RTOs. As shown in table 1, these orders establish a more standardized framework of rules for, among other things, how RTOs quantify and compensate demand-response activities in the markets they administer.

Table 1: Three Key FERC Orders Related to Demand-Response Activities

FERC order	Date	Description of key actions
Order 719	2008	• Requires Regional Transmission Organizations (RTO) to accept bids for demand-response resources in their markets for certain ancillary services, among other things • Permits entities called aggregators that combine the demand-response activities of multiple retail consumers into RTO markets, assuming such activity is not precluded by state law
Order 745[a]	2011	• Requires RTOs to pay providers of demand-response (including consumers) in wholesale energy markets the market price for electricity if doing so: (1) displaces electricity generation in a way that helps an RTO balance supply and demand and (2) is deemed cost-effective, meaning that the benefit from the reduction of the market price resulting from demand-response activities is greater than any money paid for the demand-response activities
Order 676-G	2013	• Incorporated by reference certain standards related to quantifying demand-response activities—including specific processes to help with measurement and verification of demand-response activities and common definitions and processes regarding demand-response activities in organized wholesale electric markets

Sources: GAO analysis of FERC orders and other filings.

[a]Order 745 is currently being contested in the U.S. Court of Appeals for the D.C. Circuit.

These orders have addressed several aspects of demand-response activities. For example, in Order 676-G, FERC adopted standards established by the North American Energy Standards Board that provide detailed guidance about quantifying consumers' demand-response activities.[40] Quantifying demand-response activities requires creating baselines—administrative estimates of consumers' expected electricity consumption for every hour of every day of the year against which any reductions in electricity use from demand-response activities are measured. Because consumer electricity use typically varies throughout the day, RTOs have no way of knowing exactly how much electricity a consumer is planning to use at specific times. The baseline—that is, the estimated amount of electricity a consumer would have used if not participating in demand-response activities—is key to determining the amount of electricity reduction for which a demand-response provider will be compensated. Additionally, through Order 745, FERC established a framework for determining the level of compensation for consumers' demand-response activities. The order generally requires that, when certain conditions are met, demand-response providers receive the market price for electricity, equal to what owners of power plants would be paid.

FERC Collects Data and Reports on Demand-Response Activities, but These Efforts Have Limitations

Since 2006, FERC has taken steps to collect data and report on demand-response activities, but these efforts have limitations. In particular, electricity markets have changed substantially since FERC began undertaking these efforts, but FERC has not reviewed the scope of its data collection and reporting efforts to determine whether additional data should be included. Further, FERC has, in some limited instances, made certain adjustments after these data are collected and before making them available to the public but does not fully document these adjustments or the reasons for making them.

[40] The North American Energy Standards Board serves as an industry forum for the development and promotion of standards for wholesale and retail natural gas and electricity, as recognized by its customers, business community, participants, and regulatory entities. The North American Energy Standards Board developed standards related to the measurement and verification of demand-response activities, which FERC incorporated by reference in Order 676-G. Measurement and verification involves quantifying consumers' demand-response activities. As a result, in this report, we refer to measurement and verification as quantifying demand-response activities.

FERC Has Taken Steps to Collect and Report Data on Demand-Response Activities

In accordance with the Energy Policy Act of 2005, FERC has collected data used to develop annual reports—FERC's *Assessment of Demand Response and Advanced Metering*—about the extent to which advanced meters are used and consumers' demand-response activities in the United States.[41] To support the development of these annual reports, FERC has conducted a nationwide, voluntary survey every other year to collect information from utilities and other entities, such as RTOs, on their use of advanced meters, consumer participation in demand-response programs, and the extent to which consumers' demand-response activities reduce peak demand. FERC makes the original survey data available on its website and summarizes key statistics about demand-response activities and advanced metering based on this survey and other sources in its annual report.[42] For example, FERC's 2012 report included statistics on the potential reduction in peak demand from consumers' participation in demand-response activities in total, by program approach (e.g., specific time-based pricing approaches),[43] by market (e.g., wholesale and retail), and, for retail demand-response activities, by class (e.g., commercial, industrial, and residential). The

[41]In section 1252(e)(3) of the Energy Policy Act of 2005, Congress required FERC to prepare an annual report, by appropriate region, that assesses demand-response resources, including those available from all consumer classes. Pub. L. No. 109-58, § 1252(e)(3), 119 Stat. 966 (2005). The report is to identify and review the following for the electric power industry: (1) saturation and penetration rate of advanced meters and communications technologies; (2) existing demand-response programs and time-based rate programs; (3) the annual resource contribution of demand resources; (4) the potential for demand-response resources as a quantifiable, reliable resource for regional planning purposes; (5) steps taken to ensure that, in regional transmission planning and operations, demand resources are provided equitable treatment; and (6) regulatory barriers to improve customer participation in demand–response activities.

[42]In years where FERC does not conduct a survey, its annual report consists of updates based on publicly available information and discussions with market participants and industry experts.

[43]The potential to reduce peak electricity demand describes the capability of consumers participating in demand-response programs to reduce their electricity use which, in turn, may reduce the system's peak electricity demand. Actual reductions in peak electricity demand indicate the amount that peak demand was actually reduced as a result of consumers' actual demand-response activities. In many cases, consumers agree in advance to provide grid operators with a certain amount of demand-response resources, which reflects their demand-response potential. However, in practice, grid operators determine, based on system needs, whether and when to call upon consumers to provide the agreed-to amount of demand-response activities. Consumers may or may not provide the agreed-to amount of demand-response activities, but they may face a penalty if they do not.

FERC survey data and report are the only source of broad data on demand-response activities we identified with this much detailed information by program approach. According to FERC officials, they are not aware of any other comprehensive data sources with data on demand-response activities and consumer participation by program approach.

Other sources of data on demand-response activities, while useful, are more limited in scope. For example, RTOs collect some data, but they focus only on a specific RTO region, and the RTOs may not collect consistent information for purposes of comparison across RTOs. The EIA also collects some data on demand-response activities; however, these data only focus on retail markets. Additionally, the North American Electric Reliability Corporation, known as NERC, collects some data but has only performed mandatory data collections since 2011. These data primarily focus on operator-initiated approaches, although a 2011 report from NERC states that there are plans to expand reporting to include additional consumer-initiated approaches in the future.

FERC Has Not Reviewed the Scope of Its Data Collection and Reporting

Since it initially designed its survey 8 years ago, FERC has considered some potential improvements to the survey, but it has not comprehensively reviewed the scope of its data collection and reporting efforts to address certain data limitations and changes in electricity markets over this period. FERC officials told us that, when designing the initial 2006 survey and annual report format, FERC sought to collect and report data that were consistent with the statutory requirements outlined in the Energy Policy Act while minimizing respondent burden to improve the response rate for its voluntary survey. The Energy Policy Act requires FERC to report on existing demand-response approaches, the annual size of demand resources, and regulatory barriers to improving consumer participation in demand-response activities and peak reduction programs, among other things. FERC's report generally addresses these issues but, in some cases, the information it provides is limited and does not include some additional information or details that may be useful to data users—such as regulators, utilities, and the public—for further documenting changes in trends in demand-response activities and progress in addressing certain barriers. Examples are as follows:

- FERC collects and reports data on the extent to which demand-response activities at utilities and other entities surveyed reduce peak demand in megawatts (MW), but it does not collect or report data on what the total peak demand is for these reporting utilities and other entities. Without these data, the potential reduction in peak demand that reporting utilities' and other entities' demand-response activities achieve cannot be calculated as a percentage of their total peak demand, potentially limiting users' ability to understand the impact of consumers' demand-response activities.

- FERC reported in its 2012 report that the limited number of retail consumers paying prices that vary with the cost of serving them is an ongoing barrier to expanding demand-response activities, but its report provides limited data on consumer participation in approaches, such as real-time pricing programs, that could potentially address this barrier. Specifically, the report provides information on the number of utilities and other entities offering certain programs with prices that vary with the cost of serving consumers, such as time-of-use prices and real-time prices. However, the report does not provide much information on the number of consumers participating in these approaches over time—information needed to understand trends in the use of these approaches and whether steps are needed to encourage additional consumer participation.[44]

- FERC does not collect some potentially valuable data about the characteristics of consumers providing demand–response resources. For example, FERC officials told us they do not collect data about the class of consumers —e.g., residential, commercial, and industrial—providing demand-response resources in the RTO markets they regulate, although FERC does collect this information about consumers participating in retail programs. In addition, FERC does not collect data on the size of consumers—for example, small businesses compared with large industrial manufacturers—participating in demand-response activities. Not having these data limits data users' understanding of the extent to which different types of consumers are participating in demand-response activities and whether additional opportunities exist for increasing the participation of certain types of consumers. Based on estimates the individual

[44]FERC's 2012 *Assessment of Demand Response and Advanced Metering* report includes data on the number of residential consumers participating in time-of-use programs. It does not include data on other consumer types, for example, commercial and industrial consumers, participating in this type of program, and it does not include data on consumers participating in other programs, such as real-time pricing programs, where prices vary with the cost of serving consumers. However, FERC provides access to these other data through data spreadsheets posted on its website.

RTOs provided, demand-response resources are typically provided by larger consumers, such as industrial and commercial facilities. Each RTO collects data about consumers in different categories and groups the data in different ways. For example, data collected by one RTO—New York ISO—indicate that approximately 57 percent of the demand-response resources in its region are from the industrial sector and 14 percent are from the commercial sector.[45] Other RTOs told us that no data were available on the categories of customers providing demand-response resources. Another RTO—ISO New England—told us that all the demand-response resources in its region are provided by industrial and commercial consumers, but that disaggregated data are not available.[46]

Moreover, FERC officials agreed that there have been significant changes in the electricity markets and participation in demand-response activities since the survey was initially developed. FERC staff considered some potential improvements to the survey instrument, including ways to make questions less burdensome and improve data quality. However, these officials told us that FERC did not comprehensively review the content of the survey or its final report, instead seeking to make its reporting consistent across years. FERC officials also noted that changes to its survey will need to be approved by the Office of Management and Budget.[47]

[45]The New York ISO reported other categories of data that could potentially be combined with the above categories, including light manufacturing (10 percent) and other commercial (5 percent).

[46]ISO New England is an RTO serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

[47]Federal agencies must obtain approval from the Office of Management and Budget under the Paperwork Reduction Act (Pub. L. No. 96-511, 94 Stat. 2812 (1980), codified at 44 U.S.C. §3501 et seq.) before requesting information from the public, such as through a survey. The Paperwork Reduction Act was enacted to minimize the paperwork burden resulting from the collection of information by or for the federal government. The act generally provides that every federal agency must obtain approval from the Office of Management and Budget before using identical questions to collect information from 10 or more persons. To obtain approval, agencies must provide to the Office of Management and Budget: (1) a description of the information to be collected, (2) the reason the information is needed, and (3) estimates of the time and cost for the public to answer the request. Examples of information collections include surveys, permits, questionnaires, and reports.

We have previously reported that evaluation can play a key role in program management and oversight—including evaluation of activities with an identifiable purpose.[48] In this context, FERC's data collection and reporting efforts to comply with the Energy Policy Act of 2005 would benefit from such an evaluation in light of the changes FERC acknowledges have occurred in electricity markets and in demand-response activities more specifically. Such an evaluation can provide feedback on program design and execution, and the results may be used to improve the design of the program. In addition, the National Research Council's Committee on National Statistics has reported in its *Principles and Practices for a Federal Statistical Agency*, that statistical agencies should continually look to improve their data systems to provide information that is accurate, timely, and relevant for changing public policy and data user needs. Although FERC is not a federal statistical agency, we believe the practices outlined in this publication are relevant to its data collection and reporting efforts because FERC is uniquely positioned to collect these data, and they remain the only source of broad demand-response data we identified with detailed information about demand-response approaches. Other federal agencies that are not statistical agencies may find it useful to periodically reassess the data they collect. For example, the Merit Systems Protection Board, which is also not a federal statistical agency, has periodically reassessed the content of a key survey it produces. Specifically, the Merit Systems Protection Board has been administering its Merit Principles Survey for the past 30 years to capture the attitudes, opinions, and views of the federal workforce and has stated that it has included a core set of items in its survey repeatedly, allowing comparisons over time, but has changed the survey considerably, reflecting the need to cover timely research topics. By not reviewing the contents of its survey on demand-response activities and annual report in light of the significant changes in the electricity market and demand-response activities over the last 8 years, FERC cannot ensure that its survey and report fully capture information that is most useful to data users today. As a result, information that could assist regulators in determining how to focus their oversight efforts—data

[48]GAO, *Program Evaluation: Strategies to Facilitate Agencies' Use of Evaluation in Program Management and Policy Making,* GAO-13-570 (Washington, D.C.: June 26, 2013). Additionally, in a 2012 report, GAO stated that a program can be defined in various ways, including an activity or project with an identifiable purpose or set of objectives. GAO, *Designing Evaluations (2012 revision)* GAO-12-208G (Washington D.C.: January 2012).

on the impact of demand-response activities; the extent to which progress has been made in addressing barriers to expanding demand-response activities, such as the limited number of retail consumers paying prices that vary with the cost of serving them; and trends in consumer participation—may not be readily available. Without additional evaluation of its program activity responsible for its annual *Assessment of Demand Response and Advanced Metering*—the only data collection we identified with this level of detailed information—FERC may be missing opportunities to improve the report and survey's design, which could limit users' ability to understand the impact of demand-response activities and determine whether changes are needed to improve the effectiveness of demand-response efforts.

FERC Does Not Fully Document Adjustments It Makes to Its Data

FERC adjusts some survey data collected for its annual *Assessment of Demand Response and Advanced Metering* report before publishing them; however, these adjustments are not well documented. The original data FERC collects from its survey are available to the public on its website, but these data do not always match data in FERC's reports. FERC officials told us that, in some limited cases, they used their judgment to adjust the original survey data to improve their quality and accuracy prior to using these data in the reports FERC issues to the public. For example, FERC staff told us that they have previously modified the survey data to ensure duplicate data on demand-response activities are not reported in both the retail and wholesale market categories and to improve the consistency of the data. However, FERC neither fully documents these adjustments, or the reasons for them internally or in its annual reports, nor makes its final, modified data set available to the public. As a result, it is difficult for data users to replicate the statistics in FERC's annual reports, which could limit the usefulness of the data to these users. We compared key statistics included in FERC's 2012 report and the associated original survey data reported on FERC's website and were unable to replicate FERC's results in some cases. For example, in some cases, our analysis of the original survey data yielded different results about the extent to which certain demand-response approaches are used at the wholesale level than what FERC published in its annual report.

Best practices for data management advise that key steps to modify data be documented. Specifically, the Office of Management and Budget's 2006 *Standards and Guidelines for Statistical Surveys* advises that data collected through surveys should be coded to indicate any actions taken during editing or that copies of the unedited data, along with the edited data, be retained. Because FERC neither fully documents the modifications it makes to the data or maintains a final version of the modified data, FERC officials could not provide reasons for many of the specific differences we identified between the original survey data and the data reported in FERC's 2012 annual report or verify whether these differences were the result of appropriate modifications or errors. These officials told us they had not identified a need to document this information to date, but that they would consider documenting it in the future. Although the rationale for FERC's data modifications may be sound, because they are not fully documented, it is unclear what changes were made, the reasons they were made, and whether these changes are appropriate. Furthermore, since the users of these data, such as state regulators and the public, may not have the means or ability to easily replicate FERC's efforts to modify the survey data, they must either analyze the original survey data or rely on only the statistics that FERC included in its final report—options which may be less informative. This could, for example, limit data users' understanding of how the number of consumers participating in certain demand-response approaches has changed over time—information that could be useful to regulators for understanding the extent to which consumer willingness to participate in certain approaches is, or is not, changing. By not fully documenting the adjustments made to its data, FERC is limiting the usefulness of these data to users and limiting their transparency for analysis. Greater transparency of these data could provide a better foundation for analysis of trends in specific demand-response approaches and the extent to which progress has been made in addressing barriers to demand-response activities.

Demand-Response Activities Have Increased Overall, but Their Characteristics Have Varied

The extent of demand-response activities has increased overall since our 2004 report, more than doubling between 2005 and 2011. Specifically, according to data reported in FERC's 2012 *Assessment of Demand Response and Advanced Metering* report, the extent of demand-response activities reported by utilities and other entities responding to FERC's survey more than doubled from a total of 29,653 MW of potential reduction in peak demand in 2005 to 66,351 MW in 2011,[49] or about 8.5 percent of the peak U.S. demand in 2011.[50] Of this 66,351 MW, 57 percent (37,543 MW) was provided through retail demand-response activities, while 43 percent (28,807 MW) was provided through wholesale demand-response activities.[51] Demand–response activities in both retail and wholesale markets have increased over this same period, but their characteristics have varied. In retail markets, FERC data indicate that the quantity of demand-response activities increased 81 percent from 2005 through 2011. Further, operator-initiated approaches were more widely used than consumer-initiated approaches. In wholesale markets, FERC data indicate that demand-response activities more than tripled from 2005 through 2011, but the extent of demand-response activities has varied by RTO region over time and by the services provided.

[49]We were not able to identify a single data source that comprehensively quantifies the extent and type of demand-response activities in retail and wholesale markets. For this reason, for information on the extent to which demand-response activities have changed over time, we provide data from FERC's annual *Assessment of Demand Response and Advanced Metering* report. These data were gathered through surveys FERC conducted and, unless otherwise noted, the data we present reflect the data reported by the 59 percent of utilities and other entities responding to the survey, rather than the extent of demand-response activities throughout the United States. In addition, most of the demand-response statistics FERC included in its 2012 report relate to potential reduction in peak demand. As a result, we have also focused our analysis of FERC data on potential reductions in peak demand.

[50]FERC does not collect data in its survey on peak electricity demand for all reporting utilities and other entities. As a result, we were unable to compare FERC's estimate of the potential of demand-response activities to reduce peak electricity demand to the actual peak demand of the utilities and other entities responding to its survey. According to data from DOE's EIA—which collects and analyzes a variety of energy and electricity data nationwide about topics such as energy supply and demand—2011 summer peak demand for the continental United States was 782,469 MW.

[51]Totals in the draft may not sum exactly due to rounding.

Demand-Response Activities in Retail Markets Have Increased Overall, but Consumer Type and Approaches Varied

FERC data indicate that the extent of demand-response activities in retail markets has increased overall but varied by consumer type and approach. Specifically, data from FERC's 2012 *Assessment of Demand Response and Advanced Metering* report indicate that the extent of retail demand-response activities has increased 81 percent overall from a reported 20,754 MW of potential reduction in peak demand in 2005 to a reported 37,543 MW in 2011. Commercial and industrial consumers were responsible for more of these retail demand-response activities than residential consumers. For example, of the 37,543 MW of potential reduction in peak demand from retail demand-response activities in 2011, 28,088 MW (75 percent) was from commercial and industrial consumers, while 8,134 MW was from residential consumers (22 percent).[52] The relatively lower contribution in MW of demand-response activities by residential consumers is particularly notable because, according to a 2009 FERC report, residential consumers represent the most untapped potential for demand-response activities.[53] Demand-response activities from residential consumers can be particularly important because residential consumers can be responsible for a large share of peak demand, which can strongly affect prices during the hours of peak electricity consumption. For example, according to data from the Texas grid operator, over 50 percent of peak demand during Texas summers may come from residential consumers.

Data from FERC and EIA also indicate that retail consumer participation in demand-response programs varies by approach, with operator-initiated approaches more widely used than consumer-initiated approaches.[54]

[52]Demand-response activities from consumers FERC categorized as "other" were responsible for the remaining 1,321 MW (4 percent) of this potential reduction in peak demand from retail demand-response activities.

[53]FERC, *A National Assessment of Demand Response Potential,* June 2009.

[54]We were not able to identify a data source that comprehensively quantifies the extent of consumer participation in various demand-response approaches in retail markets. For this reason, to analyze the extent of consumer participation in various demand-response approaches, we analyzed survey data FERC collected to develop its 2012 report. Unless otherwise noted, the data we present reflect the data reported by the 59 percent of utilities and other entities responding to the survey. They do not represent the extent of demand-response activities throughout the United States. Furthermore, the data we report may not match what was reported in FERC's 2012 *Assessment of Demand Response and Advanced Metering* report, since the agency made modifications to improve data quality prior to publication. Because these modifications were not documented, we could not verify their relevance to our analysis and instead chose to report the original survey data. More information on our approach to analyzing these data can be found in appendix I.

Data collected for FERC's 2012 report indicate that approximately 6.5 percent of retail consumers of utilities and other entities responding to the survey—about 8.5 million of 130.6 million consumers—were enrolled in a demand-response program in 2011.[55] Of these 8.5 million consumers, approximately 6.0 million (71 percent) participated in programs that used operator-initiated approaches.[56] Consumers enrolled in demand-response programs using operator-initiated approaches accounted for approximately 27,422 MW of potential reduction in peak demand for 2011. Industrial and commercial retail consumers provided 19,089 MW (70 percent) of this potential reduction, and residential consumers provided 7,151 MW (26 percent).[57] Table 2 shows the extent to which consumers participate in two key operator-initiated approaches.

Table 2: Examples of Operator-Initiated Approaches

Name	Description	Number of consumers enrolled in this approach (as a percentage of consumers enrolled in operator-initiated approaches)	Potential reduction in peak demand (as a percentage of potential reduction in peak demand from all operator-initiated approaches)
Direct demand control	Compensates consumers for allowing the utility or grid operator to remotely interrupt electricity use by one or more electrical devices, such as pool pumps or air conditioners. In some cases, electricity may be interrupted for an hour or more; in other cases, the operator may "cycle" the equipment—that is, shut it down for several short periods, which can have less impact on the consumer.	5.8 million (97 percent)	9,112 MW (33 percent)

[55]In many cases, consumers were not able to participate in demand-response programs through their utilities. Of the 130.6 million consumers of utilities responding to FERC's 2012 survey, 16.5 million or 13 percent were from utilities that did not offer demand-response programs.

[56]The 6.0 million consumers that used operator-initiated approaches represent approximately 5 percent of the 130.6 million consumers of utilities responding to FERC's survey.

[57]Consumers identified as "other" were responsible for the remaining 1,182 MW (4 percent) of potential reduction in peak demand from operator-initiated approaches.

Name	Description	Number of consumers enrolled in this approach (as a percentage of consumers enrolled in operator-initiated approaches)	Potential reduction in peak demand (as a percentage of potential reduction in peak demand from all operator-initiated approaches)
Interruptible prices	Participants—typically, large industrial or commercial consumers—receive a discount on electricity prices paid in exchange for agreeing to interrupt electricity use when directed to do so by the grid operator. In some cases, consumers give grid operators the ability to interrupt their electricity use directly by a preestablished amount for a certain number of hours per year.	.04 million (about 1 percent)	14,960 MW (55 percent)

Sources: GAO analysis of 2011 FERC survey data collected for FERC's 2012 *Assessment of Demand Response and Advanced Metering* and other sources.

Of the 8.5 million consumers who utilities and other entities reported as participating in demand-response programs, approximately 2.3 million (27 percent) participated in programs that used consumer-initiated approaches, including some retail pricing plans that sought to better align consumer prices with the cost of serving those consumers.[58] According to our analysis of FERC's survey data for 2011, consumers enrolled in demand-response programs that used these approaches accounted for approximately 9,920 MW of potential reduction in peak demand for the given year. Industrial and commercial retail consumers provided 8,893 MW (90 percent) of this 9,920 MW of the potential reduction. Table 3 shows the extent to which consumers participate in three key types of consumer-initiated approaches.

[58]The approximately 2.3 million consumers that used consumer-initiated approaches represent approximately 2 percent of the 130.6 million consumers from utilities responding to FERC's survey.

Table 3: Examples of Consumer-Initiated Approaches

Name	Description	Number of consumers enrolled in this approach (as a percentage of consumers enrolled in consumer-initiated approaches)	Potential reduction in peak demand (as a percentage of potential reduction in peak demand from all consumer-initiated approaches)
Time-of-use prices	Sets preestablished prices for predetermined parts of the day (i.e., off-peak, often during the night and early morning; midpeak, often during the day and late evening; peak, often in the late afternoon and early evening). The highest prices are established for peak periods when demand and the cost of serving consumers are generally highest, based on historical and projected cost and consumption information. Periods may vary seasonally, for example, with different peak periods in the summer than in the winter. Prices generally remain consistent throughout a given period, regardless of specific levels of hourly demand or changes in the cost of serving consumers.	2.2 million (98 percent)	7,373 MW (74 percent)
Critical peak prices[a]	In some cases, in addition to the time-of-use prices, a utility may also establish a "critical peak price," which is higher than the on-peak price and is designed to encourage consumers to make even more significant reductions in their electricity use during a few specific hours. Such a price would be initiated in response to particularly high costs of serving consumers or reliability concerns. A critical peak price is generally used only for a limited number of days and hours as determined by the utility, and consumers may not know that a critical peak price will go into effect until the day before or day of.	0.02 million (about 1 percent)	431 MW (4 percent)
Real-time prices	Consumers are charged prices that typically vary at least hourly based on their utility or retail service providers' cost of serving them. For example, this may include prices that vary with the wholesale price of electricity.	0.02 million (about 1 percent)	1,905 MW (19 percent)

Sources: GAO analysis of 2011 FERC survey data collected for FERC's 2012 *Assessment of Demand Response and Advanced Metering* and other sources.

[a]This included what FERC called "critical peak pricing" and "critical peak pricing with load control" in its 2012 report.

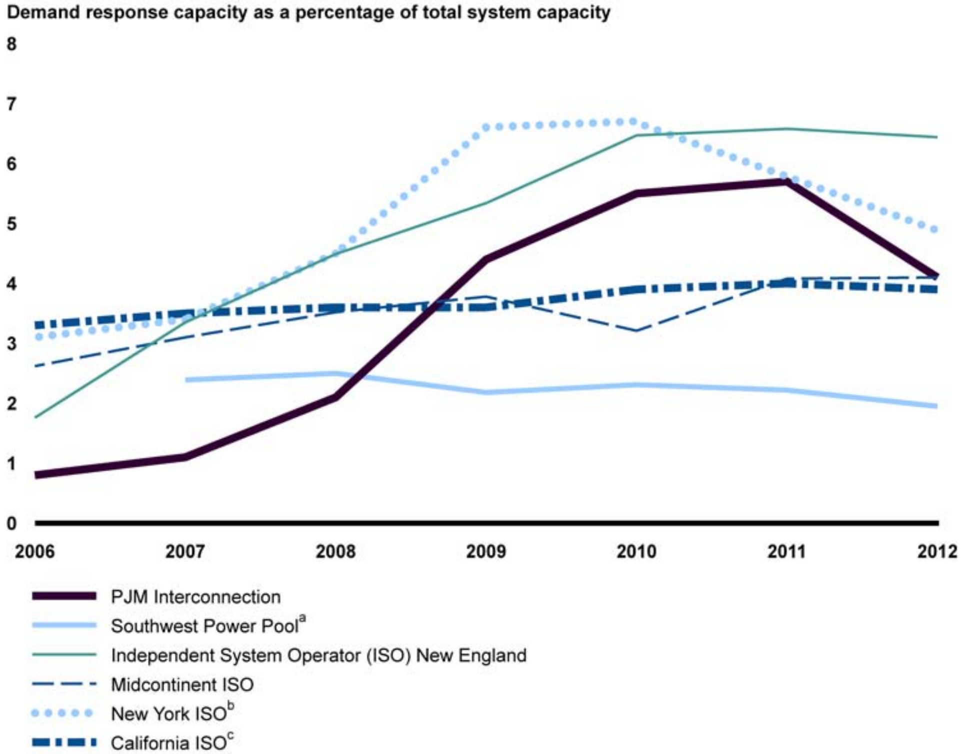
In addition to FERC's 2011 survey data, data from an EIA survey of utilities in 2011 also indicate that more consumers reported participating in programs that use operator-initiated approaches than consumer-initiated approaches.[59] According to the EIA data, 3.7 percent of retail consumers (5.4 million of 144.5 million) of utilities that responded to the survey reported participating in operator-initiated approaches in 2011, and 2.8 percent of retail consumers (4.0 million of 144.5 million) of such utilities reported participating in consumer-initiated approaches. EIA data show that reported retail demand-response activities resulted in the potential to reduce peak electricity demand by 26,596 MW in 2011. Actual reductions in peak electricity demand—a result of consumers' actual demand-response activities—in 2011 were much lower—12,126 MW.

Wholesale Demand-Response Activities Have Increased Overall and Have Varied by Region and the Service Provided

Data from FERC and the RTOs indicate that the extent of wholesale demand-response activities has increased overall but varies regionally and by the service provided. In its 2012 *Assessment of Demand Response and Advanced Metering* report, FERC reported data that show that the extent of wholesale demand-response activities has increased overall, more than tripling from a reported 8,899 MW of potential reduction in peak demand in 2005 to 28,807 MW of potential reduction in peak demand in 2011. According to RTO data, these demand-response resources in wholesale markets overseen by each RTO have varied over time, as shown in figure 3.

[59]EIA collected this information through a mandatory 2011 survey it conducted of utilities. In this survey, it asked 3,287 utilities how many consumers participated in what it called "incentive-based" demand-response approaches and "time-based rate" approaches. Examples EIA provided of "incentive-based" approaches included financial incentives, direct demand control, and interruptible prices, among other things. Examples EIA provided of "time-based rate" approaches included real-time prices, critical peak prices, and time-of-use rates, among other things. EIA does not ask those surveyed to provide more detailed information about demand-response approaches. We believe that these approaches generally align with the two demand-response approaches presented in our report: operator-initiated and consumer-initiated, respectively.

Figure 3: Regional Transmission Organization Demand-Response Capacity as a Percentage of Total System Capacity (2006 – 2012)



Source: Data provided by the above Regional Transmission Organizations (RTO).

Note: This figure shows the percentage of each RTO's demand-response capacity as a percentage of each RTO system's total capacity to meet consumer demand (i.e., "total installed capacity"). These numbers were initially prepared by the RTOs for FERC as a part of two annual reports on RTO performance metrics. The RTOs provided data for more recent years to us. Given the unique nature of each RTO region, including the markets RTOs offer and opportunities for demand-response activities, each RTO's methodology for calculating this metric may vary. Because most Electric Reliability Council of Texas activities are not regulated by FERC, the Electric Reliability Council of Texas was not required to submit information to FERC for this performance metric.

[a]The Southwest Power Pool provided updated data to us for this metric. As a result, its data do not match the data reported in the FERC annual reports on RTO performance metrics. Additionally, because the Southwest Power Pool's markets were not active in 2006, data are not available for that year.

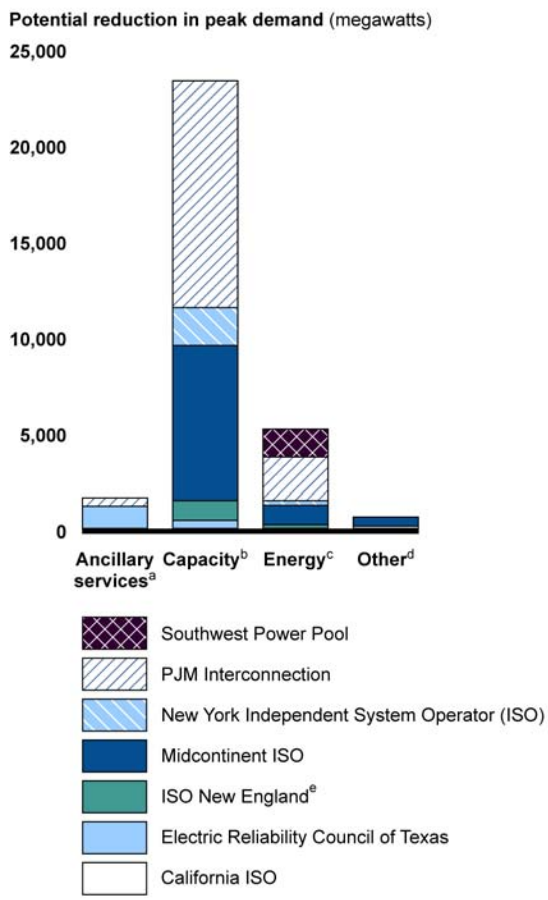
[b]Beginning with the 2010 data, New York ISO made modifications to its approach for calculating this metric.

[c]As initially reported to FERC, the California Independent System Operator included retail demand-response activities and interruptible load programs in its calculation of regional demand-response activities. With one exception, these retail programs are not operated or triggered by the California ISO.

The extent of wholesale demand-response activities in RTOs also varies by the service they provide, with demand-response resources used to provide capacity being the most common. Demand-response resources that provide capacity involve demand-response providers making commitments to the RTO to reduce their or their customers' use of electricity when the grid operator directs them to do so, for example, because of reliability concerns from higher than expected demand or a generating unit that was expected to produce electricity but could not do so. According to stakeholders, these commitments to reduce demand are functionally similar to power plant operators agreeing to increase their generation of electricity. As shown in figure 4, data from FERC and the RTOs indicate that 76 percent of the wholesale demand-response resources in the RTO regions were used to provide capacity.[60] Less common are demand-response resources to provide ancillary services, which, according to our analysis of FERC data, accounted for 5 percent of the demand-response resources in RTO markets in 2011. Likewise, demand-response resources to provide energy accounted for about 17 percent of demand-response resources in RTO markets, according to our analysis of FERC's data.

[60]According to our analysis of FERC data, 76 percent of demand-response activities were from consumer agreements to provide capacity in the future. When requested by the grid operator, for example, due to a concern about reliability, these agreements may result in demand-response activities used for energy, which are not reflected in this graphic.

Figure 4: Demand-Response Resources in Regional Transmission Organization Regions in 2011 Used to Provide Ancillary Services, Capacity, and Energy, Measured in Megawatts of Reported Potential Reduction in Peak Demand



Sources: GAO analysis of data from the Federal Energy Regulatory Commission and the above Regional Transmission Organizations (RTO).

Note: This figure provides data on the potential reduction in peak demand from demand-response resources in RTO areas. These demand-response resources are reflected in both the retail and wholesale demand-response activity totals presented in other parts of this report. The RTOs provided these data to the Federal Energy Regulatory Commission (FERC) in the survey associated with FERC's 2012 *Assessment of Demand Response and Advanced Metering* report. With assistance from the RTOs, we categorized RTO demand-response programs based on whether they addressed a need for ancillary services, capacity, energy, or other. In some cases, demand-response programs have been updated or changed by the RTOs since this information was reported to FERC. Additionally, FERC took various steps to modify reported categories for the purpose of improving data quality prior to reporting similar information in its 2012 *Assessment of Demand Response and Advanced Metering* report. Because these modifications were not documented, we were unable to verify their appropriateness for inclusion in this analysis. As such, in all cases but one, we used the original survey data reported on FERC's website for this analysis. In the case of data from the Midcontinent Independent System Operator, FERC staff informed us that the data reported on the agency website was not correct and provided us with the corrected survey data.

[a]Ancillary services involve demand-response providers making small adjustments in the amount of electricity used or delivered for short periods of time to help stabilize the grid.

[b]Capacity involves demand-response providers making commitments to the RTO to reduce their or their customers' use of electricity when the grid operator directs them to. In some cases when requested by the grid operator, for example, due to a concern about reliability, these commitments may result in demand-response activities for energy, which are not reflected in this graphic.

[c]Energy involves demand-response providers lowering their or their customers' use of electricity, which can help maintain the overall balance of electricity generation and consumption.

[d]The other category includes demand-response resources from Midcontinent Independent System Operator and California Independent System Operator that are used to provide both energy or ancillary services. To avoid double counting, we included these demand-response activities in the other category.

[e]For ISO New England, we excluded 877 MW of potential reduction in peak demand reported to FERC because ISO New England explained that this is more properly categorized as energy efficiency, rather than demand-response activities.

Demand-Response Efforts Have Resulted in Benefits, but Current Efforts Continue to Pose Challenges in Wholesale Markets

According to stakeholders, current demand-response efforts provide benefits for consumers, including increasing reliability, lower prices, and delaying the need to develop new power plants and transmission lines. However, FERC's efforts to remove barriers and to encourage demand-response activities have made wholesale markets more complex by introducing administrative functions that, according to stakeholders, have led to challenges, and it is too soon to tell whether FERC's steps to address these challenges will be effective. In addition, according to some stakeholders and reports we reviewed, retail prices remain largely unresponsive to market conditions, which poses challenges by limiting the potential for consumers to respond to changes in the cost of producing electricity or prices in wholesale markets.

Stakeholders Identified Examples of Benefits Provided by Demand-Response Efforts

Stakeholders we interviewed identified examples of how demand-response efforts have resulted in benefits, including increased reliability, lower prices, and delayed need to develop additional power plants and transmission lines. Specifically, examples are as follows:

- **Increased reliability**. Many stakeholders noted that demand-response activities can enhance the reliability of the electricity system by providing an additional tool to manage emergencies, such as electricity shortages. For example, according to documentation from PJM Interconnection, the demand-response activities of consumers in its region helped the RTO maintain reliability in 2013 during an unusual September heat wave that led to two of the highest electricity use days of the year since July. According to this documentation, demand-response activities estimated to total 5,949 MW—comparable to the electricity output of five nuclear power plants—

helped stabilize the grid. In addition, in January 2014, cold temperatures and power plant outages in Texas triggered an emergency reliability alert. ERCOT—Texas' grid operator—utilized the demand-response activities of consumers in the region, in addition to voluntary requests for consumers to conserve activity, to help stabilize the grid.

- **Lower prices**. Several stakeholders noted that demand-response activities lower wholesale market prices by helping grid operators avert the need to use the most costly power plants during periods of otherwise high electricity demand. For example, according to representatives from PJM Interconnection, prices spiked on July 17, 2012, during a heat wave, when electricity demand rose to its highest levels that year. According to these representatives, demand-response activities served as an alternative to generating additional electricity, which lowered prices, although given the complex set of factors like weather and location that affect prices, the representatives could not quantify the extent of the price reduction attributable to demand-response activities.

- **Delayed need for power plants and transmission lines**. Several stakeholders we spoke with—including representatives from PJM Interconnection; Midcontinent Independent System Operator;[61] and ISO New England—noted that demand-response activities may help delay the need to develop additional power plants and transmission lines. For example, according to documents from the Midcontinent Independent System Operator, demand-response activities in its region delayed the need to construct new power plants, which amounted to an estimated annual benefit of between $112 and $146 million.

[61]The Midcontinent Independent System Operator is an RTO that coordinates the markets and the movement of wholesale electricity. It operates in all or parts of the following U.S. states: Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, North Dakota, South Dakota, Texas, and Wisconsin.

FERC's Efforts to Remove Barriers and Encourage Demand-Response Activities Have Made Wholesale Markets More Complex and Introduced Challenges, and It Is Too Soon to Evaluate Steps to Address Challenges

FERC's efforts to remove barriers and to encourage demand-response activities in wholesale markets have added complexity to these markets by introducing administrative functions that, according to stakeholders, have led to challenges. Stakeholders identified key challenges to quantifying and compensating wholesale demand-response activities, and it is too soon to evaluate whether FERC's steps to address these challenges will be effective.

Stakeholders Stated That Quantifying Wholesale Demand-Response Activities Poses Two Key Challenges That Require Time and Resources to Address

Stakeholders we spoke with highlighted two key challenges to quantifying demand-response activities: (1) developing baselines and (2) the potential for manipulation of baselines. FERC has taken steps to address these challenges by adopting standards for quantifying demand-response activities and undertaking enforcement activities, but these steps require time and resources, and it is too soon to tell whether they will be effective.

First, several stakeholders said that developing baselines in electricity markets—that is, an estimate of how much electricity a consumer would have consumed if not for their demand-response activities—can be difficult. Individual electricity consumption reflects factors unique to individual consumers that are inherently difficult to predict. Specifically, consumers' past electricity use does not necessarily predict future use because electricity use depends on many variables, such as weather and, for large industrial consumers, production cycles. For example, the electricity demand of some industrial and commercial consumers is difficult to estimate because their electricity consumption varies based on changes in the demand for the products they produce. Further, determining when to measure a baseline can be difficult since consumers' electricity use may vary frequently and electricity use before and after a consumer's demand-response activities may not accurately reflect the extent of the consumer's demand-response contribution. For example, comments from an industrial coalition and two demand-response aggregators to FERC describe a potential situation in which a steelmaker has a furnace temporarily out of service for maintenance. After maintenance is completed, if the steelmaker chooses to take a demand-response action by delaying its next production cycle, measuring this steelmaker's baseline immediately before the steelmaker took the demand-response action—when its furnace was out of service—would not reflect the steelmaker's contribution. Baselines can have significant implications for demand-response activities. If a baseline is set too high, consumers may be compensated for a greater quantity of electricity resulting from their demand-response actions than the quantity they actually provided, potentially raising costs to all electricity consumers who ultimately pay for demand-response activities. If the baseline is set too low, consumers may not be credited with providing the quantity of electricity resulting from the demand-response actions they actually provided, and they may be less willing to take demand-response actions in the future, limiting the potential benefits. As a result, RTOs and demand-response providers must devote resources to the efforts of developing reasonable and fair baselines for demand-response programs to operate effectively.

Second, some stakeholders noted that using baselines as a key component of compensation for demand-response activities subjects them to manipulation, which requires RTOs and FERC to devote time and resources to oversight and enforcement. For example, in recent years, FERC has identified multiple instances in which consumers manipulated their baseline to receive additional financial compensation for demand-response activities or to avoid financial penalties for not providing the quantity of demand-response activities they agreed to. Specifically, in June 2013, FERC reported what it believed were irregular activities by a company that manages sports and entertainment facilities. According to a FERC document, witnesses reported that stadium lighting at one of the company's baseball stadiums was turned on 2 hours before a demand-response event was scheduled to begin.[62] No games were scheduled for that day, indicating that the increased electricity use was not needed for operations at the ballpark. These actions could have artificially inflated the company's baseline, thereby increasing the company's compensation for the reduction in demand that resulted from switching the lights off during the demand-response event. FERC recently approved a $1.3 million settlement with the company.[63] More recently, FERC fined two Maine paper mills after concluding that they had manipulated New England's

[62]143 FERC ¶ 61,218, *Order Approving Stipulation and Consent Agreement,* June 7, 2013, Docket No. IN12-15-000.

[63]FERC's enforcement office identified violations of the RTO tariff and FERC's antimanipulation rule. Furthermore, according to the FERC enforcement order, the aggregator received unjust profits. As a condition of the agreement, the aggregator neither admitted nor denied these violations but agreed to the penalties imposed by FERC.

demand-response programs.[64] In both cases, FERC determined that the paper mills had improperly set their baseline electricity usage by lowering their use of on-site generation below what was their normal practice. According to FERC, doing so increased their consumption of electricity from the grid and inflated their baselines. Once the baseline was set, FERC determined that the mills returned to their normal practice of using their on-site generation, which made it appear that they had taken demand-response actions by lowering their use of electricity from the grid. FERC recently approved an approximately $3 million settlement with one paper mill, and the other case is currently being contested in court. FERC officials told us that FERC's enforcement office continues to pursue investigations related to fraudulent demand-response activities. As a result of the potential for such manipulations, RTOs and FERC must devote time and resources toward oversight and enforcement tasks, such as monitoring, investigating, and adjudicating potential violations of the rules for demand-response activities.

Stakeholders Stated That Compensating Wholesale Demand-Response Activities Also Poses Challenges and Disagreed about FERC's Approach

Stakeholders we spoke with also highlighted challenges to compensating demand-response activities. The stakeholders we spoke with disagreed on the value of demand-response activities relative to electricity generation and how to compensate consumers for their demand-response activities. FERC sought to address these challenges in Order 745, issued in 2011, which provides rules for compensating consumers in wholesale energy markets, but it is too soon to tell if this will be effective.[65]

Some stakeholders noted that reasonable compensation for demand-response activities is needed to ensure an appropriate amount of participation. If the quantity of electricity reduced as a result of demand-response activities is too small, the price and reliability benefits that demand-response activities provide may be reduced. In contrast, if the quantity of electricity reduced as a result of demand-response activities is too high, it may dampen the incentives to invest in new power plants, which could reduce their availability for meeting demand in the long run.

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[64]In addition, an energy consulting firm and an executive with the consulting firm were also charged with fraudulent behavior for their support of one of the paper mills. FERC commenced an action in the U.S. District Court for an order affirming a combined penalty of $8.75 million.

[65]Order 745 is currently being contested by a number of electricity stakeholders in the U.S. Court of Appeals for the D.C. Circuit.

Central to the issue of reasonable compensation is the fact that, because both demand-response activities and electricity generation from power plants can be used to help meet demand for electricity, they compete for compensation in the wholesale market.

Some stakeholders told us that they believe that demand-response providers should receive less compensation than power plants for the services they provide. Specifically, these stakeholders said the following:

- Some stakeholders noted that power plants—assets with long useful lives—are more dependable in the long run than demand-response resources. For example, these stakeholders told us that owners of power plants are typically obligated to ensure that power plants are available to generate electricity. In contrast, these stakeholders noted that there may not be such a requirement for mandatory participation by demand-response providers. For example, representatives from one RTO noted that consumers enter into agreements to provide demand-response resources through aggregators and may change their availability on a month-to-month basis. As a result, they said that the RTO is not able to accurately predict how many demand-response resources its region will have in the future. In addition, while the amount of electricity generation that power plants can generally provide is known, there may be limits to how often consumers can be requested to curtail their electricity consumption and for how long. For example, the market rules for PJM Interconnection's most widely subscribed demand-response program limit PJM's requests of customers for demand-response activities to no more than 10 interruptions from June through September with a maximum interruption of 6 hours. Representatives from PJM Interconnection told us they are attempting to increase the use of demand-response approaches with fewer restrictions.[66]

- Several stakeholders noted that providing equal compensation for demand-response activities as electricity generation may result in benefits to demand-response providers in excess of what would be economically justified. Several stated that, in their view, if these resources are compensated equally, the providers are effectively benefitting twice—once when they are paid for their demand-response

[66]According to a PJM representative, beginning on June 1, 2014, two additional demand-response programs with fewer limitations will be available.

activities and a second time because they save money by not having to purchase as much electricity as they were originally planning to. One stakeholder noted that while it may be reasonable to provide compensation to demand-response providers at a level equal to power plants if the providers had first purchased the electricity and were just reselling it, demand-response providers may have not done so. In essence, demand-response providers may be compensated for agreeing to reduce their use of electricity that they may not have purchased in the first place. Some stakeholders noted that providing equal compensation could result in more demand-response resources than are economically justified.

Some stakeholders told us they believe that demand-response providers should receive compensation equal to the compensation power plants receive for generating electricity. Specifically, stakeholders said the following:

- Some stakeholders noted that providing equal compensation can encourage demand-response resources to participate in wholesale markets in which they provide benefits. According to one stakeholder, demand-response activities can provide reliability benefits, including addressing localized reliability concerns. Localized reliability concerns sometimes arise when the transmission lines leading to a local area do not have the capability to transport sufficient electricity for that area. Even though adequate electricity is available to meet overall demand, there may not be sufficient transmission available to deliver the electricity at certain points during the day or year. One stakeholder told us that, in these instances, the demand-response activities of consumers living in the local area could help resolve the reliability concern. Two other stakeholders—a representative of a demand-response aggregator and a state public utility commission official—told us that, without equal compensation, the quantity of demand-response activities in the wholesale energy markets would likely be smaller.

- Some stakeholders told us that, although demand-response activities and electricity generation are different kinds of resources, providing equal compensation is appropriate since demand-response activities provide a benefit to the market by replacing the need to have power plants provide additional electricity. One stakeholder said that equal compensation always provides an economic benefit to consumers since FERC requires demand-response activities to be cost-effective. This means that the estimated benefit from the reduction of the wholesale market price attributable to demand-response activities should be greater than the amount of compensation paid for the demand-response activities. Another stakeholder noted that equal compensation in electricity markets is designed to provide a competitive price that balances supply and demand in the marketplace in an unbiased manner. The purpose of equal compensation is not to provide equal benefit to all resources, since each resource—including power plants with different fuel types—has varying costs and will, therefore, benefit from equal compensation to varying degrees.

In 2011, FERC issued Order 745 generally requiring that, when certain conditions are met, demand-response providers should receive equal compensation. Prior to issuance, FERC issued a Notice of Proposed Rulemaking and provided an opportunity for the public to comment. In the final order, FERC acknowledged divergent opinions on the appropriate level of compensation, but it determined that equal compensation should generally be provided for demand-response activities that provide the same services as generation. It may take time to determine whether Order 745 will have the desired effect.

Stakeholders Identified Two Additional Challenges as a Result of Demand-Response Efforts

Stakeholders identified the following two additional challenges that have developed related to demand-response efforts:

- **Environmental impacts of backup or replacement generation**.[67] Some stakeholders highlighted challenges associated with the use of backup generators for demand-response activities. Some consumers may use backup generators—on-site generating units that replace electricity that would have been provided by the grid—to generate electricity to offset some or all of their demand reductions. Although these backup generators can play an important role in maintaining reliability, they may be more polluting than the power plants serving the grid. EPA officials told us that they did not know the environmental impact of backup generation being used to offset demand-response activities and said that the impact will depend on how often backup

[67]Demand-response activities can result in environmental benefits; however, determining the net environmental benefits of demand-response activities was beyond the scope of this report. In general, the extent of environmental benefits depends on many factors, for example, whether electricity use is reduced outright or shifted to other hours. In addition, whether consumers use backup generators to offset their reductions in electricity use, will also affect environmental benefits.

generators are used for this purpose and their individual emissions profiles. According to an EPA final rule, starting with calendar year 2015, owners and operators of backup generators subject to EPA's rules must annually report data on the extent to which their generators are used for demand-response activities.[68]

- **Demand-response dependability**. As demand-response activities increase and become a larger percentage of overall system demand, the likelihood increases that a consumer will be called upon more often for their demand-response activities. Some stakeholders noted that consumers may become fatigued as the number of demand-response events increases, making them less likely to reduce electricity demand to agreed-upon levels. NERC has recently begun taking steps to collect data about this issue.[69]

Retail Prices Remain Unresponsive to Market Conditions, which Poses Challenges in Wholesale Markets, Including Higher Demand and Prices

Retail prices, which are outside of FERC's jurisdiction, remain largely unresponsive to wholesale market conditions, which poses challenges in wholesale markets. These unresponsive retail prices limit the potential for consumers to respond to changes in the cost of producing electricity or prices in wholesale markets which, in turn, leaves electricity consumption and wholesale prices higher than they otherwise would be. In our 2004 report,[70] we reported that a barrier to demand-response activities is that retail electricity prices generally did not vary with wholesale market conditions—such as changing demand for electricity and the cost of serving consumers—but were instead based on average electricity costs over an extended period.[71] In particular, in 2004, we concluded that retail

[68]*National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines; New Source Performance Standards for Stationary Internal Combustion Engines*; Final Rule, 78 Fed. Reg. 6674 (Jan. 30, 2013), codified at 40 C.F.R. Parts 60 and 63.

[69]NERC is collecting this data through its Demand Response Availability Data System initiative.

[70]GAO-04-844.

[71]Under the basic model for designing unvarying, average retail electricity prices, all the costs of producing electricity are combined. The resulting amount is divided among various classes of consumers, for example, industrial, commercial, and residential consumers, and consumers within each class pay an unvarying, averaged price regardless of when their electricity consumption occurs. This leads to some consumers paying more and others less than the actual cost of serving them.

prices that did not vary with wholesale market conditions resulted in electricity markets that do not work as well as they could, producing prices that are higher than they would be if more consumers paid varying prices. Since that time, others have also concluded that having a limited number of consumers paying prices that are responsive to market conditions may lead to higher consumer demand for electricity than would otherwise be the case. Specifically, according to a 2008 FERC report about demand-response activities, some stakeholders, and other reports we reviewed, consumers paying average, unvarying prices may use more electricity at times of the day when the cost of serving consumers is high than they would if the price they paid reflected this higher cost of serving them.[72] More recently, some stakeholders we spoke with and reports we reviewed also concluded that if consumers' electricity use is higher than it otherwise would be, electricity prices for all consumers will also be higher. Furthermore, two stakeholders and reports we reviewed noted that higher levels of consumption must be served by building additional power plants and transmission lines, which further drives up costs and ultimately retail prices paid by consumers.

FERC has also concluded that prices that are aligned with overall market conditions could provide substantial benefits. For example, in a 2009 assessment of demand-response potential, FERC estimated that forecasted peak demand in 2019 could drop by 14 percent if two types of consumer-initiated demand-response approaches—real-time prices and critical-peak prices—became the default pricing approach for consumers.[73] Consistent with this view, some stakeholders we interviewed, reports by economists, and a FERC Advance Notice of Proposed Rulemaking,[74] reported that increasing the number of

[72]FERC, *Assessment of Demand Response and Advanced Metering* (December 2008).

[73]Under this scenario, FERC estimated that advanced metering infrastructure was universally deployed, and consumers, by default, paid real-time or critical-peak prices. Additionally, FERC estimated that other demand-response programs were available to consumers who opted-out of the above pricing approaches. FERC compared the results of this scenario with one in which no customers participated in demand-response programs.

[74]*Advance Notice of Proposed Rulemaking. Wholesale Competition in Regions with Organized Electric Markets*, RM07-19-000 and AD07-7-000 (Jun. 22, 2007). According to FERC, "where a load serving entity offers retail customers some form of time-of-use rates, the retail customers' response to rates during a higher-priced period reduces the load serving entities' wholesale demand and helps lower wholesale prices."

consumers enrolled in consumer-initiated demand-response approaches, particularly real-time pricing programs, has the potential to lower average electricity prices for all consumers as well as provide other benefits. For example, such an approach could eliminate “cross subsidies” in which one type of consumer—consumers that currently use little electricity at high-cost times—subsidizes the behavior of other consumers—those that use larger amounts of electricity at high-cost times. In addition, such an approach could provide consumers with the incentive to make more permanent shifts in the way they consume electricity, such as by making changes to electricity consumption habits, including precooling buildings prior to peak hours rather than cooling continuously throughout the day. We also previously reported that such pricing can provide incentives for the installation of more energy efficient equipment to replace equipment that consumes large quantities of electricity during periods of high demand, such as air conditioners that run during peak periods during the summer.[75] Such pricing may also make it cost-effective for some consumers to invest in renewable energy technologies such as solar panels. The times solar power can be generated often coincide with times of peak demand, when the cost of generating electricity is higher, which may make the use of solar panels more cost-effective when consumers pay real-time prices.

In particular, FERC’s data indicate that 6.5 percent of retail consumers participate in demand-response programs and approximately 2 percent in consumer-initiated approaches such as time-of-use or real-time pricing. Some stakeholders we spoke to told us that expanding the number of consumers paying prices that are responsive to market conditions—such as real-time prices—would be a more straightforward and less administratively costly alternative to FERC’s demand-response efforts.

Some stakeholders highlighted the difficulties of shifting retail pricing toward prices that more closely mirror the cost of serving consumers. For example, representatives from a large industrial company told us that it is difficult to manage their operations when paying prices that vary frequently throughout the day because electricity comprises a large portion of this company’s business expenses, and frequently varying prices make it difficult to plan production cycles. Two other stakeholders commented that if consumers’ expected cost savings from shifting their

[75] GAO-04-844.

electricity use are small, they may decide that it is not worth the effort to shift their electricity use in response to changing prices. When making this determination, consumers may consider the costs associated with managing their electricity usage in response to prices that vary frequently, including the costs of installing any needed technological infrastructure—for example, energy management control systems that allow them to automatically respond to varying prices with preprogrammed demand-response curtailment actions.

Efforts are under way in several areas to evaluate different ways of pricing electricity for retail consumers with some utilities initiating pilots. For example, Baltimore Gas and Electric completed a pilot program—converted to a permanent program in July 2013—in which residential consumers earn a bill credit for energy conserved compared with their normal usage on days identified by the utility when energy demand is high. Furthermore, Pacific Gas and Electric, which serves much of Northern and Central California, began offering a critical peak pricing program in 2008 after advanced meters had been installed. Additionally, as a part of the DOE Smart Grid Investment Grant program, DOE is helping to coordinate studies to assess consumers' responses to these new approaches.

Conclusions

Since our last report on demand-response activities in 2004, FERC has made efforts to remove barriers to expand the use of demand-response activities in wholesale markets, recognizing the importance of connecting consumers' decisions about electricity consumption to the wholesale markets FERC oversees. FERC has also undertaken efforts to study demand-response activities and collect data on the range of demand-response activities across the United States and report them annually, as required under the Energy Policy Act. However, the data FERC collects and reports—the only source of broad data we identified with detailed information by demand-response approach—have two key limitations. First, FERC has not reviewed the scope of its data collection and reporting efforts to determine whether they could be improved to better reflect changes in electricity markets and participation in demand-response activities. Second, in some cases, FERC makes certain adjustments after collecting these data but before using them in their reports required by Congress; however, it does not fully document these adjustments or the reasons for them. By taking steps to address these limitations, FERC could make its data more informative and transparent to data users and ensure that Congress has a better picture of demand-response activities—something it sought in the Energy Policy Act.

Improvements in its data collection and reporting process could also benefit regulators—such as FERC and state regulators—in determining how to focus their demand-response efforts.

Recommendations for Executive Action

We are making recommendations to improve the quality of FERC's annual reports required by Congress on demand-response and advanced metering activities and the data collected to support these reports. In particular, we recommend that the Chairman of FERC take the following two actions:

- Review the scope of FERC's efforts to prepare and publish an annual report that assesses demand-response resources and consider whether revisions to the data it collects could better inform users and improve the effectiveness of demand-response activities.

- Take steps to ensure that FERC staff fully document any modifications made to survey data prior to public reporting, including considering making its final, modified data set available to the public.

Agency Comments and Our Evaluation

We provided a draft of this report to FERC for review and comment, and FERC provided written comments, which are reproduced in appendix III. In its comments, FERC did not disagree with our findings or recommendations and stated that it would take them under advisement as it considers how best to fulfill the requirements of the Energy Policy Act of 2005. We believe in the importance of fully implementing these recommendations. FERC also provided technical comments, which we incorporated, as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Chairman of FERC, the appropriate congressional committees, and other interested parties. In addition, this report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VI.

Frank Rusco
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

This report examines efforts to expand demand-response activities in the U.S. electricity markets and provides an update on the status of demand-response activities since we previously reported on them in 2004. Specifically, this report assesses: (1) the federal government's efforts to facilitate demand-response activities; (2) Federal Energy Regulatory Commission (FERC) efforts to collect and report data on demand-response activities; (3) changes, if any, in the extent of demand-response activities in retail and wholesale markets; and (4) key benefits and challenges, if any, of current demand-response efforts.

To assess the federal government's efforts to facilitate demand-response since our 2004 report, we reviewed federal demand-response policies and interviewed officials from FERC, the Department of Energy (DOE), and the Environmental Protection Agency (EPA), key agencies involved in demand-response policy setting. These policies included FERC demand-response orders that summarize FERC's review of demand-response proposals from individual Regional Transmission Organizations (RTO), as well as FERC orders that address demand-response activities more broadly. We also spoke with FERC officials to understand their current approach to demand-response activities in wholesale markets, including decisions about how to eliminate barriers to demand-response activities in these markets. We reviewed relevant laws that outlined requirements related to demand-response efforts for FERC and others.

To assess FERC's efforts to collect and report data on demand-response activities, we reviewed FERC's approach to gathering data for its *Assessment of Demand Response and Advanced Metering* reports, which involved analyzing various aspects of the data, analyzing FERC's approach for collecting and modifying the data, and conducting interviews with FERC officials about FERC's data collection and reporting process.

To assess the changes, if any, in the extent of demand-response activities in retail and wholesale markets since 2004, we reviewed and analyzed data on demand-response activities from FERC and the Energy Information Administration (EIA), among others. Specifically, we reviewed FERC data on demand-response approaches and related reports, including FERC's 2012 *Assessment of Demand Response and Advanced Metering* report. Where appropriate, we used these data in our report to provide information on how overall levels of demand-response activities have changed over time. We also analyzed data from FERC's survey of utility demand-response activities conducted for this 2012 assessment to identify the primary demand-response approaches in use at the retail level. FERC conducted a voluntary survey of utilities to gather data on their demand-response activities and their use of advanced meters. The response rate to FERC's survey was 59 percent. Unless otherwise noted, the data we present in our report from FERC's 2012 report and associated survey reflects information reported by those utilities responding to the survey. The data do not represent the extent of demand-response activities throughout the United States. Furthermore, our analysis of survey results to identify the primary demand-response approaches at the retail level may not match what was reported in FERC's 2012 *Assessment of Demand Response and Advanced Metering* report because FERC modified these data prior to publication, as we discuss in this report. Because these modifications were not documented, we could not verify their accuracy or relevance to our analysis. As a result, when providing data about specific retail demand-response approaches, we chose to report results from the original survey data reported by the utilities, which reflect the original, unmodified survey responses. To assess the reliability of the data, we interviewed FERC officials and performed electronic testing of the data. We found some elements of the data to be sufficiently reliable for our purposes. In other cases, we were unable to determine the quality of the data and, therefore, did not include related analyses in our report. In addition to the FERC data, we reviewed EIA's 2011 data on retail demand-response activities. We reviewed related documentation about these data and interviewed EIA about their collection, and we found them to be sufficiently reliable for our purposes. We also reviewed data collected by the North American Electric Reliability Corporation (NERC) through its Demand Response Availability Data System. These data primarily focused on operator-initiated approaches, although a report from NERC says there are plans to expand reporting to include additional consumer-initiated approaches in the future. For this reason, and because the data were not categorized in a way that aligned with the specific analysis we were performing, we did not include them in our report.

We also reviewed RTOs' data on the development of demand-response activities in their region, what consumers provide demand-response activities, and documentation on available RTO demand-response approaches. We supplemented these data with our own analysis of data on RTO demand-response resources available through the FERC survey of utility demand-response activities. To analyze the FERC data, we categorized each RTO's demand-response resources according to whether they were designed to provide capacity, energy, or ancillary services and confirmed these categorizations with the RTOs. In some cases, RTO demand-response approaches had been updated or changed by the RTOs since this information was reported to FERC.

Additionally, FERC took various steps to modify reported categories prior to reporting similar information in their 2012 *Assessment of Demand Response and Advanced Metering* report. As previously noted, because these modifications were not documented, we were unable to verify their appropriateness for inclusion in our analysis. As such, for this analysis of RTO demand-response activities, we primarily used the original survey data reported on FERC's website. In the case of the Midcontinent Independent System Operator data, FERC informed us that the data reported on its website was not correct and provided us with the corrected survey data. We interviewed FERC officials about their data and performed electronic testing of the data, which we found sufficiently reliable for our purposes. As a result, the data included in our report may not always match what was reported in FERC's 2012 *Assessment of Demand Response and Advanced Metering* report.

To assess key benefits and challenges, if any, of current demand-response efforts, we conducted semistructured interviews with a nonprobability sample of 37 diverse stakeholders with expertise on demand-response issues from five categories: trade associations and public interest organizations; academics and consultants; state government, including state public utility commissions; industry, including demand-response aggregators, large users of electricity, independent power producers, and integrated utilities; and RTOs. (See app. II for a list of these stakeholders). We selected these groups to maintain balance on key issues. Often, because of business interests, these groups have different perspectives on electricity industry issues, including demand-response activities. When possible, we used a standard set of questions to discuss topics such as the strengths and limitations of U.S. demand-response approaches, barriers to expanding demand-response activities, and steps the federal government should take to develop or refine demand-response policies. However, as needed, we also sought perspectives on additional questions tailored to these stakeholders' area of expertise and sought opinions from stakeholders on controversial key issues, for example, their views on how to best compensate consumers for their demand-response activities. In addition to interviewing the aforementioned 37 stakeholders from the five categories, we had supplementary conversations with stakeholders who did not easily fit in one of the previous five categories. These stakeholders had specialized knowledge about certain aspects of the electricity industry relevant to our study, for example, experience evaluating the competitiveness of the FERC-regulated wholesale markets. In total, we spoke with 42 stakeholders as outlined in appendix II. Throughout the report we use the indefinite quantifiers, "some," "several," and "many" to inform the reader of the approximate quantity of stakeholders that agreed with a particular idea or statement. We refer to “some” as 3-6 stakeholders, “several” as 7-12 stakeholders, and “many” as 12-27 stakeholders. Because this was a nonprobability sample, the information and perspectives that we obtained from the interviews cannot be generalized to similar groups of stakeholders. Such an approach, however, allowed us to get more in depth responses about certain key issues related to our objectives, including the connection between retail electricity prices and the cost of serving consumers. We also reviewed current reports—including empirical studies—on demand-response issues. We identified these reports during the course of our own research, by recommendation from stakeholders, and through a literature review of retail and wholesale demand-response approaches.

We conducted this performance audit from September 2012 to March 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Stakeholders Interviewed

Trade Associations and Public Interest Organizations	• American Public Power Association • Compete Coalition • Demand Response and Smart Grid Coalition • Edison Electric Institute • Electricity Consumers Resource Council • Electric Power Supply Association • ISO/RTO Council • National Association of Regulatory Utility Commissioners • The National Rural Electric Cooperative Association • Public Citizen
Academics and Consultants	• The Brattle Group • Charles Goldman, Lawrence Berkeley National Laboratory • NERA Economic Consulting • Dr. Frank Wolak, Stanford University • Dr. Jay Zarnikau, University of Texas at Austin
State Government	• Illinois Commerce Commission • Maryland Office of People's Counsel • Maryland Public Service Commission • Pennsylvania Public Utility Commission • Public Utility Commission of Texas
Industry	• EnerNOC • Energy Curtailment Specialists • CBRE • Gerdau Corporation • Linde Energy Services • American Electric Power • Calpine • CPS Energy • Exelon Corporation • Southern Company
RTOs	• California Independent System Operator • Electric Reliability Council of Texas • ISO New England • Midcontinent Independent System Operator • New York Independent System Operator • PJM Interconnection • Southwest Power Pool

Others

- Scott Hempling
- Monitoring Analytics
- Potomac Economics
- North American Electric Reliability Corporation
- Vermont Energy Investment Corporation

Appendix III: Comments from the Federal Energy Regulatory Commission

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426

OFFICE OF THE CHAIRMAN

March 7, 2014

Mr. Frank Rusco
Director, Natural Resources and Environment
United States Government Accountability Office
441 G Street, NW
Washington, D.C. 20548

Dear Mr. Rusco:

Thank you for your February 6, 2014 electronic transmission of the draft report, *Electricity Markets – Demand-Response Activities Have Increased, but FERC Could Improve Data Collection and Reporting Efforts*. I welcome the opportunity to comment on the draft report, the stated purpose of which is to examine U.S. efforts to expand demand response activities since GAO last reported on this topic in 2004 and to assess: (1) the federal government's efforts to facilitate demand-response activities; (2) FERC efforts to collect and report data on demand response activities; (3) changes, if any, in the extent of demand-response activities in retail and wholesale markets; and (4) key benefits and challenges, if any, of current demand-response efforts.

I appreciate that the draft report acknowledges the work of FERC to remove barriers to the participation of demand response in the organized wholesale energy markets. The inclusion of demand response in the organized wholesale markets has not been without controversy, as evidenced by the stakeholder comments captured in the draft report. I note that the draft report makes no recommendations in this regard.

The draft report makes two specific recommendations regarding FERC's efforts to collect and report data on demand response activities: first, that the scope of the data collection and reporting effort be reviewed to expand the collection of information beyond the survey's initial scope and improve usefulness to a broader audience, and second, that steps be taken to fully document modifications to the reported data. I note and appreciate that the draft report states that while FERC is not a federal statistical agency, its survey effort is the only source of broad demand response data, with detailed information by demand response approach, identified by GAO. Given this, I am taking the draft report's recommendations and findings under advisement as we contemplate how in the future to best fulfill the requirements of the Energy Policy Act of 2005.

Again, I appreciate the opportunity to review and comment on the draft report.

Sincerely,

Cheryl A. LaFleur
Acting Chairman

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Frank Rusco, 202-512-3841 or ruscof@gao.gov

Staff Acknowledgments

In addition to the individual named above, Jon Ludwigson (Assistant Director), Margaret Childs, Alysia Davis, Philip Farah, Cindy Gilbert, Paige Gilbreath, Catherine Hurley, Alison O’Neill, Dan C. Royer, Kiki Theodoropoulos, and Barbara Timmerman made key contributions to this report.

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