



December 2017

# ELECTRICITY MARKETS

Four Regions Use  
Capacity Markets to  
Help Ensure  
Adequate Resources,  
but FERC Has Not  
Fully Assessed Their  
Performance

Accessible Version

# GAO Highlights

Highlights of [GAO-18-131](#), a report to congressional committees

## Why GAO Did This Study

Electricity grid operators, who operate the network of power lines, seek to ensure they will have adequate resources, such as power plants, to meet customers' future electricity needs. Grid operators use various approaches to do so, including capacity markets—markets through which owners of power plants can be paid in exchange for making a commitment that their power plant will be available to provide electricity at a specified time in the future. FERC is responsible for overseeing grid operators as well as capacity and other electricity markets to ensure that the markets result in prices that are “just and reasonable.”

A report accompanying a bill for 2016 energy and water development appropriations includes a provision for GAO to review the use of capacity markets in the United States. GAO's report (1) describes U.S. capacity markets, (2) examines available information about resource adequacy and related costs in regions with and without capacity markets, and (3) examines the oversight of capacity markets. To conduct this work, GAO analyzed data on electricity costs and resource trends from the four regions with capacity markets, reviewed relevant reports and filings, and interviewed government officials and grid operators' representatives.

## What GAO Recommends

GAO is making three recommendations, including that FERC (1) take steps to improve the quality of its data and (2) regularly assess the overall performance of capacity markets. FERC generally agreed with GAO's findings and recommendations.

View [GAO-18-131](#). For more information, contact Frank Rusco at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov).

December 2017

## ELECTRICITY MARKETS

### Four Regions Use Capacity Markets to Help Ensure Adequate Resources, but FERC Has Not Fully Assessed Their Performance

## What GAO Found

In four regions of the United States, the Federal Energy Regulatory Commission (FERC) has approved capacity markets. These markets are generally designed to provide an additional financial incentive to build and retain enough power plants to meet electricity needs, beyond incentives provided through other electricity markets. However, these four capacity markets have differences. For example, two obtain commitments from plant owners 3 years before electricity is needed, while two obtain commitments closer to when electricity is needed.

Available information on the level of resource adequacy—the availability of adequate power plants and other resources to meet customers' electricity needs—and related costs in regions with and without capacity markets is not comprehensive or consistent. For example, available data show that regions with capacity markets spent over \$51 billion from 2013 through 2016 for commitments from power plant owners that their plants would be available to provide electricity. However, these payments may not reflect the full cost of resource adequacy in these regions, and data on the other costs were not available. Moreover, consistent data on historical trends in resource adequacy and related costs are not available for regions without capacity markets, though forward-looking projections based on the latest available data indicate that most of the country is expected to have adequate resources through 2026. FERC collects some useful information in regions with and without capacity markets, but GAO identified problems with data quality, such as inconsistent data. According to federal standards for internal control, agencies should use quality information to achieve their objectives. By improving data quality, FERC's and Congress' ability to understand and oversee the capacity markets could be enhanced.

FERC, with assistance from grid operators and others, conducts oversight of capacity markets to, among other things, detect potential misconduct by market participants. However, FERC has not fully assessed the overall performance of capacity markets. In particular, FERC has not established performance goals for capacity markets, measured progress against those goals, or used performance information to make changes to capacity markets as needed. GAO's prior work has found that federal agencies can use performance information to improve results. Additional performance goals could be useful, based on GAO's review of FERC and other documents. For example, in 2013, in an internal examination of one region's capacity market, FERC staff identified five desirable characteristics—for example, whether power plants and other resources receiving capacity payments were available when needed—against which FERC conducted a one-time assessment. This represents one example of performance goals that FERC could develop to measure capacity market performance, but FERC has not conducted this analysis for other regions with capacity markets nor updated this analysis. Capacity markets have faced performance problems in the past, with three regions raising concerns since 2014 that the design of their markets was not sufficient to ensure that there were adequate resources to meet customer demand in their regions. By more fully assessing performance, FERC may increase opportunities to identify and address potential performance problems and to share effective approaches across capacity markets. This may help ensure customers do not pay more than necessary for resource adequacy.

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#### Abbreviations

ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
GPRA	Government Performance and Results Act of 1993
ISO	Independent System Operator
MW	Megawatts
NERC	North American Electric Reliability Corporation
PJM	PJM Interconnection
RTO	Regional Transmission Organization

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December 7, 2017

The Honorable Lamar Alexander  
Chairman  
The Honorable Dianne Feinstein  
Ranking Member  
Subcommittee on Energy and Water Development  
Committee on Appropriations  
United States Senate

The Honorable Mike Simpson  
Chairman  
The Honorable Marcy Kaptur  
Ranking Member  
Subcommittee on Energy and Water Development, and Related Agencies  
Committee on Appropriations  
House of Representatives

Businesses rely on electricity to produce trillions of dollars in products and services, and residential customers rely on electricity to power household appliances and other devices important to their daily lives. Having an adequate supply of electricity from power plants is vital to meeting businesses' and residential customers' electricity needs at any given moment and to helping prevent power outages that could have significant adverse impacts on businesses and people.

Different regions of the country use different approaches to ensure adequate electricity supplies. In some regions, entities called regional transmission organizations (RTO) manage the system of electricity lines that comprise the grid and help ensure enough electricity is available to meet customers' electricity needs in the future. Some of these RTOs use capacity markets—auctions through which owners of power plants can be compensated for agreeing to make their plants available to provide electricity at a specified time in the future. These markets are designed to, among other things, provide power plant owners with a financial incentive to build and retain enough plants to meet customers' future electricity needs.

Responsibility for regulating the electricity industry is divided between the states and the federal government. Most electricity customers 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 have a variety of responsibilities, such as approving the prices retail customers pay and how those prices are set. However, before electricity is sold to retail customers, it may be bought, sold, and traded in wholesale electricity markets that the federal government oversees through the Federal Energy Regulatory Commission (FERC).<sup>1</sup> As part of this oversight, FERC is responsible for overseeing RTOs' development and operation of capacity markets to ensure they result in prices that are just and reasonable and not unduly discriminatory or preferential.<sup>2</sup>

A report accompanying H.R. 2028, a bill for the Energy and Water Development and Related Agencies Appropriations Act, 2016, includes a provision for us to review several issues related to electricity capacity markets and their functions. Our report (1) describes the capacity markets that RTOs have developed, (2) examines available information about resource adequacy and related costs in regions with and without capacity markets, and (3) examines the oversight of capacity markets.

To address these three objectives, we reviewed reports and other documentation from several sources, including all seven RTOs, independent market monitors, academic and industry researchers, and consumer groups.<sup>3</sup> We also reviewed relevant federal law, including the Federal Power Act, and FERC orders that established and modified capacity markets. To describe capacity markets that RTOs have developed, we reviewed annual reports from independent market monitors, analyses of capacity market operations by industry researchers, rules describing the design and operation of capacity markets, and proposals from the RTOs and stakeholders to modify individual elements of capacity markets. We also interviewed officials at FERC, representatives at each of the four RTOs with capacity markets, and representatives at the independent market monitors for each of these four RTOs. These officials and representatives discussed how these markets

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<sup>1</sup>FERC has up to five commissioners who are appointed by the President of the United States with the advice and consent of the Senate. Commissioners serve 5-year terms and have an equal vote on regulatory matters.

<sup>2</sup>In this report, we refer to this requirement as "just and reasonable."

<sup>3</sup>Independent market monitors are private companies that assist RTOs in overseeing capacity markets and other RTO-operated markets.

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were designed and the strengths and limitations of various approaches to capacity market design.

To examine available information about resource adequacy and related costs in regions with and without capacity markets, we analyzed data from the four RTOs with capacity markets, the North American Electric Reliability Corporation (NERC),<sup>4</sup> and an independent proprietary database (SNL Financial) to describe trends in resource adequacy in the United States.<sup>5</sup> We obtained summary data on resource adequacy from RTOs for the years in which these RTOs had operating capacity markets to summarize trends in resource adequacy and related auction prices. We also reviewed resource adequacy projections developed by NERC. In addition, we obtained data on the costs of wholesale electricity markets from the four RTOs with capacity markets for available years. We took steps to assess the reliability of all data used for this report, including reviewing documentation on the data, interviewing knowledgeable officials, and reviewing the data for errors and inconsistencies. We found the data from the RTOs and SNL Financial to be sufficiently reliable for the purposes of our reporting objectives. Detailed analysis and more information on our approach to reviewing the data on resource adequacy can be found in appendix I. More detailed data about market costs and prices can be found in appendix II and III, respectively. We also reviewed FERC's Common Metrics Report, which includes data on the performance of organizations operating the electrical grid for several regions with and without capacity markets. However, we identified errors and inconsistencies in the FERC Common Metrics Report that made it unreliable for the purposes of our reporting objectives. These problems are described in detail later in our report.

To examine the oversight of capacity markets, we reviewed RTO regulatory filings made with FERC pertaining to capacity markets. We also reviewed FERC decisions outlined in FERC orders approving and

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<sup>4</sup>NERC is the federally designated U.S. Electric Reliability Organization and is overseen by FERC. NERC has responsibility for conducting reliability assessments and developing and enforcing mandatory standards to ensure the reliability of the bulk power system—that is, facilities and control systems necessary for operating the transmission system, as well as certain generation facilities needed for reliability.

<sup>5</sup>S&P Global Market Intelligence is a provider of financial data, news, and analytics. The data sourced in this report are from S&P Global Market Intelligence's SNL Financial database, which has information on power plant generating units. For this report, we refer to the source of the data for our analysis as SNL Financial.



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denying proposals to change capacity market rules. We reviewed internal FERC documents that described FERC's oversight process, including policy and procedure manuals and internal memorandums. We reviewed reports developed by the RTOs and independent market monitors providing their analysis of capacity market results, as well as FERC orders and RTO rules describing the oversight responsibilities of the RTOs and independent market monitors. In addition, we interviewed representatives from the RTOs and independent market monitors, as well as FERC officials responsible for oversight of capacity markets. These interviews included a focus on how FERC officials obtain information to assess proposed changes to capacity market rules, how they analyze the results of capacity market auctions, and how they coordinate their oversight activities with independent market monitors and the RTOs. We assessed FERC's oversight process against leading practices for planning.<sup>6</sup> We also considered standards established in GAO's *Standards for Internal Control in the Federal Government*.<sup>7</sup>

We conducted this performance audit from March 2016 to December 2017 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.

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## Background

This section provides information on maintaining the reliability of the electricity grid, regulation of electricity markets, planning and financial

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<sup>6</sup>Specifically, we assessed FERC's oversight process against requirements in the Government Performance and Results Act of 1993 (GPRA), as significantly enhanced by the GPRA Modernization Act of 2010, Pub. L. No. 103-62, 107 Stat. 285 (1993) and Pub. L. No. 111-352, 124 Stat. 3866 (2011). While these requirements are only applicable at the agency level, we have previously reported that they can serve as leading practices for planning at lower levels of the agency, such as individual programs or initiatives. GAO, *Grants Management: EPA Partially Follows Leading Practices of Strategic Workforce Planning and Could Take Additional Steps*, [GAO-17-144](#) (Washington, D.C.: Jan. 9, 2017) and *Environmental Justice: EPA Needs to Take Additional Actions to Help Ensure Effective Implementation*, [GAO-12-77](#) (Washington, D.C.: Oct. 6, 2011).

<sup>7</sup>GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

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incentives for ensuring the adequacy of resources to meet customers' electricity needs, and regional approaches to ensuring the adequacy of such resources.

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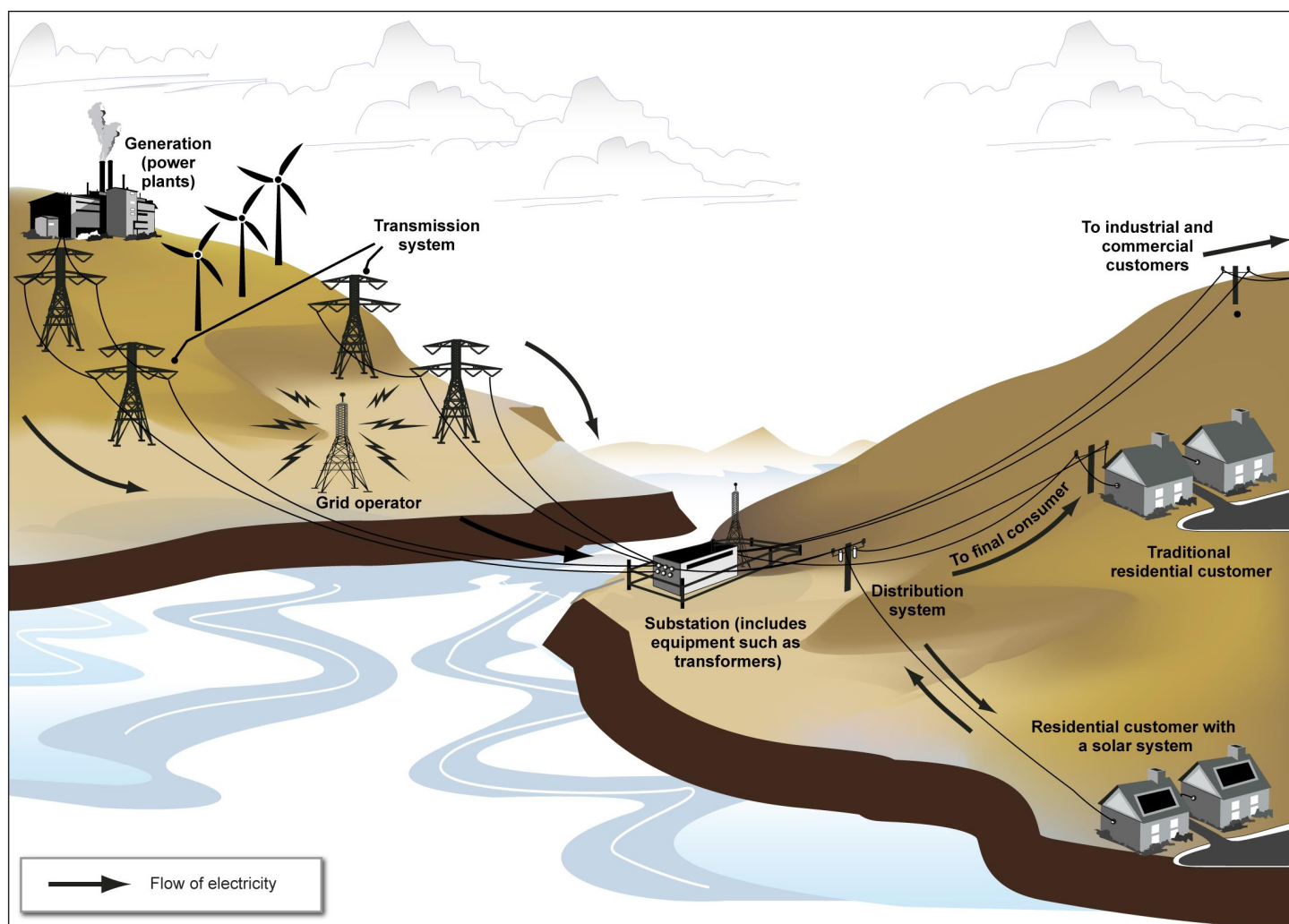
## Maintaining the Reliability of the Electricity Grid

Electricity is supplied through a network of power plants and power lines, which is collectively referred to as the electricity grid. The grid comprises four key functions: generation, transmission, distribution, and grid operations (see fig. 1). Electricity can be generated at power plants by burning fossil fuels such as coal, natural gas, or oil; through nuclear fission; or by harnessing renewable sources such as wind or solar. Once electricity is generated, it is transmitted over high-voltage, long-distance transmission lines to transformers that convert it to a lower voltage to be distributed through a local distribution system for use by residential and other customers. Grid operators manage the physical transmission of electricity and determine which power plants supply the electricity to meet customers' electricity needs. Electricity suppliers coordinate the financial sale of electricity to customers. In some regions of the country, the grid operator and electricity supplier are the same entity, often referred to as an "integrated utility." In other parts of the country, different entities fulfill these responsibilities.<sup>8</sup>

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<sup>8</sup>In this report, we use the term "grid operator" to refer to entities responsible for planning and operating the grid. We use the term "electricity supplier" to refer to entities responsible for selling electricity to customers.

Figure 1: The Electricity Grid



Source: GAO. | GAO-18-131

As previously reported by GAO, because electricity is not typically stored in large quantities, grid operators constantly balance the generation and consumption of electricity to reliably deliver electricity to customers as needed. To accomplish this, grid operators must have adequate resources available to meet the highest levels of customers' electricity needs. These resources include power plants with sufficient generating capacity—the maximum capability of a power plant to generate electricity, typically measured in megawatts (MW). Resources can also include demand-response agreements—agreements with commercial and

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residential customers to reduce their consumption when needed in exchange for a payment. Resources may also include energy efficiency improvements that provide permanent, continuous reductions in electricity consumption. An energy efficiency resource could include the installation of more efficient devices or equipment, such as more efficient lighting.

Maintaining a reliable supply of electricity generally requires grid operators to coordinate three broad types of services as follows:

- **Capacity:** Grid operators ensure there are power plants and other resources with adequate capacity, measured in MW, to reliably meet customers' expected future electricity needs.
- **Energy:** Grid operators schedule which power plants will generate electricity throughout the day to maintain the balance of electricity generation and consumption. As a general rule, grid operators will schedule the least costly power plants to run first and run them longest, and schedule the most costly power plants to run last and run them less often.
- **Ancillary services:** Grid operators procure several ancillary services needed to ensure that supply and demand remain in balance from moment to moment so that they can deliver electricity within technical standards—for example, at the right voltage and frequency. Ancillary services generally involve resources—such as power plants and large consumers of electricity—being available on short notice to increase or decrease their generation or consumption.

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## Regulation of Electricity Markets

In much of the western, central, and southeastern United States, the grid operator role is carried out by integrated utilities that also act as electricity suppliers. These integrated utilities operate the grid and provide generation, transmission, and distribution services to all retail customers in a specified area. In these areas, states oversee utility decisions about the amount of capacity to procure from power plants and other resources but the utilities propose how to procure those resources—for example, by building a new power plant.<sup>9</sup> In other parts of the United States, RTOs act as grid operators and manage regional networks of electric transmission lines that would otherwise be operated by individual utilities. In some RTO

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<sup>9</sup>As a general matter, state governments regulate retail electricity sales and intrastate transmission, often through state public utilities commissions.

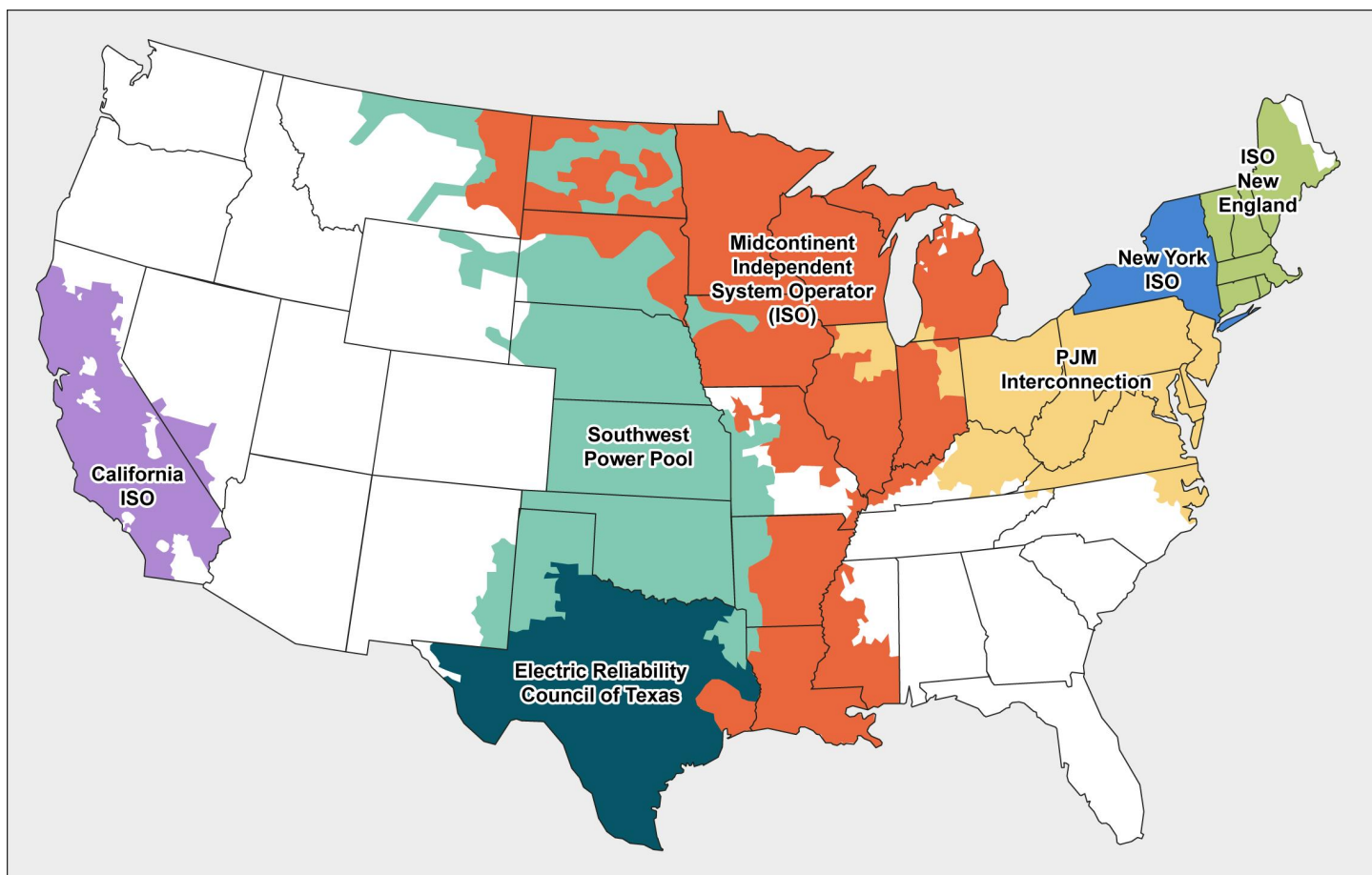
areas, integrated utilities act as electricity suppliers of generation, transmission, and distribution services to retail customers. In other RTO areas, electricity suppliers purchase electricity produced at independently owned power plants to sell to retail customers.<sup>10</sup> Seven RTOs operate across the United States: the California Independent System Operator (California ISO), Southwest Power Pool, Electric Reliability Council of Texas (ERCOT), Midcontinent ISO, PJM Interconnection (PJM), New York ISO, and ISO New England, as illustrated by Figure 2.<sup>11</sup> These RTOs cover part or all of 38 states and the District of Columbia. In addition to their grid operator responsibilities, these RTOs operate wholesale electricity markets to buy and sell services needed to maintain a reliable grid, such as capacity, energy, and ancillary services.

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<sup>10</sup>In these areas, a separate company provides transmission and distribution service to customers, with the RTO coordinating transmission grid operations.

<sup>11</sup>Before the creation of RTOs, FERC approved the creation of entities called independent system operators (ISO). These entities perform many functions similar to those of RTOs. 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 those names.

**Figure 2: Map of Seven Regional Transmission Organizations in the United States**



Sources: Federal Energy Regulatory Commission; Map Resources (map). | GAO-18-131

Note: Many parts of the United States, including the West and Southeast, do not have regional transmission organizations. These areas are unshaded.

Under the Federal Power Act, FERC has oversight of wholesale electricity sales in most of the contiguous United States and is responsible for determining that wholesale prices—including those set in markets operated by RTOs—are just and reasonable and not unduly discriminatory or preferential.<sup>12</sup> As generally set out in FERC Order 719, improving the competitiveness of organized wholesale markets is integral

<sup>12</sup>This authority is granted under sections 205 and 206 of the Federal Power Act, 16 U.S.C. §§ 824d-824e. FERC does not regulate wholesale sales of electricity in ERCOT, which is separate from the rest of the U.S. grid.

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to ensuring prices in these markets are just and reasonable. In its role as regulator of wholesale markets, FERC can penalize market participants that manipulate the market.<sup>13</sup> FERC also requires the RTOs to take steps to monitor the markets.<sup>14</sup> In addition, FERC is responsible for approving and enforcing standards established by NERC to ensure the reliability of the generation and transmission functions of the electricity grid.<sup>15</sup> These standards outline general requirements for planning and operating the bulk power system.<sup>16</sup>

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## Planning and Financial Incentives for Ensuring Resource Adequacy

Grid operators and other entities take steps to ensure there are power plants and other resources (e.g. demand-response agreements) with adequate capacity to meet customers' electricity needs; this is referred to as resource adequacy. To do so, grid operators and other entities<sup>17</sup> (1) make planning decisions to ensure electricity suppliers can meet their customers' electricity needs and (2) develop financial incentives to ensure needed power plants and other resources are built.

Regarding planning decisions, grid operators and others generally develop a plan to ensure power plants and other resources with sufficient capacity are available to meet customers' electricity needs. These plans include ensuring that enough power plants and other resources are available in the case of an unexpected loss of a power plant or higher-than-expected electricity demand. There are three general planning

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<sup>13</sup>Section 222 of the Federal Power Act, 16 U.S.C. § 824v, prohibits market manipulation and authorizes FERC to promulgate rules to protect electric ratepayers.

<sup>14</sup>FERC Order 2000 requires RTOs to monitor the markets, periodically assess market behaviors, and provide reports on market power abuses and market design flaws. In 2008, FERC issued Order 719, which defines market monitor functions as evaluating existing and proposed market rules and recommending proposed changes, reviewing and reporting on the performance of the wholesale markets to the RTOs and others, and identifying and notifying FERC of activities by market participants or RTOs that may require investigation.

<sup>15</sup>16 U.S.C. § 824o(d) (2017).

<sup>16</sup>The bulk power system refers to facilities and control systems necessary for operating the electric transmission network, as well as power plants needed for reliability.

<sup>17</sup>These other entities can include state public utility commissions, other state agencies, and nonprofit entities.

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methods to identify and meet estimated resource needs, based on information from reports we reviewed.

- **Integrated resource planning.** This method is generally used in areas with integrated utilities and involves state regulators reviewing utility estimates of electricity demand as well as proposals on how they intend to meet those needs—for example, by building a new power plant.
- **Resource adequacy requirements.** This method, used in some areas with RTOs, involves a state regulator or grid operator annually establishing a resource adequacy requirement, in MW, that electricity suppliers must meet in order to ensure there are adequate power plants and other resources to meet their customers' electricity needs. Depending on the requirements of the individual RTO, electricity suppliers may be able to meet these requirements by participating in centralized markets, with power plants they own, or by entering into agreements with independent owners of power plants and other resources.
- **Planning estimates.** This method, used in one area with an RTO, ERCOT, involves the grid operator developing an estimate of needed resources for planning purposes but not requiring that electricity suppliers procure this amount of resources or overseeing a formal process for procuring them. This method relies on electricity suppliers to determine how to procure resources and the quantity of resources to procure. The quantity of resources ultimately procured may be higher or lower than the estimate of what is needed.

Regarding developing financial incentives to build and retain power plants, there are two general types, cost-based incentives and market-based incentives, based on information from reports we reviewed.

- **Cost-based incentives.** These are generally used in areas where integrated utilities provide generation service for their customers, for example, by building and operating power plants that supply customers with electricity. With cost-based incentives, a state regulator agrees to set electricity prices at a level that will provide the utility with an opportunity to recover its costs of supplying electricity (e.g. the cost of building and operating a power plant) and earn a rate of return on its investment.
- **Market-based incentives.** Owners of power plants and other resources earn revenue for selling electricity and other services in RTO-operated wholesale markets approved by FERC or through contracts they individually negotiate with electricity suppliers. Market-



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based incentives provide owners of power plants and other resources with the opportunity to recover their costs and earn a profit, but neither of these is guaranteed. When determining whether to build a new power plant or retain an existing plant, power plant owners consider the estimated total revenue they can earn through multiple market-based incentives, including multiple RTO-operated wholesale markets.

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## Regional Approaches to Ensuring Resource Adequacy

In practice, regions across the United States ensure resource adequacy using various approaches comprised of one or more of the planning methods and types of financial incentives described above, based on information we reviewed from industry researchers. The resource adequacy approach used in regions outside RTOs involves integrated resource planning and cost-based incentives. Resource adequacy approaches in regions with RTOs vary, and multiple types of planning methods and financial incentives may be used.<sup>18</sup> A key variation with RTOs' resource adequacy approaches is whether the RTO utilizes a capacity market as part of its approach.

- Three RTOs—the California ISO, Southwest Power Pool, and ERCOT—do not utilize capacity markets as a component of their approaches to ensuring resource adequacy. Instead, to varying degrees, these RTOs provide market-based and cost-based incentives. Both the California ISO and Southwest Power Pool also establish resource adequacy requirements that electricity suppliers must meet. In contrast, ERCOT does not require electricity suppliers to meet a resource adequacy requirement. Rather, the ERCOT market relies on incentives provided through energy and ancillary services markets as well as long-term contracts with electricity suppliers to encourage independent owners of power plants and other resources to build and retain adequate resources to meet customer electricity needs, according to ERCOT officials. According to documentation from ERCOT, prices in its energy market are allowed to rise to higher levels than in other RTOs. This provides an opportunity for owners of power plants and other resources to earn

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<sup>18</sup>In RTO areas with integrated utilities, the process involves integrated resource planning and cost-based incentives, as described above. RTO areas without integrated utilities may establish a resource adequacy requirement that electricity suppliers must meet, and they typically rely on market-based incentives to ensure independent power plant owners build and maintain needed power plants.

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additional revenue in the energy market and provides an economic signal when additional resources are needed.

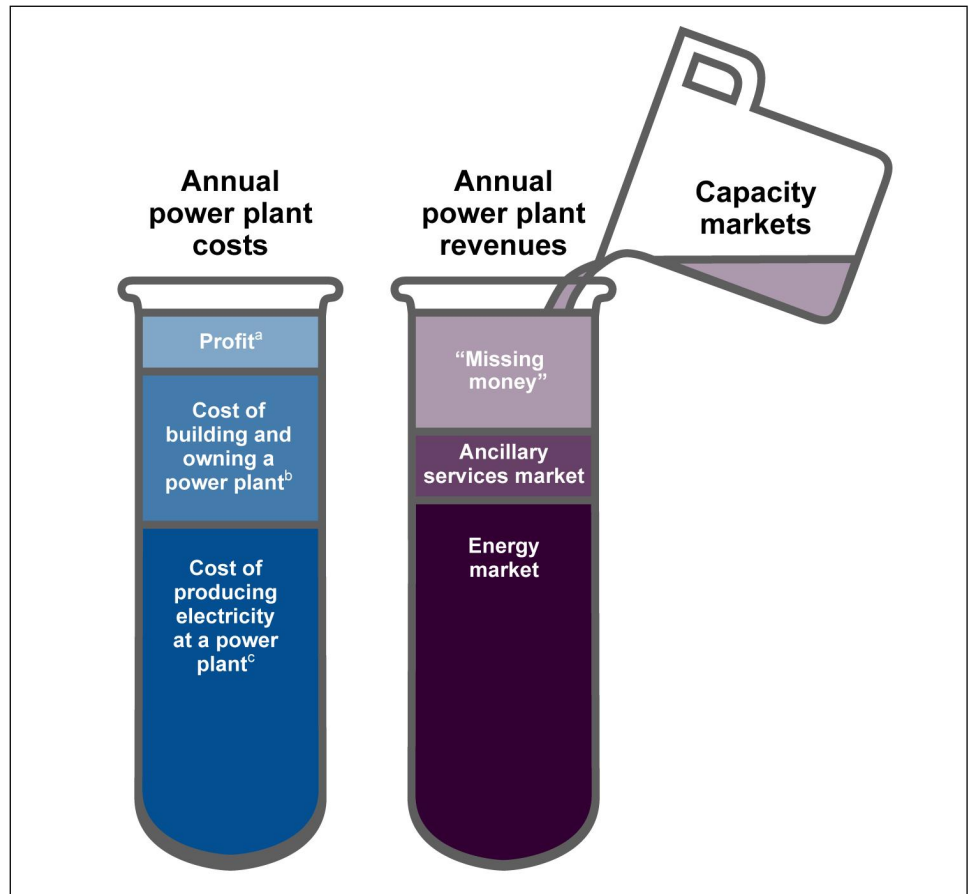
- Four RTOs—ISO New England, Midcontinent ISO, New York ISO, and PJM—use capacity markets as a component of their resource adequacy approaches.<sup>19</sup> More specifically, these RTOs rely on incentives provided through the energy and ancillary services markets they administer, as well as contracts with electricity suppliers to encourage independent owners of power plants and other resources to build and retain adequate resources to meet customers' electricity needs. However, these RTOs have capped how high prices can rise in their energy markets, which can, in addition to other factors, reduce the revenue available to power plant owners through these markets.<sup>20</sup> This may result in what some RTO officials and others have referred to as “missing money”—insufficient revenue to fully cover the cost of building and operating the plants needed to meet resource adequacy requirements. These RTOs have designed additional markets—capacity markets—to address concerns that revenue from the energy and ancillary services markets is not sufficient to cover some power plant owners' costs or would not provide sufficient financial incentive for companies to build and retain power plants when and where they are needed. As shown in figure 3, revenue from capacity markets is designed to supplement the revenue that power plant owners earn through the energy and ancillary services markets in these regions and provide the “missing money.”

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<sup>19</sup>As noted above, in some portions of these RTOs, integrated utilities may serve as electricity suppliers.

<sup>20</sup>Another factor is that some RTOs may desire a level of resource adequacy that is higher than what would be achieved using only an energy market.

**Figure 3: Illustrative Example of How Capacity Markets Provide “Missing Money” In a Given Year**



Source: GAO analysis of market monitor and industry documents. | GAO-18-131

Notes: This is an illustrative example of how the annual costs and potential profit of a hypothetical power plant compare to its annual revenues and the role that capacity market revenue can play in providing the “missing money.” The relative sizes of the specific costs and revenues depicted in the graphic are for illustrative purposes only and do not reflect the distribution of actual costs and revenues for a given plant. In practice, owners of actual power plants may have costs and revenues similar to or different from the proportions reflected here. Furthermore, costs and revenues vary from year to year. In any given year, owners of a power plant may earn revenue greater or less than that year’s costs, which affects whether the owners earn any profit and how much profit they earn. Before building a power plant, owners evaluate the total revenues they expect to earn over a power plant’s operational life and compare that to the total expected costs, choosing to build a new power plant if the total revenues exceed total costs and they can earn sufficient profit. As a general matter, owners of existing power plants seek to recover all of their costs from the markets they participate in; if they cannot, they may consider retiring the power plant.

<sup>a</sup>Profit refers to the amount of profit needed to attract and retain investments in power plants.

<sup>b</sup>The cost of building and owning a power plant includes the cost of building the plant and the associated financing costs together with other costs that do not vary with the amount of electricity produced, such as property taxes.

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<sup>c</sup>The cost of producing electricity at a power plant—for example, fuel and some maintenance costs—varies with the amount of electricity produced.

Market participants and others in the electricity industry have had mixed views about the need for, and success of, capacity markets. Some RTOs, market monitors, and industry stakeholders identified benefits they believe these markets have provided, such as helping owners of power plants and other resources offset their costs by providing “missing money”; attracting investment in new, low-cost power plants and other resources; and ensuring resource adequacy. Other industry stakeholders have identified challenges with these markets, including their complexity and their high cost relative to their benefit.

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## Four RTOs Have Developed Different Capacity Markets That Have Changed over Time

The four RTOs that use capacity markets to help ensure resource adequacy have developed different capacity markets that have changed over time. Each of the four markets share broad similarities, including the influence of administrative decisions made by the RTOs. However, even with these similarities, capacity markets in each of the four RTOs have some differences. Furthermore, these markets have undergone changes since their inception.

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## Each of the RTO Capacity Markets Shares Broad Similarities and Is Influenced by Administrative Decisions

The four capacity markets in ISO New England, Midcontinent ISO, New York ISO, and PJM share broad similarities. For example, all four administer periodic auctions to help ensure that there are sufficient power plants and other resources to meet customers’ expected future electricity needs at a price that is as low as possible while still providing adequate financial incentive to build and retain needed power plants, based on our review of RTO and other documents. Owners of power plants and other

resources<sup>21</sup> can earn revenue in capacity auctions in exchange for making a “capacity commitment”—an agreement that their power plants or other resources will be available to meet customers’ electricity needs during a specific future period, called the “delivery period,” if needed.<sup>22</sup> To participate in the auction, owners of power plants and other resources generally “offer” to make a capacity commitment in MW at a specified price. RTOs administer the auction by selecting offers on behalf of electricity suppliers and establishing a final auction price. Capacity commitments procured through the auctions count toward each electricity supplier’s resource adequacy requirement, and each electricity supplier pays a share of the total costs of the capacity commitments, generally in proportion to their customers’ share of the region’s total electricity needs.

Although capacity auctions are a market-based approach to resource adequacy, auction outcomes are influenced by administrative decisions made by the RTO, based on our review of documents, including a 2013 FERC report<sup>23</sup> on capacity markets and reports from academic and industry researchers. Examples of administrative decisions include:

- **Amount of Capacity to Procure.** RTOs make administrative decisions about the amount of capacity commitments to procure through the auctions based on estimates of customers’ future electricity needs.<sup>24</sup> The amount of capacity commitments procured

<sup>21</sup>The four RTOs allow different types of power plants and other resources to participate in the capacity auctions. This includes power plants inside the RTO and power plants outside the RTOs’ boundaries connected by transmission lines that allow electricity to be imported into the RTOs. In addition, the RTOs allow consumers of electricity who enter into demand-response agreements to participate in the auctions. Some RTOs allow energy efficiency resources, as well as qualifying transmission upgrades, to participate in the capacity auctions.

<sup>22</sup>According to representatives from PJM, ISO New England, and Midcontinent ISO, owners of power plants are generally required to participate in capacity auctions in their regions. According to representatives from New York ISO, owners of power plants may be required to participate in capacity auctions in their regions under certain circumstances.

<sup>23</sup>Federal Energy Regulatory Commission, *Centralized Capacity Market Design Elements, Commission Staff Report* (Washington, D.C.: Aug. 23, 2013).

<sup>24</sup>Based on documents we reviewed from Midcontinent ISO and an industry researcher, Midcontinent ISO designed its auction to procure a specific amount of capacity commitments from power plants and other resources. The other three RTOs designed their auctions with an administratively defined, sloped demand curve that, combined with offers from owners of power plants and other resources, determines the specific amount and price of capacity commitments procured through the auction.

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varies from auction to auction and is based on a number of considerations, such as estimates of how demand may change.

- **Limits on Offers.** RTOs may place limits on the price at which owners of power plants and other resources offer to make a capacity commitment. RTOs do so as part of their efforts to ensure auctions produce competitive outcomes in which no one power plant owner can unduly influence the capacity auction price.<sup>25</sup>
- **Capacity Auction Prices.** RTOs make administrative decisions, based on estimates and assumptions of power plant revenue and costs, which affect the price paid for capacity commitments through the auctions. Furthermore, in each of the four RTOs, there is an upper limit on how high the final auction price can rise so that prices do not rise substantially above the regional cost of building a new—typically gas-fired—power plant.

RTOs administer the auctions and, in doing so, select the lowest priced offers to make capacity commitments subject to potential limits on the ability to transmit electricity. Each of the RTOs has identified geographic areas, or zones, where the capacity of transmission lines to transmit electricity into or out of the zone is limited. As a result of these limitations, it may not be possible to bring less expensive electricity from outside the zone to meet customers' electricity needs inside the zone. In this case, capacity commitments may be needed from more expensive power plants and other resources inside the zone, which can raise the auction price in these zones relative to areas without transmission limitations.

Beyond these factors, according to RTO officials and other reports, capacity markets are generally designed to be neutral about the types of power plants and other resources from which they procure capacity commitments. Some RTO officials and other stakeholders told us that as a result of this resource-neutral approach, capacity markets can cost-effectively meet customers' electricity needs using the lowest cost resources available. Other stakeholders have reported that the auctions' focus on cost means that environmental and operational characteristics that have value are not captured in the capacity auction outcomes.

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<sup>25</sup>All four RTOs have developed rules that may place an upper limit on the price at which owners of power plants and other resources offer to make capacity commitments. These maximum offer limits have been implemented differently across RTOs. In addition, three RTOs have placed a lower limit on the price at which owners of some new power plants and other resources can offer to make a capacity commitment.

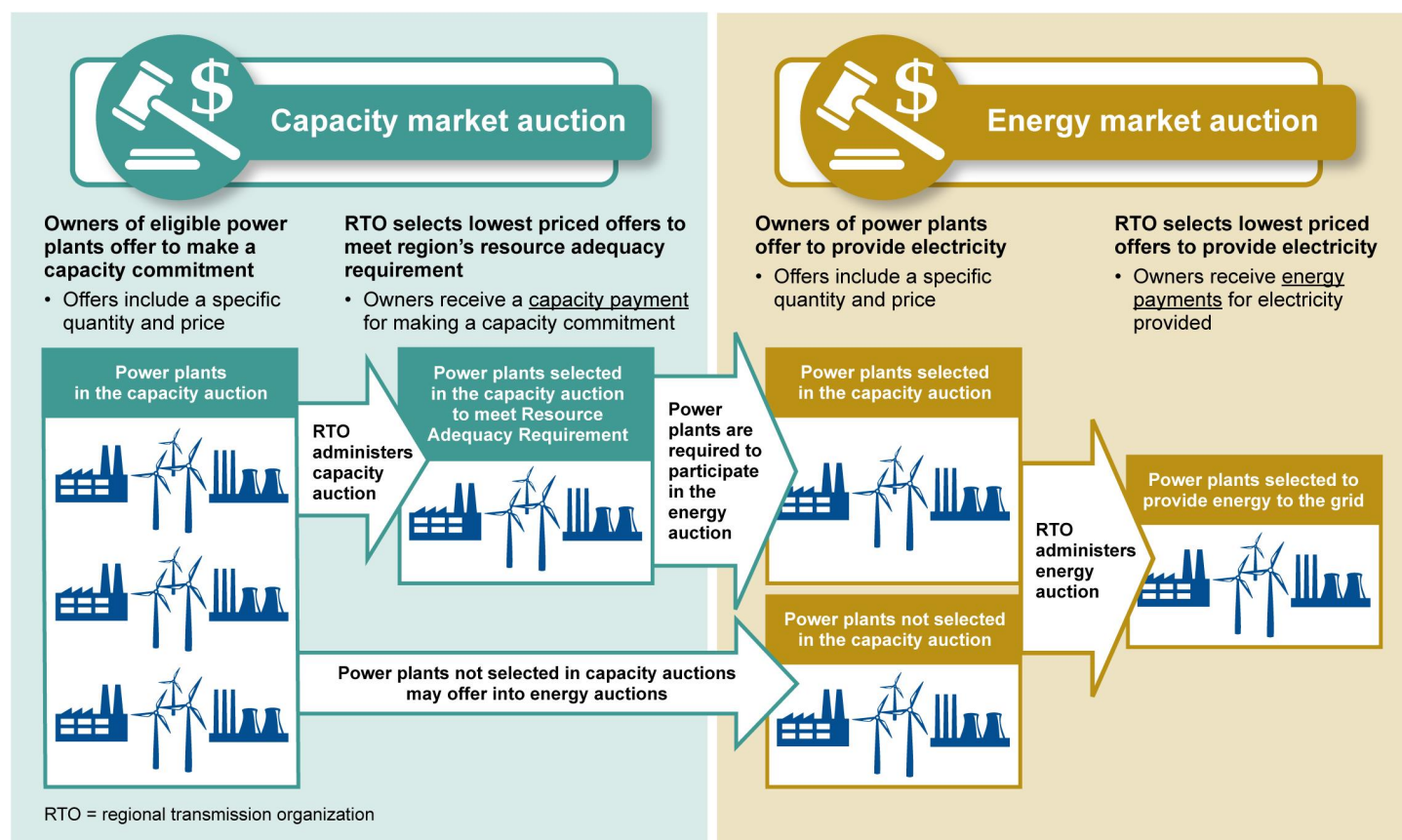
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Owners of power plants and other resources selected in an auction receive payments in exchange for making a capacity commitment.<sup>26</sup> As part of meeting their capacity commitments, RTOs generally require owners of power plants to participate in energy auctions that the RTO operates to meet energy needs throughout the delivery period for the capacity auction. As outlined in figure 4, if owners of power plants and other resources selected in the capacity market auction are also selected in the energy market auction, the owners receive a payment for their capacity commitment as well as a separate payment for the electricity they provide. According to one market monitor we spoke with, owners of some types of power plants—for example, nuclear plants, which operate frequently—earn most of their revenue through the energy markets compared to the capacity markets. However, other power plants—for example, combustion turbines that operate less frequently—earn a greater share through the capacity markets.

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<sup>26</sup>Power plants and other resources that do not fulfill their commitments may be subject to a penalty.

Figure 4: Generalized Description of Power Plant Payments in RTO Capacity and Energy Auctions



Source: GAO analysis of industry documents. | GAO-18-131

Note: The above figure is a generalized representation of how RTOs administer capacity and energy auctions. The details of how auctions are administered and auction requirements vary by region.

## Each of the Four RTOs Implements Its Capacity Market Differently

Even with some overall similarities, the capacity markets in ISO New England, Midcontinent ISO, New York ISO, and PJM have been implemented differently. In particular, each of the four RTOs has developed unique and complex frameworks for how these markets are designed and implemented, including the following three key differences:

- **Requirement to procure capacity commitments through the auction.** The four RTOs with capacity markets vary as to the extent to which they require electricity suppliers in their regions to use capacity



markets to meet their resource adequacy requirement or whether they allow electricity suppliers to meet their resource adequacy requirement using other approaches, based on information we reviewed from RTOs and industry researchers. PJM and ISO New England generally require electricity suppliers to use capacity markets to meet their resource adequacy requirement.<sup>27</sup> In PJM and ISO New England, electricity suppliers procured 93 percent and 97 percent, respectively, of total resource capacity through the auctions administered in 2017.<sup>28</sup> In contrast, Midcontinent ISO and New York ISO do not require electricity suppliers to meet their resource adequacy requirement using the capacity markets administered by the RTOs. Rather, in these regions, electricity suppliers can also meet their resource adequacy requirement outside the auctions, for example, with power plants they own or through contracts negotiated with owners of power plants and other resources. For example, more than one-third of Midcontinent ISO's capacity commitments were procured outside its 2017 auction. Midcontinent ISO's footprint contains many integrated utilities that either own power plants or take steps to procure their own capacity to ensure resource adequacy. (See app. I for additional detail on capacity commitments procured through the auctions and outside the auctions in the four RTOs with capacity markets.)

- **Auction delivery period and timing.** The RTOs vary in the length of the delivery period for the capacity commitments being auctioned and how far in advance of the delivery period they hold the auctions, based on information we reviewed from RTOs and industry researchers. (See fig. 5.) New York ISO oversees a series of capacity auctions—a seasonal auction, a monthly auction, and a final auction—that take place between 6 months and a few days before a 1-month delivery period. In Midcontinent ISO, a single auction for

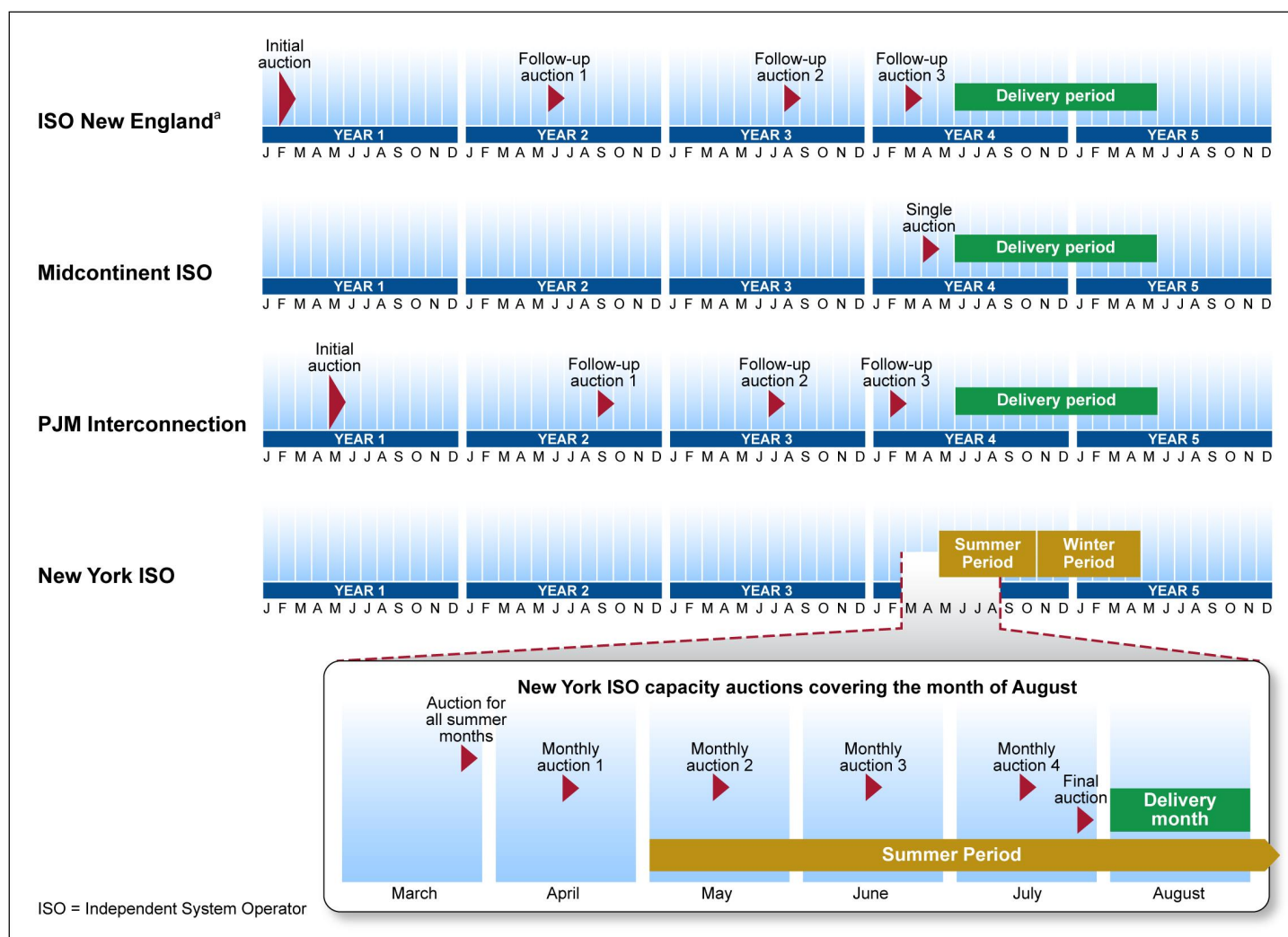
<sup>27</sup>In ISO New England, capacity commitments procured through the auctions exclude capacity commitments obtained through an interconnection project with Canada. In PJM, under certain circumstances, electricity suppliers may be exempted from using the capacity auctions. Under the “Fixed Resource Requirement” approach, PJM allows electricity suppliers who are fully able to meet their resource adequacy requirements—for example, with power plants and other resources they own or through individual agreements they negotiate—to opt out of PJM's capacity market auctions.

<sup>28</sup>According to PJM representatives, capacity auction rules can accommodate electricity suppliers that own power plants and other resources or that negotiate contracts for these resources directly. Such arrangements are facilitated through the PJM capacity market because the electricity supplier's costs are offset by the revenue received by its own power plants through the auction.

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capacity is held 2 months in advance of a 1-year delivery period. Because these capacity auctions are held close to the period when the resources are needed, only owners of existing power plants that are already built can participate in these auctions, according to RTO officials. In contrast, ISO New England's and PJM's primary capacity auctions are approximately 3 years in advance of a 1-year delivery period. According to RTO officials in these regions, this 3-year period allows investors who plan to build, but have not yet built, a power plant to participate in the auctions and potentially be selected to make a capacity commitment before making their major investment to build the power plant. According to FERC and RTO officials, prices in these advance capacity auctions, combined with expected revenue from other wholesale markets, can provide a market signal about whether new power plants are needed. According to data from ISO New England and PJM, in the auctions administered in 2017, approximately 1 percent and 2 percent, respectively, of all resource capacity procured was from new power plants and modifications to existing power plants that allowed them to generate more electricity than they had in the past. See appendix I for more detail. Both ISO New England and PJM conduct subsequent auctions to account for changes in the amount of resources that electricity suppliers are expected to need to meet customers' electricity demand. These subsequent auctions provide opportunities for owners of power plants and other resources who obtained capacity commitments to transfer these commitments to others.

Figure 5: Capacity Market Auction Time Frames and Delivery Periods



Source: GAO analysis of regional transmission organization documents. | GAO-18-131

<sup>a</sup>In addition to the auctions shown in the graphic, ISO New England holds follow-up auctions during the delivery year to allow owners of power plants and other resources and electricity suppliers to adjust their capacity commitments.

- Auction format.** According to industry researchers and RTO and other documents we reviewed, within the four capacity market auctions, the particular auction format used to procure the capacity commitments varies. For example, in PJM, Midcontinent ISO, and New York ISO, owners of power plants and other resources “offer” to make a capacity commitment at a specified price that is not revealed to the other market participants. The RTO then sequences the offers

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from lowest price to highest price. Beginning with the lowest priced offers, these RTOs select as many offers as are needed to meet the electricity needs of customers in the region. In contrast, ISO New England follows what is referred to as a “descending clock” auction, in which the RTO administratively determines a starting auction price and then begins to lower the price. In this type of auction, owners of power plants and other resources participating in the auction exit the auction as the price drops below the price at which they are willing to make a capacity commitment. Once the auction reaches a price at which the exit of additional power plants and other resources would cause the RTO to miss its resource adequacy requirement, the auction stops. In all four RTOs, the final price established in the auction is paid to all owners of power plants and other resources whose offers to make a capacity commitment are selected, regardless of what offer price they submitted.

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## Capacity Markets Have Changed over Time

Capacity markets in all four RTOs have undergone multiple changes since they were initially developed, based on FERC and RTO documents we reviewed. FERC officials estimated that there have been 190 proposals to change capacity markets from 2012 through July 2017, of which 125 were approved and resulted in a change to the markets.<sup>29</sup> Capacity market changes allow RTOs to make improvements and adapt to changes in the industry and the market; however, frequent rule changes may create uncertainty for market participants. Some of these rule changes affect how the auctions are implemented from year to year. For example, RTOs have periodically changed the boundaries of capacity zones in their regions to better reflect transmission constraints. Other changes to capacity markets have affected the auction’s underlying design. For example, in 2014 and 2015, ISO New England and PJM separately received approval from FERC to modify their capacity markets to better ensure that power plants with capacity commitments were available to generate electricity when they agreed to be.

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<sup>29</sup>This includes FERC’s combined estimate of the number of filings under sections 205 and 206 of the Federal Power Act related to capacity markets. See 16 U.S.C. §§ 824d-824e (2017).

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## Comprehensive, Consistent Information Is Not Available on Resource Adequacy or the Costs of Ensuring It in Regions with and without Capacity Markets

Regions with and without capacity markets collect different information on the extent to which resource adequacy has been maintained and on the costs of ensuring resource adequacy, which results in information that is not comprehensive and consistent. Additionally, information on the total cost to customers of ensuring resource adequacy is not consistent across regions with and without capacity markets. FERC's Common Metrics Report contains additional data on trends in resource adequacy and related costs, but we identified problems with the quality of this data.

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## Available Information on Resource Adequacy Is Not Comprehensive and Consistent, but Projections Indicate Regions Are Expected to Maintain Resource Adequacy, and the Types of Power Plants Available Have Changed

Consistent information is not available on historical levels of resource adequacy because regions collect different information, but projections made by NERC based on data from grid operators indicate that most regions are expected to maintain adequate resources from 2017 through 2026. Additionally, regions with and without capacity markets have experienced changes in the types of power plants available, which can affect how these regions ensure adequate resources are available to meet customer needs.

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Regions Collect Different Information on the Historical Levels of Resource Adequacy, but Projections Indicate Most Regions Are Expected to Maintain Adequate Resources

Historical information collected by grid operators, including RTOs, on levels of resource adequacy maintained across regions differs, which makes data provided by these regions difficult to compare. All four RTOs with capacity markets —ISO New England, Midcontinent ISO, New York ISO, and PJM—collect and publish data that summarize the results of their capacity auctions and that show the amount of capacity commitments the RTOs procured to meet resource adequacy requirements. These data indicate that each RTO has met region-wide resource adequacy requirements—the combined requirement for all of the electricity suppliers in an RTO region—through capacity commitments procured in and out of the capacity markets. (See app. I for more detailed results, by auction, for each RTO with a capacity market.) However, because of variations in capacity market designs, RTO data have substantial differences that may limit direct comparison across RTOs with capacity markets, according to FERC officials we interviewed. For example, New York ISO operates a series of capacity auctions for each delivery month, whereas the other three RTOs primarily procure commitments in a single auction for an entire delivery year. Because of this design difference, auction results for New York ISO cover a different time frame than the auction results for other regions and are not directly comparable.

Furthermore, due to differences in regional approaches to ensuring resource adequacy, consistent data on resource adequacy are not available in regions without capacity markets. More specifically, the data on capacity commitments, which are an indicator of resource adequacy in regions with capacity markets, are not available for regions outside RTOs or for areas served by RTOs that do not operate capacity markets. In regions outside RTOs, utilities typically own power plants or procure access to power plants through long-term contracts they negotiate with power plant owners, so they do not need to procure capacity commitments from owners of each power plant on a yearly or monthly basis. In addition, the three RTOs without capacity markets take different approaches to reporting on resource adequacy in their regions. For example, according to ERCOT representatives, ERCOT does not collect data on the amount of capacity commitments procured because the RTO does not establish a resource adequacy requirement for electricity suppliers or require electricity suppliers to procure capacity commitments. The two other RTOs that do not use capacity markets—California ISO

and Southwest Power Pool—establish resource adequacy requirements for electricity suppliers and receive information from electricity suppliers that show how they expect to meet their requirements. However, neither RTO has published historical information comparable to the information published by the RTOs with capacity markets, based on our review of information provided by the RTOs.

Although consistent historical data on resource adequacy are not available, forward-looking, regional projections developed by NERC provide insight into the future capacity of power plants that are expected to be available in regions relative to the overall level of demand—an indicator of future levels of resource adequacy. According to projections developed by NERC, all regions of the country are expected to maintain projected reserve margins—the percentage of power plant capacity above expected demand—at 16 percent or higher from 2017 through 2021.<sup>30</sup> During this period, all regions are expected to maintain reserve margins above planning targets set by the regions' grid operators. NERC's projections show declines in expected reserve margins over the longer term in most areas of the country, but most regions of the country are still expected to maintain reserve margins above their planning targets.<sup>31</sup> NERC officials we interviewed stated that NERC's projections are based on the latest resource adequacy data and that, over long periods, there is uncertainty related to resource availability. For example, power plant owners may choose to retire a plant earlier than what is reflected in the NERC assessment. As a result, NERC projections may not represent actual capacity commitments procured or capacity that will definitely be available.

#### Regions with and without Capacity Markets Have Experienced Changes in the Power Plants Potentially Available to Meet Customers' Electricity Needs

Although there are differences in the availability of historical data on resource adequacy across the United States, national data we obtained

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<sup>30</sup>NERC's projections are from its electricity supply and demand database as of 2016 and are based on data and information collected from NERC regions. These regions include the RTOs as well as regions of the country without RTOs, such as the southeastern United States.

<sup>31</sup>Midcontinent ISO's anticipated reserve margin—a reserve margin calculated by NERC based on the resources that are most likely to be available—is projected to drop below its planning targets from 2022 through 2026.

from SNL Financial provide information on the generating capacity of power plants across the United States.<sup>32</sup> These data do not specifically reflect the availability of plants to meet customers' electricity needs at a given time because, among other things, they do not account for power plant outages and other contingencies. However, these data provide some insight into resource adequacy by providing a measure of the maximum generating capacity potentially available from power plants in a region and how the types of plants available have changed over time.

According to our analysis of these data, from 2006 to 2017, the total capacity of power plants grew approximately 11 percent, from approximately 1,023,000 MW to 1,140,000 MW.<sup>33</sup> In the seven RTOs and two geographic regions without RTOs (one in the southeast and one in the west) that we analyzed, all regions experienced increases in total generating capacity. In addition, each of these regions has experienced changes in the types of power plants available to ensure resource adequacy. For example, all saw dramatic increases in generating capacity from solar and wind plants, and seven of the nine regions had increases in power plants fueled by natural gas.<sup>34</sup> Over the same period, seven of the nine regions experienced declines in generating capacity from coal-fueled power plants through retirements of existing units.<sup>35</sup> Specifically, our analysis of SNL Financial data indicates that from 2006 through 2016, power plant owners retired approximately 53,000 MW of

<sup>32</sup>For the purpose of this analysis, we classified power plant units as being in an RTO if that RTO was responsible for decisions about when the unit sent electricity to the grid. We classified power plant units outside an RTO based on their NERC region. Specifically, the western region is made up of units in the Western Electricity Coordinating Council region that were not controlled by California ISO. The southeast region is made up of units in SERC Reliability Corporation and Florida Reliability Coordinating Council not controlled by an RTO. We excluded Alaska, Hawaii, and a small number of units that could not accurately be placed in a region. SNL Financial's data classifies power plant units based on the most recent available information for each RTO.

<sup>33</sup>2017 figures represent available data on power plant capacity as of July 2017.

<sup>34</sup>The regions that experienced increases in natural gas generating capacity included regions with and without capacity markets. Regions without capacity markets that experienced increases were: California ISO, Southwest Power Pool, the Southeastern Region, and the Western Region. Regions with capacity markets that experienced increases were: ISO New England, New York ISO, and PJM.

<sup>35</sup>The regions that experienced declines in coal-fueled power plant capacity included regions with and without capacity markets. Regions without capacity markets that experienced declines were: California ISO, the Southeastern Region, and the Western Region. All RTO regions with capacity markets experienced declines.

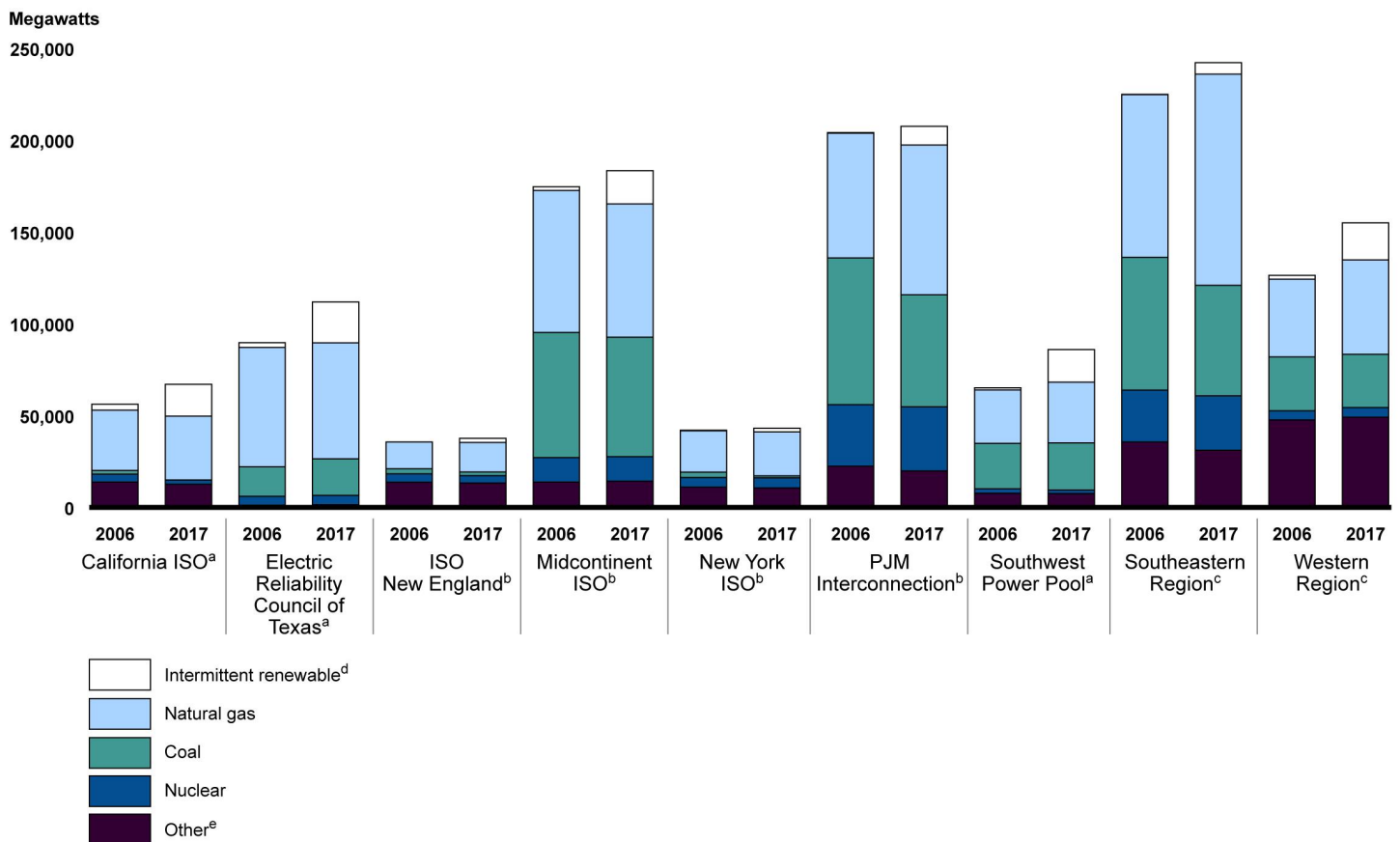


coal-fueled capacity (18 percent of coal capacity operating in 2006). Furthermore, approximately 12,000 MW of additional coal capacity was scheduled for retirement across several regions from 2017 through 2021.<sup>36</sup> Figure 6 shows the changes in power plant capacity by fuel source and region from 2006 to 2017, based on our analysis of SNL Financial data. We previously reported that a variety of factors were driving changes in the types of power plants available to produce electricity, such as low natural gas fuel prices, increases in coal prices, state and federal policies, and low expected growth in demand for electricity.<sup>37</sup>

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<sup>36</sup>Figures reflect data obtained from SNL Financial as of July 2017. Generating capacity for power plants projected to begin operation or retire after that point are based on scheduled times in SNL's database at the time we accessed the data.

<sup>37</sup>GAO, *Electricity: Generation Mix Has Shifted, and Growth in Consumption Has Slowed, Affecting System Operations and Prices*, [GAO-15-524](#) (Washington, D.C.: May 29, 2015); and GAO, *EPA Regulations and Electricity: Update on Agencies' Monitoring Efforts and Coal-Fueled Generating Unit Retirements*, [GAO-14-672](#) (Washington, D.C.: Aug. 15, 2014).

**Figure 6: Power Plant Generating Capacity by Fuel Type and Region of the Country, for 2006 and 2017**

ISO = Independent System Operator

Source: GAO analysis of SNL Financial data. | GAO-18-131

Notes: For the purpose of this analysis, we classified power plant units as being in a regional transmission organization (RTO) if that RTO was responsible for decisions about when the unit sent electricity to the grid. We classified power plant units outside an RTO based on their North American Electric Reliability Corporation regions. Specifically, the western region is made up of units in the Western Electricity Coordinating Council region that were not controlled by California ISO. The southeast region is made up of units in SERC Reliability Corporation and Florida Reliability Coordinating Council not controlled by an RTO. We excluded Alaska, Hawaii, and a small number of units that could not accurately be placed in a region. SNL Financial's data classifies power plant units based on the most recent available information for each RTO. 2017 figures represent available data on power plant capacity as of July 2017.

<sup>a</sup>Regional transmission organizations without capacity markets.

<sup>b</sup>Regional transmission organizations with capacity markets.

<sup>c</sup>Regions without regional transmission organizations.

<sup>d</sup>Intermittent renewable power plants are powered by wind or solar sources.

<sup>e</sup>Other sources include biomass, geothermal, hydroelectric, and non-renewable resources, such as propane.

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Changes in the types of power plants available in a region can affect the region's resource adequacy and introduce other challenges for meeting customers' electricity needs, according to our review of RTO and NERC reports. For example, grid operators in regions that rely substantially on power plants fueled by intermittent sources of renewable energy—such as solar and wind power—may need to ensure they have adequate power plants available that are capable of rapidly increasing their electricity generation when electricity provided by solar and wind power plants declines. According to a California ISO representative and RTO documents we reviewed, the California ISO—which manages an area with a significant percentage of intermittent renewable generating capacity—requires electricity suppliers to procure a specified amount of flexible resources. This can include power plants fueled by natural gas with the capability of quickly increasing or decreasing their electricity generation to accommodate changes in the electricity generation of intermittent renewable sources. Moreover, regions that rely heavily on a particular resource—for example, natural gas—can face greater risk of not ensuring resource adequacy than plants with a more diverse portfolio of resources, according to NERC reports we reviewed, and these regions may need to take steps to mitigate those risks.<sup>38</sup> For example, ISO New England—one of the regions NERC identified as heavily reliant on natural gas—developed a program to promote reliability in the winter when natural gas supplies can become constrained. According to ISO New England representatives, this program, which will terminate after the 2017-2018 winter, was designed to ensure there are adequate inventories of oil, additional demand-response resources, and contracts for liquefied natural gas.

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### Information on the Total Cost of Ensuring Resource Adequacy Differs across Regions with and without Capacity Markets

The availability of information on the total cost of ensuring resource adequacy differs across regions with and without capacity markets. Regions can use a mix of different approaches to compensate owners for

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<sup>38</sup>North American Electric Reliability Corporation, *2016 Long-Term Reliability Assessment* (December 2016); and North American Electric Reliability Corporation, *2013 Special Reliability Assessment: Accommodating an Increased Dependence on Natural Gas for Electric Power Phase II: A Vulnerability and Scenario Assessment for the North American Bulk Power System*. (May 2013).

the costs of building and retaining power plants—including contracts negotiated with electricity suppliers, wholesale electricity markets operated by the RTOs, and cost-based incentives. However, comprehensive data are not publicly reported on one of these approaches—contracts negotiated between power plant owners and electricity suppliers—according to FERC officials and representatives of RTOs we interviewed.<sup>39</sup> Such contracts can be an important tool in maintaining resource adequacy in some areas. For example, California ISO's approach relies heavily on contracts to secure commitments from owners of power plants to be available to provide electricity, including long-term contracts over many years and short-term contracts to meet monthly needs, according to representatives from California ISO. In addition, the data that are available on the cost of resource adequacy approaches are not always consistent across regions with RTOs and regions without RTOs. RTOs, including those with and without capacity markets, collect data on the costs associated with procuring specific services, such as capacity, energy, or ancillary services through the RTO-operated wholesale markets. On the other hand, integrated utilities, which serve as electricity suppliers in regions without RTOs and in some RTO regions, collect data on the costs of building, operating, and maintaining power plants—data that are not readily comparable to auction data collected by RTOs. As a result of the differences in the data collected by grid operators and the lack of data for some costs, comprehensive, consistent data are not available on the total cost of ensuring resource adequacy across the country.

Data collected by the RTOs with capacity markets, however, provide insight into the wholesale cost of ensuring resource adequacy in these regions, though these data are not comparable across these RTOs, in part because they do not always represent the full cost of resource adequacy in these regions. The wholesale markets operated by the RTOs—including capacity, energy, and ancillary services markets—collectively provide financial incentive to power plant owners to build and retain power plants. Energy markets have accounted for the largest portion of RTO market costs across RTOs with capacity markets, according to data we obtained from four RTOs, often more than 80 percent (see fig. 7). Specifically, from 2013 through 2016, the period of time during which all four of these RTOs had operating capacity markets,

<sup>39</sup>According to FERC officials, FERC receives information on some, but not all, contracts negotiated between power plant owners and electricity suppliers. However, this contract information is not directly connected to capacity market activities.

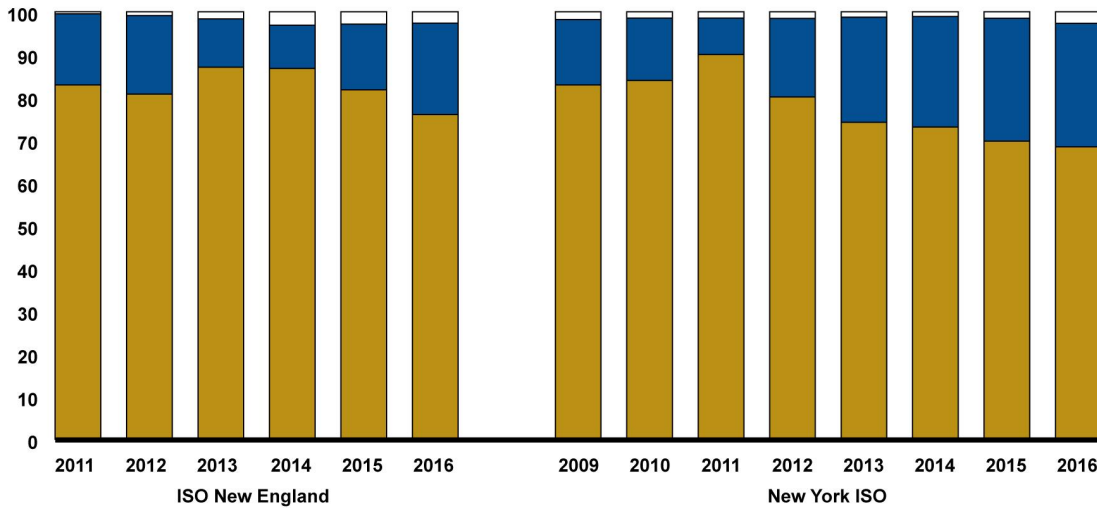
they had combined energy market costs of approximately \$271 billion dollars, capacity market costs of \$51 billion, and ancillary services market costs of \$5 billion.<sup>40</sup> (See app. II for more data on costs of markets operated by the RTOs.) However, these costs may not represent the total cost associated with ensuring resource adequacy in these RTOs, because electricity suppliers may procure capacity commitments outside the auctions. For example, Midcontinent ISO meets approximately one-third of its resource adequacy requirement through mechanisms outside the RTO-operated markets, such as through contracts negotiated with electricity suppliers or direct ownership of power plants by electricity suppliers. Available data we obtained on the cost of ensuring resource adequacy for Midcontinent ISO and the other RTOs do not reflect the cost of procuring capacity outside the auction. Furthermore, the degree to which the costs of wholesale markets operated by the RTOs are passed through to retail customers can vary based on several factors.

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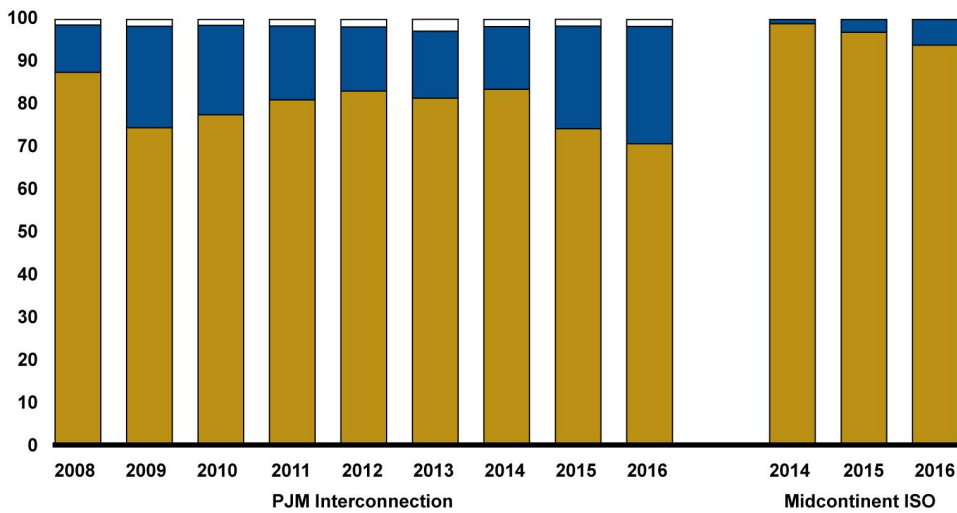
<sup>40</sup>We adjusted data on RTO market costs to 2016 dollars using the Gross Domestic Product price index. The market costs exclude costs for RTO administration and transmission system costs. Midcontinent ISO began operating its capacity market in June 2013, incurring approximately \$15 million in costs in this market for that calendar year. The 2013 costs for Midcontinent ISO are included in the cost calculations above.




**Figure 7: Percentage of Total Market Costs for Available Years for Regional Transmission Organizations (RTOs) with Capacity Markets**

Percentage of total RTO market costs



Percentage of total RTO market costs



 Ancillary services market  
 Capacity market  
 Energy market

ISO = Independent System Operator

Source: GAO analysis of RTO financial data. | GAO-18-131

Note: The figure above includes available data for years in which the RTO operated a capacity market for the full year.

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Variations in the cost of ensuring resource adequacy are influenced by the price of capacity, which has varied over time in each of the RTOs with a capacity market. For example, in PJM, prices for capacity in zones without transmission limitations varied from a low of \$16 per MW-day in the 2012/2013 delivery year to a high of \$174 per MW-day for the 2010/2011 delivery year. According to RTO officials, changes in capacity prices over time can reflect several factors, including the availability of power plants and other resources and changes in energy market prices. For example, according to ISO New England representatives, ISO New England experienced low capacity prices in its earlier auctions when the region had power plants and other resources in excess of its capacity needs. However, the region's excess generating capacity has declined as power plants have retired, resulting in higher capacity prices in later auctions, according to ISO New England representatives.

In addition, capacity auction prices vary by location, with differences occurring across and within RTOs. Several factors may contribute to variations in capacity auction prices across RTOs, including differences in the availability and type of resources across regions, differences in regional energy market and fuel prices, and differences in overall market design, among others. Prices have also varied across different zones within each RTO. For example, in the 2016/2017 delivery year for ISO New England, the Boston zone experienced capacity prices of \$222 per MW-day for existing power plants and other resources, compared to \$105 per MW-day in other zones.<sup>41</sup> According to ISO New England documentation we reviewed, transmission limitations into the Boston zone, combined with limited capacity at local power plants, resulted in higher demand for capacity commitments relative to available supply. A new power plant proposed within the zone was able to commit to provide the capacity needed to meet expected customer demand, but at a higher price than in other zones.

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<sup>41</sup>This was the capacity price paid to existing power plants in the Boston zone, converted to dollars per MW-day for consistency. New power plants in the Boston zone received a higher price of \$500 per MW-day.

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## FERC's Common Metrics Report Data Provide Some Useful Information, but We Identified Problems with Their Quality

In addition to the data presented elsewhere in this report, FERC's Common Metrics Report contains some data on trends in resource adequacy and related costs; however, we identified problems with the quality of this data. FERC's Common Metrics Report was developed in response to a recommendation we made in September 2008 on the need for information about the performance of electricity markets.<sup>42</sup> The data in FERC's report provide some insight into individual RTO performance, including, among other things, levels of resource adequacy and wholesale market costs. In particular, FERC collects metrics from RTOs and several non-RTO electricity suppliers covering a 5-year period and publishes them in a report it produces approximately every 2 years, called the Common Metrics Report.<sup>43</sup> FERC's Common Metrics Report includes data on reliability, grid operations, market operations, and RTO organizational effectiveness.<sup>44</sup> According to FERC officials we interviewed, the report was not specifically designed to provide data to assess capacity markets or other approaches to ensuring resource adequacy, and there are differences across these markets that sometimes make comparison challenging. Nevertheless, FERC officials said, the report contains six metrics that could be useful for examining individual capacity markets, including a comparison of actual and planned reserve margins and a metric on wholesale power costs in RTO-operated markets (i.e., for capacity, energy, and ancillary services).<sup>45</sup> For example,

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<sup>42</sup>[GAO-08-987](#).

<sup>43</sup>This report includes information from the four RTOs with capacity markets, two RTOs without capacity markets and several electricity suppliers outside RTOs.

<sup>44</sup>Federal Energy Regulatory Commission, *Common Metrics Report*, Docket No: AD14-15-000 (Washington, D.C.: October 2016). This report contains 30 common metrics from RTOs and non-RTO electricity suppliers. In addition, RTOs voluntarily provided FERC with selected data on RTO-specific metrics that are not comparable to non-RTO electricity suppliers, including organizational effectiveness metrics such as RTO administrative costs and customer satisfaction with RTO performance. Seven non-RTO electricity suppliers provided data to FERC. The 2016 report provides data from 2010 through 2014.

<sup>45</sup>Other potentially relevant metrics identified by FERC include market charges by transaction type, the difference between a new power plant's production costs and energy price received, a count of the number and generating capacity of power plants operating under contracts that require them to run for reliability purposes, and the percentage of demand-response resources out of all generating capacity.



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the comparison of actual and planned reserve margins indicates the extent to which regional approaches to planning for and obtaining an adequate supply of power plants are sufficient. Similarly, information in the report on the total costs paid through the RTO-operated markets illustrates the relative contribution of each market to total costs across the RTOs' markets.

In assessing the reliability of data in FERC's Common Metrics Reports, we identified inconsistencies and errors in the data for resource adequacy metrics that relate to capacity markets and other approaches to maintaining resource adequacy. For example, Midcontinent ISO officials submitted data to FERC for the metric on wholesale power costs using a methodology that did not include costs from capacity markets. More specifically, Midcontinent ISO reported \$0 per MW hour for capacity market costs in 2014 when the market had about \$320 million in costs.<sup>46</sup> This was inconsistent with data submitted by other RTOs with capacity markets, which included capacity costs. In addition, other RTOs submitted incomplete data for this metric or submitted data using different categories than the other RTOs.<sup>47</sup> Data for resource adequacy in the report also contained errors. For example, in the 2014 Common Metrics Report, FERC published a chart incorrectly showing that Southwest Power Pool had lower actual reserve margins than its planned reserve margins in every calendar year from 2006 through 2010.<sup>48</sup> In the subsequent report, published in 2016, FERC reported data from 2010 through 2014 and corrected the error for the year 2010. However, the 2016 report did not address the inconsistency across its 2014 and 2016 reports or discuss the changes from the prior report. As a result, users of these data, such as Congress, stakeholders, and the public—the audiences we noted in our September 2008 report<sup>49</sup>—may interpret the data as showing that Southwest Power Pool reversed a trend of low actual reserve margins as opposed to understanding that the data from prior years were incorrect.

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<sup>46</sup>We adjusted RTO market cost data to 2016 dollars using the Gross Domestic Product price index.

<sup>47</sup>The Common Metrics Report stated that data were not available for 2010 through 2013 for Southwest Power Pool and that data were not available for 2014 for California ISO.

<sup>48</sup>The 2014 Common Metrics report provided data from 2006 through 2010.

<sup>49</sup>[GAO-08-987](#).

FERC could improve the quality of its data if it used standardized definitions for the metrics and included more quality checks in its data collection process. FERC officials stated that when developing the metrics, they worked with RTOs and non-RTO electricity suppliers to identify the common metrics that could be collected; however, FERC has not developed an approach to promote data consistency where possible, such as establishing definitions for key terms and metrics. Instead, FERC accepts data however it is provided by the RTOs and non-RTO electricity suppliers, according to FERC officials. As such, RTO and non-RTO electricity suppliers may submit and FERC may publish inconsistent data in instances where additional consistency is possible. Furthermore, FERC's quality checks historically have been limited. For its first two metrics reports, FERC officials told us they only collected graphs of the metrics data, rather than the underlying data itself. This limited FERC's ability to conduct quality checks on the metrics it published. FERC officials told us they began collecting the actual data for the metrics for the 2016 report, allowing them to conduct basic quality assurance checks, including verifying that the data they published matched what was submitted by RTOs and non-RTO electricity suppliers. However, according to FERC officials, while they conducted a high-level review of data submissions for reasonableness, they did not validate the data.<sup>50</sup> Without validating the data, FERC is unable to assure that metrics were calculated accurately and, where possible, were comparable to other data being reported. Under federal standards for internal control, agencies should use quality information to achieve their objectives.<sup>51</sup> Quality information can include, among other things, information that is complete, accurate, and provided on a timely basis so that it can be used for effective monitoring.

FERC officials acknowledged the problems we identified with the data collected for the Common Metrics Report and, in response to concerns we raised, stated that they are considering additional steps for the upcoming Common Metrics Report. Steps under consideration include developing a reference guide to define the metrics and key terminology and transitioning to a structured data collection tool. However, FERC has

<sup>50</sup>This review led to individual follow-ups with respondents and data corrections for some metrics. However, these checks were not sufficient to correct errors identified by GAO or ensure that the underlying data were valid or accurate. In addition, FERC issued two errata for this report, one in October 2016 and one in August 2017 with further corrections to the report.

<sup>51</sup>[GAO-14-704G](#).

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not initiated the process to collect information for the upcoming Common Metrics Report and has not taken actions to implement changes in its data collection processes. Without taking sufficient steps to improve the quality of data, there continues to be a risk that errors, missing data, and inconsistent reporting of data will reduce the quality of reports published by FERC, a source of data that could be used to better understand capacity market performance. Improving the quality of the data FERC collects and publishes could enhance the ability of FERC and Congress to understand trends in the markets and oversee these markets.

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## FERC Oversees Capacity Markets with Assistance from Other Entities but Has Not Fully Assessed the Overall Performance of These Markets or Risks to Achieving Their Objectives

FERC, with assistance from other entities, oversees capacity markets but has not assessed the overall performance of these markets or risks to achieving their objectives. FERC and other entities conduct various oversight activities and take steps to address concerns that are identified. However, FERC has not assessed overall capacity market performance. FERC also has not taken steps to fully assess and respond to risks to achieving capacity markets' objectives.

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## FERC and Other Entities Conduct Various Oversight Activities and Take Some Steps to Address Concerns That Are Identified

To ensure capacity markets are free of manipulation and to ensure electricity prices are just and reasonable, FERC oversees capacity markets with assistance from the following entities:

- **RTOs.** RTOs are responsible for developing and implementing market rules, approved by FERC, that provide the framework for the design and operation of wholesale electricity markets in general and capacity

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markets in particular. Additionally, FERC required the RTOs to devise an approach to monitor the markets they develop.<sup>52</sup>

- **Independent market monitors.** In the four RTOs with capacity markets, private companies provide independent market monitoring services. Two companies currently provide market monitoring services to the four RTOs with capacity markets: Monitoring Analytics and Potomac Economics. In addition to these independent market monitors, ISO New England and New York ISO have developed internal market monitoring groups that perform additional market monitoring functions, according to RTO documentation.
- **Capacity market stakeholders.** Stakeholders with an interest in the capacity markets include owners of power plants and other resources who offer to make capacity commitments, electricity suppliers who pay for these commitments, owners of transmission lines, state regulators, and consumer advocates. Stakeholders do not have a formal oversight role, but their participation in and observation of the capacity markets allows them to periodically identify potential problems with these markets' design and implementation. FERC and the RTOs provide stakeholders with opportunities to share input with them.

FERC and these entities conduct various oversight activities to identify potential problems with capacity markets that may result in them producing prices that are not just and reasonable. In conducting these activities, RTOs, independent market monitors, and stakeholders gather information on potential problems with capacity markets and share that information with FERC. Examples of oversight activities are listed below.

- **Assessing market competitiveness and efficiency.** FERC has found that market competitiveness is integral to ensuring just and reasonable prices in wholesale electricity markets, one of FERC's requirements under the Federal Power Act.<sup>53</sup> In this context, RTOs and independent market monitors take steps to assess capacity

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<sup>52</sup>Federal Energy Regulatory Commission, *Order No. 2000. Regional Transmission Organizations. Final Rule.* (Washington, D.C.: Dec. 20, 1999).

<sup>53</sup>In the context of capacity markets, competitiveness refers to having sufficient numbers of owners of power plants and other resources competing against each other in the capacity auction so that any individual resource owner cannot unduly influence the final auction price. According to FERC officials, if markets are not deemed competitive, the results that they produce may still be just and reasonable if noncompetitive behavior is mitigated.

market competitiveness and efficiency, including reviewing market participants' behavior before, during, and after the conclusion of capacity market auctions. For example, before and during an auction, RTOs and independent market monitors may analyze whether the market is sufficiently competitive, including to what extent owners of power plants and other resources control a large share of the market and could influence the outcomes of the capacity auction in an uncompetitive way. According to documents we reviewed from RTOs and discussions with a market monitor, this may include an examination of data on market share and power plant costs. In addition, after the auction concludes, independent market monitors conduct market-wide assessments and other analyses to determine whether auctions were efficient and results were competitive, according to documents we reviewed from independent market monitors. These assessments may include an examination of the revenue that owners of power plants earn through the capacity and other markets compared to power plant costs. Such analyses can help the independent market monitors assess whether these markets are providing adequate revenue to ensure that there are sufficient resources to meet customer needs in the region but that owners of power plants are not earning excessive profits.

- **Collecting and disseminating information about capacity markets.** RTOs and independent market monitors collect and disseminate information on capacity markets. Among other things, RTOs and independent market monitors publish regular reports and summaries that can include descriptive information on capacity market prices, total capacity market costs, and the quantity and type of capacity procured. RTOs may also publish more detailed data on capacity auctions. For example, Midcontinent ISO publishes detailed data on capacity market offers made by owners of power plants and other resources.<sup>54</sup> According to FERC officials, the agency receives briefings on auction results from RTOs and holds regular meetings with independent market monitors, during which it reviews auction results.
- **Conducting ad-hoc assessments of specific capacity market issues.** FERC, RTOs, and the independent market monitors conduct ad-hoc assessments of specific capacity market issues. For example, in 2016, PJM issued a report that assessed whether the capacity market and other markets it operates were providing adequate

<sup>54</sup>To protect proprietary information, these data do not identify individual market participants.

incentives to encourage the development of new power plants and other resources when needed in the region.<sup>55</sup> In addition, in 2015, FERC officials assessed how market participants' behavior, including power plant owners' offers to make capacity commitments, had changed in one RTO's capacity market. FERC conducted this assessment to understand how a major modification of that RTO's capacity market rules affected market participant behavior, according to FERC officials.

- **Investigating violations of market rules or law.** FERC, independent market monitors, RTOs, and stakeholders can identify potential violations of capacity market rules or illegal activity. This could include attempts by power plant owners to drive up prices by not offering to make a capacity commitment for all available capacity. Independent market monitors and RTOs may identify concerns through their analysis of detailed market data available to them, while stakeholders may identify concerns through their participation in and observation of the markets. Additionally, FERC conducts routine screening of capacity market outcomes to identify potentially manipulative activities. When other entities refer potentially manipulative activity to FERC or when FERC identifies such activity through its routine screening, its Office of Enforcement can conduct in-depth investigations during which officials collect and examine detailed information from RTOs, market participants, and others. According to FERC officials, from 2010 through 2016, FERC conducted 25 investigations related to capacity markets.<sup>56</sup> For example, according to a 2014 FERC order, after a referral from ISO New England and its independent market monitor, FERC began a non-public investigation into the bidding behavior in ISO New England's eighth capacity auction, including a limited review of the bidding behavior of a particular power plant owner.<sup>57</sup> According to FERC, of the 25 investigations, 23 were started based on referrals from entities other than FERC, primarily independent market monitors; the other 2 investigations began in response to issues identified by FERC. In addition to investigations, FERC officials also conduct routine audits of RTOs and market participants to identify instances in which they are not complying with capacity market rules. According to FERC

<sup>55</sup>PJM Interconnection, *Resource Investment in Competitive Markets*. (May 5, 2016).

<sup>56</sup>According to FERC officials, this includes investigations that were initiated, under way, and terminated during this time frame.

<sup>57</sup>Federal Energy Regulatory Commission, *Order to Show Cause*, (Sept. 16, 2014) 148 FERC ¶ 61,201.

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officials, since 2007, FERC has conducted 41 audits related to capacity markets, 9 of which addressed compliance with market rules.

- **Collecting the views of stakeholders.** RTOs and FERC take steps to collect the views of stakeholders about how capacity markets are performing. For example, as we reported in September 2008, each RTO has a unique process for soliciting stakeholder input (e.g., participating in stakeholder meetings) on various issues, including market rules.<sup>58</sup> FERC gathers input from stakeholders through formal proceedings it conducts to review proposed changes to capacity market rules. In addition, FERC hosted two technical conferences—one in 2013 and one in 2017—related to capacity market issues during which FERC received testimony from various stakeholders about their assessments of the state of capacity markets. At the 2017 conference, for example, several stakeholders raised concerns about capacity market performance, including whether capacity markets ensure adequate resources at a reasonable cost, and discussed whether alternative approaches are needed.
- **Identifying and evaluating the need for changes to capacity market rules.** Various entities have a role in identifying the potential need for changes to capacity market rules. Independent market monitors identify concerns and recommend changes to capacity market rules in their annual, publicly available state-of-the-market reports. For example, in its 2016 annual report about PJM's markets, PJM's independent market monitor identified several capacity market design features that it said could threaten competitive outcomes, and it made recommendations for addressing those concerns through changes to market rules.<sup>59</sup> RTOs also identify the potential need for changes in the course of their operation of these markets as well as through their process for soliciting stakeholder input. FERC is responsible for evaluating the need for changes to capacity market rules and has two ways of doing so. The first begins when an RTO proposes a change to the rules for the capacity market it operates. The second begins when either FERC or any other entity challenges an existing market rule. In both instances, independent market monitors and other stakeholders can comment on the merits of the rules under consideration.

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<sup>58</sup>See [GAO-08-987](#).

<sup>59</sup>Monitoring Analytics, *2016 State of the Market Report for PJM* (March 9, 2017).

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FERC, RTOs, and the independent market monitors take the three following general types of action to address problems that are identified through these oversight activities, according to documents we reviewed from FERC and others:

- **Modify Auction Offers.** RTOs and independent market monitors can modify capacity market offers. According to a FERC report, market power mitigation—in which offers are modified to approximate price levels that would be produced by a competitive market—is designed to ensure competitive offers even when competitive conditions are not present. On the basis of information gathered through their reviews of market competitiveness, RTOs and independent market monitors may take actions—such as placing a cap on the price at which owners of power plants and other resource can offer to provide capacity—to ensure the market produces competitive results. For example, PJM's independent market monitor reported in its 2016 annual report about PJM's markets that PJM's overall capacity market structure was not competitive for the auction held in 2016. However, the independent market monitor found participant behavior and overall market performance to be competitive because it took steps to mitigate the impacts of the noncompetitive market structure, for example, by placing a cap on the price at which owners of power plants and other resources could offer to provide capacity.<sup>60</sup>
- **Penalize Misconduct.** FERC can penalize misconduct, such as market manipulation, that is identified through its own and other entities' oversight activities. According to a 2016 FERC report on enforcement, when FERC finds that market manipulation has occurred, officials attempt to settle with the investigated party with appropriate penalties and future compliance improvements.<sup>61</sup> If a settlement cannot be reached, FERC directs the investigated party to explain why a violation did not occur. Based on that information and information from FERC officials, if FERC concludes that the investigated party committed a violation and that penalties or repayment of funds is appropriate, it will issue an order assessing penalties. Among other things, FERC can require that funds obtained

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<sup>60</sup>According to the PJM independent market monitor's 2016 annual report, almost all PJM capacity auctions held since 2007 have failed PJM's test of market competitiveness. As a result, according to PJM's independent market monitor, all offers since 2007 have been capped with only minor exceptions.

<sup>61</sup>Federal Energy Regulatory Commission, *2016 Report on Enforcement* (Washington D.C.: Nov. 17, 2016).



through illegal activities be repaid and can issue civil penalties of up to \$1 million per violation per day. According to FERC officials, of the 25 investigations related to capacity markets from 2010 through 2016, 6 were settled with penalties that totaled approximately \$138 million. Of the remaining 19 investigations that were not settled, 7 were closed with no further enforcement action, 1 was closed after completion of litigation that determined there was not an enforcement violation, and 11 remain as pending investigations.

- **Change Market Rules.** FERC can change an RTO's capacity market rules, either by acting on changes proposed by an RTO or by directing changes on its own initiative or in response to a complaint. Underlying any of these changes is FERC's responsibility to ensure that market rules, including capacity market rules, produce prices that are just and reasonable. FERC officials we interviewed told us that the agency has not developed explicit criteria for determining whether a market rule would produce prices that are just and reasonable. Moreover, according to FERC officials, both federal courts and FERC have interpreted this standard broadly in the context of electricity markets such that there is often more than one approach that will produce prices that are just and reasonable. FERC Commissioners exercise professional judgment in determining whether the just and reasonable standard has been met after reviewing the evidence presented in a proceeding. Furthermore, according to FERC officials, in evaluating the need for change, FERC also considers the frequency and significance of recent capacity market rule changes. This consideration represents a view that FERC-directed changes may be disruptive in the midst of significant RTO-directed changes.

## FERC Has Not Fully Assessed Overall Capacity Market Performance

While FERC has conducted assessments of individual aspects of capacity markets, it has not fully or regularly assessed these markets' overall performance, and it does not use performance information to make improvements.<sup>62</sup> The Government Performance and Results Act of 1993 (GPRA), as significantly enhanced by the GPRA Modernization Act of 2010, requires federal agencies to use performance data to drive

<sup>62</sup>In 2002, we reported that FERC had not defined and implemented an effective approach to monitor competitive energy markets. GAO, *Energy Markets: Concerted Actions Needed by FERC to Confront Challenges That Impede Effective Oversight*, [GAO-02-656](#) (Washington, D.C.: June 14, 2002).

decision making by establishing performance goals, assessing progress toward these goals, and planning corrective actions when goals are not met.<sup>63</sup> We have previously reported that requirements under these acts can also serve as leading practices, serving as a framework for planning at lower levels of the agency, such as individual programs or initiatives.<sup>64</sup> These practices are reinforced by GAO's standards for internal control, which require agencies to design control activities to achieve objectives and respond to risk, for example, by comparing actual performance to planned or expected results.<sup>65</sup> As discussed below, FERC has not established performance goals that capacity markets are to achieve, nor has it assessed progress toward these goals. Moreover, FERC has not used such performance information to make changes, as needed, to capacity markets.

- **Establishing performance goals and assessing progress.**

According to a 2013 publicly available FERC staff report on capacity markets, the overall objective of capacity markets is to ensure there are adequate resources to meet customers' electricity needs at just and reasonable prices,<sup>66</sup> but FERC has not identified measurable performance goals that would allow it to track individual RTOs' progress toward achieving this objective, nor has FERC regularly assessed performance against these goals. According to Circular A-11 from the Office of Management and Budget, a performance goal identifies the level of performance to be accomplished within a timeframe, expressed as a tangible, measurable objective or as a quantitative standard, value, or rate.<sup>67</sup> Although the RTOs with capacity markets track whether they meet their resource adequacy requirements, FERC has not adopted this as a performance goal for

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<sup>63</sup>Pub. L. No. 103-62, 107 Stat. 285 (Aug. 3, 1993) and Pub. L. No. 111-352, 124 Stat. 3866 (Jan. 4, 2011).

<sup>64</sup>[GAO-17-144](#) and [GAO-12-77](#).

<sup>65</sup>[GAO-14-704G](#).

<sup>66</sup>Federal Energy Regulatory Commission, *Centralized Capacity Market Design Elements, Commission Staff Report* (Washington, D.C.: Aug. 23, 2013).

<sup>67</sup>Office of Management and Budget. *Circular No. A-11. Preparation, Submission, and Execution of the Budget* (Washington, D.C.: July 2016). According to this circular, strategic objectives reflect the outcome or management impact the agency is trying to achieve. Each objective is tracked through a suite of performance goals and other indicators. Performance goals include a performance indicator (sometimes referred to as a "performance measure"), a target, and a time period.

the capacity markets or established any additional goals against which it regularly assesses progress.

Additional performance goals could be useful, based on our review of RTO and FERC documents. For example, in 2013, in an internal examination of the capacity market in PJM, FERC staff identified five desirable characteristics against which they conducted a one-time assessment. Among other things, FERC assessed (1) whether power plants and other resources receiving capacity payments were available when needed, (2) whether development of new power plants and other resources occurred when and where they were needed, and (3) whether capacity market prices were sufficiently stable to provide a reasonable signal for new investment. FERC has access to much existing information it can use to measure performance, such as data it, the RTOs, and the independent market monitors collect about the capacity markets when conducting oversight activities. For example, to conduct the 2013 PJM assessment, FERC drew heavily on the data collected by PJM's independent market monitor. FERC's one-time analysis of PJM's capacity market provides an example of potential goals that FERC could develop to more formally measure an individual RTO's capacity market performance, but FERC has not conducted this analysis for other RTOs or updated this analysis for PJM even after performance problems were identified.<sup>68</sup> More generally, FERC does not have a process for regularly using available performance information to assess how capacity markets are performing individually or to compare performance across markets or resource adequacy approaches.<sup>69</sup>

- **Using performance assessments to make changes to capacity markets.** FERC has not regularly used the assessments it makes of capacity market performance to make changes, if needed, to these

<sup>68</sup>After this analysis was conducted, PJM identified concerns about the performance of some capacity resources in its region during the "polar vortex" and another extreme cold weather event in 2014. During the polar vortex event, some operators were unable to produce electricity when called upon because they lacked fuel or for other reasons. PJM identified market rules that were not adequate to prevent or penalize poor power plant performance and took steps to change the market design.

<sup>69</sup>According to FERC officials, cross-RTO comparisons of capacity markets are complicated by regional differences, including differences in the mix of power plants and other resources and state policies. FERC officials told us it can also be complicated to draw conclusions about how a region would have performed in the absence of capacity markets. Nevertheless, FERC officials agreed that measures could be developed to provide insight into how individual capacity markets are performing over time.

markets. We previously found that managers should use performance information to continuously improve organizational processes, identify performance gaps, and set improvement goals.<sup>70</sup> We also reported that performance information can be used to identify problems and take corrective actions, as well as to identify and share effective approaches.<sup>71</sup> FERC officials told us that the information FERC collects during its oversight activities makes them more knowledgeable about capacity market results, which indirectly informs their understanding of how capacity markets perform and may indirectly help Commissioners as they make decisions about whether capacity market rules are likely to produce prices that are just and reasonable. However, FERC officials did not identify a regular process through which any assessments they make about capacity market performance are used to improve how capacity markets operate.

FERC officials we interviewed told us that they consider the performance of capacity markets when they review proposed changes to individual capacity market rules. However, a focus on examining individual proposals to change capacity market rules does not provide comprehensive insight into how capacity markets as a whole are performing and whether they have produced desired results. Capacity markets have faced performance problems in the recent past, with three RTOs raising concerns since 2014 that the design of their capacity markets was not sufficient to ensure adequate resources to meet customer needs in their regions.<sup>72</sup> Moreover, at the 2017 FERC technical

<sup>70</sup>GAO, *Executive Guide: Effectively Implementing the Government Performance and Results Act*, [GAO/GGD-96-118](#) (Washington, D.C.: June 1, 1996).

<sup>71</sup>GAO, *Managing for Results: Enhancing Agency Use of Performance Information for Management Decision Making*, [GAO-05-927](#) (Washington, D.C.: Sept. 9, 2005).

<sup>72</sup>According to a 2014 filing to FERC from ISO New England and the New England Power Pool Participants Committee—a group representing stakeholders in the region—ISO New England’s capacity market design was failing to meet its objective of ensuring reliability in a cost-effective manner. In a 2014 filing to FERC, PJM stated that while its capacity market had been successful in securing capacity commitments from power plants and other resources, the market did not adequately ensure the performance of those power plants and other resources when needed. Furthermore, in a 2016 filing to FERC, Midcontinent ISO stated that its existing resource adequacy approach—which includes a capacity market—might not meet future reliability needs for certain parts of the RTO, and in those parts of the RTO there was significant risk of resource shortfalls. In the case of ISO New England and PJM, FERC approved changes to the markets that these RTOs believe will correct these performance problems going forward. Midcontinent ISO’s proposed changes were rejected by FERC. However, according to a Midcontinent ISO representative, additional changes were made by some states that are expected to address these concerns, and Midcontinent ISO is continuing to collaborate with states on this issue.

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conference, some participants raised additional concerns about capacity market performance, though they disagreed about what changes were needed. By developing performance goals and measuring progress toward meeting them, as well as using performance information to make changes as needed, FERC would have a framework for proactively, regularly, and more fully identifying and addressing potential performance problems and identifying and sharing information about effective resource adequacy approaches among RTOs and grid operators. Addressing performance problems and sharing effective approaches may also help FERC ensure customers do not pay more for resource adequacy than they need to.

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## FERC Has Not Fully Assessed the Risks to Achieving Capacity Market Objectives

FERC has not fully assessed and responded to the risks to achieving capacity market objectives. Documentation from several RTOs and independent market monitors has identified emerging risks from policies that encourage the development and retention of specific power plants by, among other things, providing financial support that supplements the revenue the owners of these plants earn in RTO-operated electricity markets.<sup>73</sup> For example, in 2016, a law was enacted in Illinois that could provide additional payments to owners of nuclear plants in exchange for producing electricity with no air emissions. There are differing views on this law, and we did not evaluate its pros and cons. According to comments on behalf of an owner of Illinois nuclear plants expected to benefit from the law, without the additional payments this law allows, some of its nuclear plants would be at risk of shutting down. According to comments this owner filed with FERC, the payments that would be provided under this law compensate owners of nuclear plants for additional benefits the plants provide that are not rewarded through the wholesale markets—for example, the production of electricity without airborne pollutants or carbon dioxide emissions. Some other stakeholders have said the law compensates owners of uneconomic power plants and could eventually lower revenue for owners of power plants that do not receive additional payments. Another, more recent, effort has also been proposed that could provide compensation for certain power plants that

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<sup>73</sup>These policies may also come in other forms and may be enacted by various entities, including state governments or the federal government. For example, in addition to policies that provide additional financial support to certain power plants, states may require that electricity suppliers provide a certain amount of electricity to customers generated by specific types of power plants (e.g., power plants that use renewable fuel sources to generate electricity), which can indirectly encourage development of these types of plants by increasing demand for the electricity they generate. In addition, owners of power plants may receive indirect financial support, such as when power plants that use fossil fuels to generate electricity do not pay for the cost of addressing any adverse environmental or climate impacts.

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supplements what is currently provided in FERC-overseen RTO markets.<sup>74</sup>

More broadly, several RTOs and their independent market monitors have raised concerns that policies that encourage the development and retention of specific power plants pose a risk that financial incentives provided through RTO markets, including capacity markets, will be lower than needed to ensure resource adequacy. This could occur because additional financial support for specific power plants offsets their costs and allows them to make lower-priced offers in the RTO markets. Based on our review of documents from an RTO and other industry sources, these lower offers could, in turn, lead to lower market prices and thereby lower the revenue that owners of all power plants receive.<sup>75</sup> Lower revenue reduces a power plant owner's financial incentive, which can result in accelerated retirements of power plants that do not receive outside support or in reduced interest in building new plants, according to RTO documents we reviewed. Some of these RTOs and independent market monitors, as well as other stakeholders, have noted that the presence of such outside financial support raises questions about the viability of electricity markets, including capacity markets. In particular, in its 2016 State of the Market report, the PJM independent market monitor acknowledged the desire for states to protect specific types of power plants but noted that such steps threaten the long-term viability of electricity markets and their role in providing incentives to retire power plants that are not cost-effective and to build new power plants when they are needed.<sup>76</sup> Two RTOs have reported that efforts are under way to develop and evaluate proposals to address these risks to capacity markets while still accommodating states' efforts to pursue policy goals of interest.

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<sup>74</sup>In September 2017, the Department of Energy issued a Notice of Proposed Rulemaking directing FERC to issue a final rule requiring RTO electricity markets to develop and implement market rules that, among other things, would allow for the recovery of costs of certain eligible units that can provide essential energy and ancillary services and have a 90-day fuel supply on site in the event of supply disruptions. FERC requested initial comments on the proposed rulemaking from interested parties on or before October 23, 2017. We did not evaluate this proposal.

<sup>75</sup>RTO documents also raised concerns about the risk of higher resource adequacy costs for customers. According to these documents, this could occur if customers have to pay for both the capacity commitments procured through the RTO capacity auctions and the costs associated with procuring electricity from specific power plants as required by state or other policies.

<sup>76</sup>Monitoring Analytics, *2016 State of the Market Report for PJM* (March 9, 2017).

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According to federal standards for internal control, agencies should identify, analyze, and respond to risks related to achieving their defined objectives.<sup>77</sup> According to FERC officials, the agency has taken some steps to address these risks, such as issuing orders that address the effects on capacity markets of some policies that encourage the development and retention of specific power plants in individual RTOs. However, despite these actions, these risks have persisted and, according to FERC officials, have become more prominent. In response, FERC gathered additional information about the impact of such policies by convening a 2017 technical conference, which addressed this topic. However, FERC has not fully assessed the severity of the potential risks posed by these policies in each RTO with a capacity market or addressed the risk that these policies collectively pose to the ongoing viability of the capacity market model. FERC also has not identified what, if any, additional steps need to be taken in response to these risks. Moreover, FERC does not have a documented process for regularly identifying, assessing, and responding to any other risks associated with capacity markets that may arise. This largely leaves risk assessment activities, including identification of risks and development of a response, to the RTOs and independent market monitors. Under federal standards for internal control, management should design control activities to achieve objectives and respond to risks. This can include, among other things, clearly documenting internal controls in a manner that allows the documentation to be readily available for examination. These risks are emerging at a time of change for the electricity industry and at a time when prices in these RTOs' energy markets have been historically low due to low prices for natural gas and other reasons. According to a 2015 ISO New England discussion document, capacity market revenue may become even more critical to the continued operation and new development of power plants and other resources in the future.<sup>78</sup> By developing and documenting an approach for regularly identifying, assessing, and responding to the risks associated with capacity markets, FERC could better manage these risks, in turn making it more likely that there are adequate resources to meet customers' electricity needs at just and reasonable prices. Regular risk assessment could also help ensure

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<sup>77</sup>GAO-14-704G.

<sup>78</sup>ISO New England, *The Importance of a Performance-Based Capacity Market to Ensure Reliability as the Grid Adapts to a Renewable Energy Future. Revised ISO New England Discussion Paper* (Holyoke, MA: Oct. 30, 2015).



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that emerging risks are identified and addressed as changes occur in the electricity industry.

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## Conclusions

Recognizing the importance of having adequate capacity from power plants and other resources to meet customers' electricity needs, FERC has approved capacity markets in four RTOs as an alternative to resource adequacy approaches used elsewhere. Together, these four capacity markets have led to \$51 billion in costs from 2013 to 2016. Yet, after almost a decade of operation in some RTOs, stakeholders continue to raise questions about the performance of capacity markets. Furthermore, while there are four unique capacity markets in operation, FERC has not fully assessed how well the capacity markets have performed individually or overall relative to their objective of ensuring adequate resources at just and reasonable prices.

In particular, although FERC has taken some positive steps to collect data on trends in resource adequacy and related costs as part of its Common Metrics Report in response to a previous GAO recommendation, we identified problems with the quality of the data that FERC publishes. If FERC took steps to improve the quality of the data it collects and publishes—for example, by implementing improved data quality checks and standardizing definitions—this could enhance FERC's and Congress' ability to understand trends in the markets and oversee these markets.

In addition, FERC has not developed a framework consistent with leading practices to formally and regularly assess the overall performance of capacity markets, such as by establishing performance goals, measuring the progress of individual capacity markets against these goals, and using performance information to identify needed changes. Although fully comparable and consistent data is not always available on the performance of capacity markets compared to alternative resource adequacy approaches, establishing appropriate performance goals and measuring individual RTOs' progress against these goals could provide an indicator of whether capacity markets are meeting their overall objective. Furthermore, by regularly assessing the overall performance of individual capacity markets and, where possible, comparing capacity market and resource adequacy approaches, FERC could increase its opportunities to identify and address potential performance problems and

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to identify and share effective approaches being used by other RTOs and grid operators to ensure resource adequacy.

Finally, FERC has not yet developed a documented approach to regularly identify, assess, and respond to risks to achieving capacity market objectives, such as risks posed by policies enacted by states or others that encourage the development and retention of specific types of power plants. By developing and documenting such an approach consistent with federal standards for internal control, FERC could better assess and respond to these risks and other risks that may arise. FERC would, in turn, have a stronger basis for ensuring these markets are meeting their intended objective of ensuring there are adequate resources to meet customers' electricity needs at just and reasonable prices.

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## Recommendations for Executive Action

We are making the following three recommendations to FERC:

- FERC should take steps to improve the quality of data collected for its Common Metrics Report, such as implementing improved data quality checks and, where feasible, ensuring RTOs are reporting consistent metrics over time by standardizing definitions. (Recommendation 1)
- FERC should regularly assess the overall performance of capacity markets by developing goals for assessing capacity market performance, measuring the performance of capacity markets against these goals, and using performance information to make changes as needed to capacity markets. To do so, FERC should leverage data and information already being collected by FERC, the RTOs, and the independent market monitors. (Recommendation 2)
- FERC should develop and document an approach to regularly identify, assess, and respond to risks that capacity markets face. (Recommendation 3)

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## Agency Comments

We provided a draft of this report to the Federal Energy Regulatory Commission for review and comment. In comments on the draft report, FERC said it generally agreed with the draft report's findings and found the recommendations to be constructive. FERC said it is actively considering issues related to electric capacity markets in both generic and

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specific proceedings and would direct staff to develop appropriate next steps to implement GAO's recommendations. These comments are reproduced in appendix IV. In addition, FERC provided technical comments, which we incorporated, as appropriate. We also provided a copy of this report to the four RTOs with capacity markets, and they provided technical comments, which we incorporated, as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Federal Energy Regulatory Commission, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

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If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or [ruscof@gao.gov](mailto: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 key contributions to this report are listed in appendix V.

A handwritten signature in black ink, reading "Frank Rusco", followed by a long horizontal flourish.

Frank Rusco,  
Director, Natural Resources and Environment

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# Appendix I: Detailed Data on Resource Adequacy

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## Independent System Operator (ISO) New England

### Auction Background

ISO New England administers an initial capacity auction 3 years before the capacity delivery year, according to our review of ISO New England documents and interviews with ISO New England representatives. After the initial auction, ISO New England administers subsequent auctions to adjust the results of the initial auction to meet changing needs, such as when ISO New England increases or decreases its forecast of expected customer demand for electricity.<sup>1</sup> According to representatives of ISO New England, these subsequent auctions allow owners of power plants and other resources to increase or decrease the capacity commitments they made in the initial auction.<sup>2</sup> ISO New England does not have a general mechanism through which individual electricity suppliers procure capacity commitments outside the auction. However, pursuant to an agreement that predates the existence of ISO New England's capacity market, ISO New England lowers the resource adequacy requirement for certain electricity suppliers to account for transmission capacity that can be used to import electricity from Quebec.<sup>3</sup> We reflect these resources as procured outside the auction in our data below.

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<sup>1</sup>In addition to subsequent auctions, ISO New England allows owners of power plants and other resources to trade capacity commitments among themselves. If a power plant owner transfers its existing capacity commitment to another power plant owner, the latter power plant owner is then responsible for being available to produce electricity during the delivery period.

<sup>2</sup>ISO New England representatives told us that some electricity suppliers build their own power plants and procure capacity commitments from other resources via contracts they negotiate, but these power plants and other resources must be selected in the auction in order to count toward that electricity supplier's resource adequacy requirement.

<sup>3</sup>Under this agreement, ISO New England lowers the resource adequacy requirement of electricity suppliers that funded the installation of phase II of the Hydro Quebec Interconnection—a transmission line capable of delivering seven terawatt hours per year of hydroelectric power from Quebec.

## Auction Results

For all but one of its 11 capacity delivery years, ISO New England exceeded its resource adequacy requirement with capacity procured in and outside the initial auction, as shown in table 1.<sup>4</sup> In ISO New England's 8th initial auction, it was 143 megawatts (MW) short of its 32,618 MW region-wide resource adequacy requirement due to retirements of several major power plants. According to an ISO New England filing with the Federal Energy Regulatory Commission (FERC), these plants announced retirements after the period for new power plants to qualify to participate in that auction. However, due to lower expected future electricity demand and adjustments of capacity commitments from power plants and other resources in subsequent auctions, ISO New England was able to make up for the shortfall.

**Table 1: Demand, Supply, and Reserve Margins in Independent System Operator (ISO) New England's Initial Capacity Auction for Capacity Delivery Years 2010/2011 through 2020/2021**

n/a	n/a	Demand in Megawatts (MW)	Demand in Megawatts (MW)	Supply (MW)	Supply (MW)	Supply (MW)	Reserve Margin (percentage) <sup>a</sup>	Reserve Margin (percentage) <sup>a</sup>
Auction Number	Capacity Delivery Year	Expected Peak Demand	Region-wide Resource Adequacy Requirement <sup>b</sup>	Capacity Commitments Procured in Capacity Auctions	Capacity Commitments Procured Outside the Capacity Auction <sup>c</sup>	Total Capacity Commitments Procured	Calculated with Resource Adequacy Requirement	Calculated with Total Capacity Commitments Procured
1	2010 / 2011	29,035	31,480	32,085	1,308	33,392	8	15
2	2011 / 2012	29,405	31,232	34,971	851	35,822	6	22
3	2012 / 2013	29,020	30,709	34,582	854	35,436	6	22
4	2013 / 2014	28,570	30,862	35,108	856	35,964	8	26
5	2014 / 2015	29,025	31,900	34,595	891	35,486	10	22
6	2015 / 2016	29,380	32,221	33,928	973	34,902	10	19
7	2016 / 2017	29,400	31,777	33,829	985	34,815	8	18

<sup>4</sup>Under ISO New England's market rules, the auction may procure more resources than the requirement.

**Appendix I: Detailed Data on Resource Adequacy**

n/a	n/a	Demand in Megawatts (MW)	Demand in Megawatts (MW)	Supply (MW)	Supply (MW)	Supply (MW)	Reserve Margin (percentage) <sup>a</sup>	Reserve Margin (percentage) <sup>a</sup>
Auction Number	Capacity Delivery Year	Expected Peak Demand	Region-wide Resource Adequacy Requirement <sup>b</sup>	Capacity Commitments Procured in Capacity Auctions	Capacity Commitments Procured Outside the Capacity Auction <sup>c</sup>	Total Capacity Commitments Procured	Calculated with Resource Adequacy Requirement	Calculated with Total Capacity Commitments Procured
8	2017 / 2018	29,790	32,618	31,478	998	32,475	9	9
9	2018 / 2019	30,005	32,823	32,405	890	33,295	9	11
10	2019 / 2020	29,861	32,808	33,220	911	34,130	10	14
11	2020 / 2021	29,601	32,722	33,470	896	34,366	11	16

Source: GAO analysis of ISO New England capacity auction data | GAO-18-131

Notes: These data represent capacity commitments procured in ISO New England's initial 3-year forward auction and not the subsequent auctions. Data are adjusted to reflect the probability that power plants will be unavailable to produce electricity when needed 6.6 percent of the time (a region-wide average provided by ISO New England). ISO New England's published estimates typically present capacity that is not adjusted in this way, but we performed this adjustment to be consistent with our presentation of other data throughout the appendix.

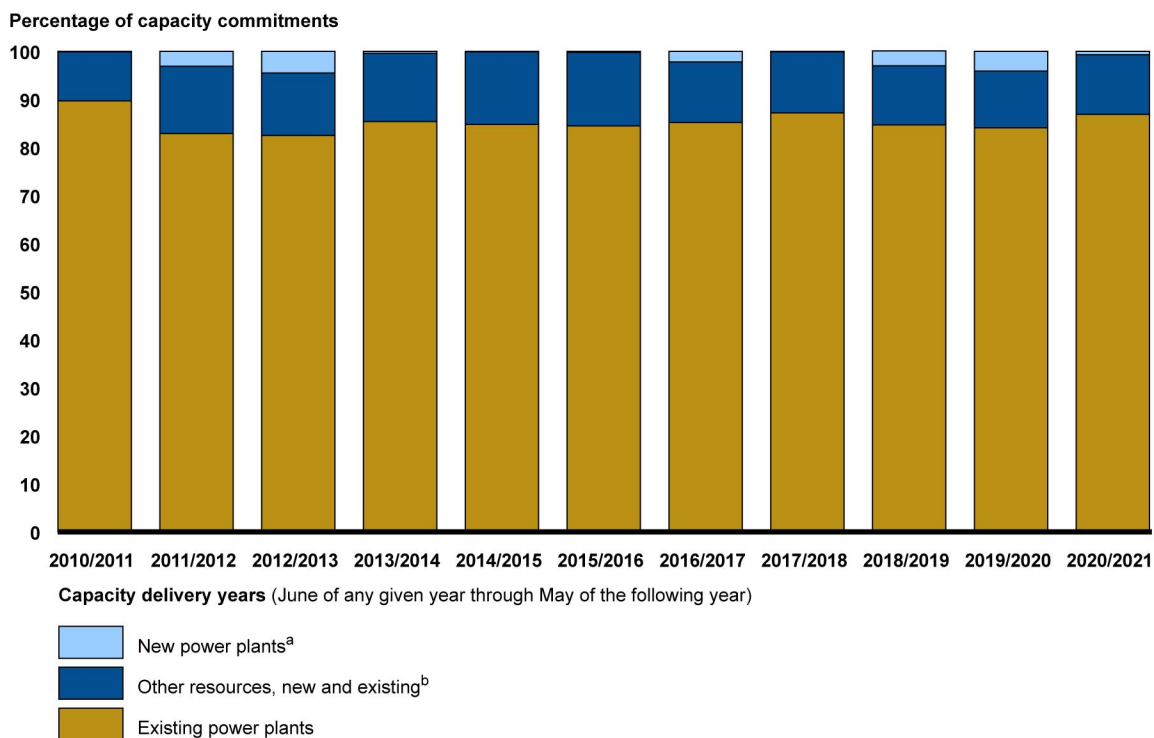
<sup>a</sup>Reserve margins represent the percent by which resources exceed expected peak demand.

<sup>b</sup>The resource adequacy requirement presented here is the Installed Capacity Requirement for a given capacity delivery year. ISO New England's initial capacity auction operates based on the Net Installed Capacity Requirement, which is calculated by subtracting an amount of generating capacity credited to certain electricity suppliers' resource adequacy requirements.

<sup>c</sup>Pursuant to an agreement that predates the existence of ISO New England's capacity market, ISO New England lowers certain electricity suppliers' resource adequacy requirements to account for transmission capacity that can be used to import electricity from Quebec. Under this agreement, electricity suppliers that funded the installation of phase II of the Hydro Quebec Interconnection—a transmission line capable of delivering seven terawatt hours per year of hydroelectric power from Quebec—are credited for capacity.

Conducting an auction for a delivery period 3 years in the future allows new resources, such as power plants under development, to participate in the auction. Data provided by ISO New England show that more than 80 percent of capacity commitments selected in the initial auction are made by existing power plants for any given delivery year, with other resources and new power plants making up the remaining commitments (see Figure 8).

**Figure 8: Percentage of Capacity Commitments by Resource Type Procured in Independent System Operator (ISO) New England's Initial Auction for Capacity Delivery Years 2010/2011 through 2020/2021**



Source: GAO analysis of ISO New England capacity auction data. | GAO-18-131

Note: Data represent capacity commitments in ISO New England's initial auction and not subsequent auctions.

<sup>a</sup>This includes newly constructed power plants and existing power plants that made upgrades to increase their generating capacity.

<sup>b</sup>"Other resources" includes new and existing demand resources and electricity imported from other regions.

## Midcontinent ISO

### Auction Background

Midcontinent ISO administers a single, voluntary capacity auction 2 months before the capacity delivery year, according to our review of Midcontinent ISO documents and interviews with Midcontinent ISO representatives. Electricity suppliers can use this auction to procure capacity commitments from power plants and other resources to meet their individual resource adequacy requirements for a given capacity delivery year. Alternatively, Midcontinent ISO allows electricity suppliers



to procure capacity commitments outside the auction by using power plants or other resources they own or by entering into contracts directly with owners of power plants and other resources. If electricity suppliers choose this option, they must submit a plan to Midcontinent ISO demonstrating how they will meet their resource adequacy requirement. The resources identified in these plans are deducted from the electricity supplier's resource adequacy requirement before Midcontinent ISO administers its capacity auction. According to Midcontinent ISO representatives, the capacity auction is the last opportunity for electricity suppliers in the region to procure capacity commitments to meet their resource adequacy requirements prior to the delivery year. Electricity suppliers may choose to opt out of the capacity auction and pay a capacity deficiency charge instead of the capacity auction price, according to the Midcontinent ISO business manual.<sup>5</sup>

### Auction Results

Midcontinent ISO met its region-wide resource adequacy requirement for all 5 of its capacity delivery years (see table 2). However, a significant portion of the power plants and other resources—between 27 and 37 percent—were procured outside each capacity auction, according to the data we analyzed.<sup>6</sup> According to Midcontinent ISO representatives, approximately 90 percent of customer demand in the region is served by integrated utilities under state regulation, which are compensated through a cost-based approach. As a result, while these electricity suppliers may participate in the capacity auction, they are not relying on the capacity auction to recover the costs of maintaining the power plant as are independent owners of power plants.

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<sup>5</sup>The capacity deficiency charge is calculated by multiplying the amount of capacity by 2.748 times the estimated cost of building a new power plant in the area where the electricity supplier is located.

<sup>6</sup>These numbers represent the power plants and other resources that electricity suppliers identified in plans submitted to Midcontinent ISO. These resources are procured outside the auction through direct ownership or contracts with power plant owners. According to officials from Midcontinent ISO, some resources reflected in the data above as being procured in the auction may still be owned by the electricity supplier or procured on a contract basis.

**Table 2: Demand, Supply, and Reserve Margins in Midcontinent Independent System Operator's (ISO) Capacity Auction for Capacity Delivery Years 2013/2014 through 2017/2018**

n/a	n/a	Demand in Megawatts (MW)	Demand in Megawatts (MW)	Supply (MW)	Supply (MW)	Supply (MW)	Reserve Margin (percentage) <sup>a</sup>	Reserve Margin (percentage) <sup>a</sup>
Auction Number	Capacity Delivery Year	Expected Peak Demand	Region-wide Resource Adequacy Requirement	Capacity Commitments Procured in Capacity Auctions	Capacity Commitments Procured Outside the Capacity Auction	Total Capacity Commitments Procured <sup>b</sup>	Calculated with Resource Adequacy Requirement	Calculated with Total Capacity Commitments Procured
1	2013/2014	91,539	97,214	62,255	34,959	97,214	6	6
2	2014/2015	127,597	136,912	89,890	47,022	136,912	7	7
3	2015/2016	127,319	136,359	88,130	48,229	136,359	7	7
4	2016/2017	125,913	135,483	99,488	35,995	135,483	8	8
5	2017/2018	125,003	134,753	85,290	49,463	134,753	8	8

Source: GAO analysis of Midcontinent ISO capacity auction data. | GAO-18-131

Note: Midcontinent ISO data are adjusted to reflect the probability that power plants will sometimes be unavailable to produce electricity when needed, for example, as a result of unplanned outages.

<sup>a</sup>Reserve margins represent the percent by which resources exceed expected peak demand.

<sup>b</sup>Midcontinent ISO's capacity market is designed to procure the exact amount of capacity commitments needed to meet the region-wide resource adequacy requirement.

Because Midcontinent ISO's auction takes place 2 months before the capacity delivery year, there is not sufficient time between the auction and the delivery year for new power plants to be built. This short time frame limits participation in the capacity auction to existing power plants. Therefore, Midcontinent ISO does not distinguish between new and existing power plants in its data.

## New York ISO

### Auction Background

New York ISO administers a series of capacity auctions in which electricity suppliers can procure capacity commitments to meet their individual resource adequacy requirements for a given month of the year, according to our review of New York ISO documents and interviews with New York ISO representatives. Alternatively, New York ISO allows electricity suppliers to negotiate contracts directly with owners of power plants and other resources to meet their individual resource adequacy

requirements.<sup>7</sup> If an electricity supplier has not obtained the required resources by the final auction before the delivery month, New York ISO will automatically enter a bid for the supplier into the auction to make up the deficiency, according to representatives of New York ISO. New York ISO conducts three types of auctions in advance of each delivery month:

1. Seasonal auction: Electricity suppliers can procure capacity commitments across a 6-month season at one price. This auction is conducted at least 30 days before each 6-month season, once for the summer months (May through October) and once for the winter months (November through April).
2. Monthly auctions: In monthly auctions, electricity suppliers can procure capacity commitments for any future month remaining in the season. For example, in the last monthly auction before the August delivery period, an electricity supplier could procure capacity commitments for August, September, or October.
3. Final auction: The final auction is held days before the monthly delivery period and is an electricity supplier's last opportunity to procure capacity commitments to meet its resource adequacy requirement. According to New York ISO representatives, more MW of capacity commitments are transacted in final auctions than in other types of auctions.

### Auction results

Because New York ISO capacity auctions are monthly, we chose to obtain data for the representative month of August.<sup>8</sup> Table 3 presents data on total MW of capacity commitments procured from 2006 through 2016 through various means—the three types of auctions New York ISO administers and the contracts electricity suppliers directly negotiate with power plant owners—in order to meet the resource adequacy

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<sup>7</sup>According to representatives of New York ISO, a small number of electricity suppliers may self-supply capacity commitments through power plants they own.

<sup>8</sup>According to representatives of New York ISO, August is an appropriate representative month, since the RTO's demand reaches its peak in the summer.

requirement for each year's August delivery month.<sup>9</sup> New York ISO exceeded its statewide resource adequacy requirement for all of these representative months.<sup>10</sup>

**Table 3: Demand, Supply, and Reserve Margins in New York Independent System Operator's (ISO) Capacity Auction for the Capacity Delivery Month of August in 2006 through 2016**

n/a	Demand in Megawatts (MW)	Demand in Megawatts (MW)	Supply (MW)	Reserve Margins (percentage) <sup>a</sup>	Reserve Margins (percentage) <sup>a</sup>
Capacity Delivery Month	Expected Peak Demand	Region-wide Resource Adequacy Requirement	Total Capacity Commitments Procured In and Outside the Auctions	Calculated with Resource Adequacy Requirement	Calculated with Total Capacity Commitments Procured
August 2006	33,295	37,154	39,829	12	20
August 2007	33,447	37,228	39,691	11	19
August 2008	33,809	36,633	39,663	8	17
August 2009	33,930	36,362	39,219	7	16
August 2010	33,025	35,045	38,609	6	17
August 2011	32,712	34,684	38,827	6	19
August 2012	33,295	35,076	38,477	5	16
August 2013	33,279	35,467	37,338	7	12
August 2014	33,666	35,812	37,547	6	12
August 2015	33,567	35,920	38,665	7	15
August 2016	33,359	35,430	38,166	6	14

Source: GAO analysis of New York ISO capacity auction data. | GAO-18-131

Note: New York ISO data are adjusted to reflect the probability that power plants will sometimes be unavailable to produce electricity when needed, for example, as a result of unplanned outages.

<sup>a</sup>Reserve margins represent the percent by which resources exceed expected peak demand.

New York ISO's earliest auction can occur up to 6 months before the capacity delivery month, which does not provide sufficient time between the auction and the delivery period for new power plants to be built,

<sup>9</sup>Data were not available to determine the capacity commitments of power plants and other resources procured through the auctions compared to those procured outside the auctions, but estimates by New York ISO show that a significant amount of capacity commitments are traded outside the auctions. Data provided by New York ISO shows that between 59 and 67 percent of the capacity commitments traded were traded outside New York ISO's auctions for the month of August.

<sup>10</sup>New York ISO's market rules allow the auction to procure more resources than the requirement.

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according to New York ISO representatives. Therefore, New York ISO data do not distinguish between new and existing power plants.

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## PJM Interconnection (PJM)

### Auction background

PJM administers an initial auction 3 years before the capacity delivery year, according to our review of PJM documents and interviews with PJM representatives. PJM also administers subsequent auctions to adjust the results of the initial auction to meet changing needs, such as when customer demand for electricity is expected to increase or decrease. According to PJM representatives, these subsequent auctions represent a small portion of the capacity commitments procured through auctions.

In general, electricity suppliers are required to procure capacity commitments to meet their resource adequacy requirements through the capacity auctions. However, PJM's rules allow electricity suppliers that meet certain criteria to opt out of the capacity auction for a set number of years and procure capacity commitments to meet their resource adequacy requirements through other means. According to PJM representatives, this "Fixed Resource Requirement" approach was developed as an alternative for utilities to meet resource adequacy requirements outside the capacity auctions through a long-term commitment of resources. In order for an area to qualify under this option, it must be a large, contiguous portion of PJM that can be effectively isolated from the broader system to ensure that the area is providing all of its own capacity.<sup>11</sup>

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<sup>11</sup>In addition, PJM had a small amount of demand-response capacity commitments procured through a program called the "Interruptible Load for Reliability program." These demand-response resources did not participate in the auction process for the first five auctions. Beginning in the 2012/2013 auction, PJM required all demand-response resources to participate in the auction.

### Auction results

PJM exceeded its resource adequacy requirement for all of its capacity delivery years from 2007/2008 through 2020/2021 with capacity commitments procured in and outside its initial auction (see table 4).

**Table 4: Demand, Supply, and Reserve Margins in PJM Interconnection's (PJM) Initial Auction for Capacity Delivery Years 2007/2008 through 2020/2021**

n/a	n/a	Demand in Megawatts (MW)	Demand in Megawatts (MW)	Supply (MW)	Supply (MW)	Supply (MW)	Reserve Margin (percentage) <sup>a</sup>	Reserve Margin (percentage) <sup>a</sup>
Auction Number	Capacity Delivery Year	Expected Peak Demand	Region-wide Resource Adequacy Requirement	Capacity Commitments Procured in Capacity Auctions	Capacity Commitments Procured Outside the Capacity Auction <sup>b</sup>	Total Capacity Commitments Procured	Calculated with Resource Adequacy Requirement	Calculated with Total Capacity Commitments Procured
Auction 1	2007 / 2008	137,421	148,277	129,409	24,133	153,542	8	12
Auction 2	2008 / 2009	139,806	150,935	129,598	24,404	154,001	8	10
Auction 3	2009 / 2010	142,177	153,480	132,232	24,694	156,926	8	10
Auction 4	2010 / 2011	144,592	156,637	132,190	25,596	157,786	8	9
Auction 5	2011 / 2012	142,390	154,251	132,222	25,186	157,408	8	11
Auction 6	2012 / 2013	144,857	157,489	136,144	23,756	159,900	9	10
Auction 7	2013 / 2014	160,634	173,549	152,743	23,560	176,304	8	10
Auction 8	2014 / 2015	164,758	178,087	149,975	29,763	179,738	8	9
Auction 9	2015 / 2016	163,168	177,184	164,561	14,407	178,968	9	10
Auction 10	2016 / 2017	165,412	180,332	169,160	14,205	183,364	9	11
Auction 11	2017 / 2018	164,479	179,545	167,004	14,538	181,542	9	10
Auction 12	2018 / 2019	161,418	174,897	166,837	14,289	181,126	8	12
Auction 13	2019 / 2020	157,189	171,037	167,306	13,944	181,250	9	15
Auction 14	2020 / 2021	153,915	167,644	165,109	13,289	178,398	9	16

Source: GAO analysis of PJM capacity auction data | GAO-18-131

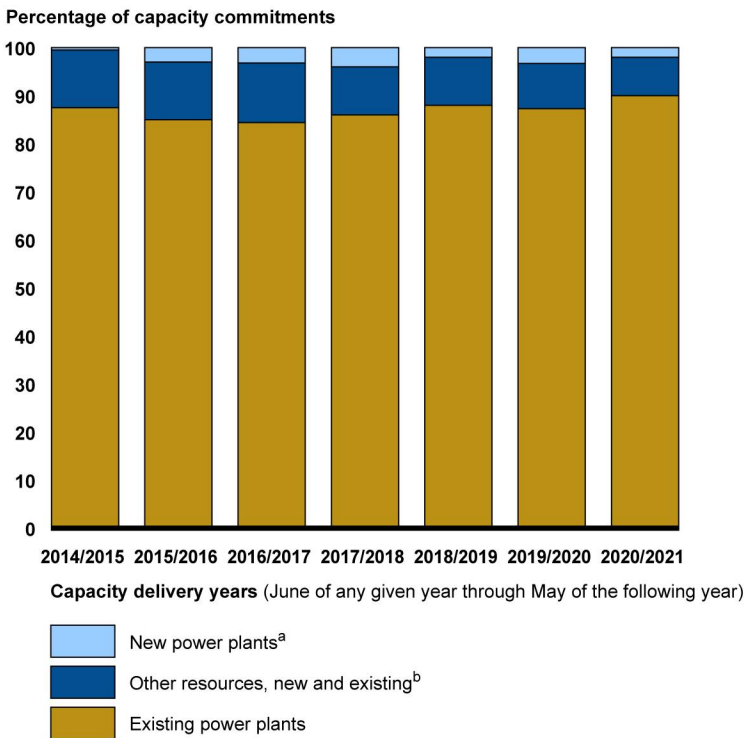
Notes: PJM data are adjusted to reflect the probability that power plants will sometimes be unavailable to produce electricity when needed, for example, as a result of unplanned outages. These data represent capacity procured in the initial 3-year forward auction and not adjustments made in subsequent auctions.

<sup>a</sup>Reserve margins represent the percent by which resources exceed expected peak demand.

<sup>b</sup>The majority of the capacity commitments procured outside the auction are procured using the Fixed Resource Requirement approach, which allows electricity suppliers that meet certain criteria to opt out of the capacity market for a set number of years. Some areas have opted back into the capacity market. For example, in auction 9, two areas that had been under the Fixed Resource Requirement approach began using the capacity auction, significantly reducing the capacity commitments procured outside the auction.

Conducting an auction for a delivery period 3 years in the future allows new resources, such as power plants under development, to participate in the auction. Data provided by PJM show that more than 80 percent of capacity commitments selected in the auction are made by existing power plants, with other resources and new power plants making up the remaining commitments (see Figure 9).

**Figure 9: Percentage of Capacity Commitments by Resource Type Procured in PJM Interconnection’s (PJM) Initial Auction for Capacity Delivery Years 2014/2015 through 2020/2021**



Source: GAO analysis of PJM capacity auction data. | GAO-18-131



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Note: Data represent capacity commitments in PJM's initial auction and not subsequent auctions.

<sup>a</sup>This includes newly constructed power plants and existing power plants that made upgrades to increase their generating capacity.

<sup>b</sup>"Other resources" includes new and existing demand resources and power imported from other regions.

### GAO's Method for Developing the Resource Adequacy Tables

GAO obtained data from regional transmission organizations (RTOs) with capacity markets to identify trends in resource adequacy. Specifically, we obtained summary data on auction results from the four RTOs with capacity markets: ISO New England, Midcontinent ISO, New York ISO, and PJM. RTO officials told us they were unable to provide certain raw data due to provisions in their tariffs that protect proprietary information of market participants. We reviewed trends in MW of capacity commitments procured by the RTOs and compared this amount to expected demand. Where data were available, we provided information separating capacity commitments obtained in the auction and those obtained outside the auction. To ensure we presented data accurately within the context of each RTO, we reviewed relevant RTO documentation, such as market rules in RTO tariffs and business manuals, and discussed differences in market operations with knowledgeable RTO representatives. Finally, we provided these tables to the RTOs to review to validate their completeness and accuracy. We took steps to present information as consistently as possible between RTOs, such as by standardizing the data on generating capacity to account for the possibility of power plants and other resources going out of service.<sup>12</sup>

Although we took steps to standardize the data where possible, each RTO operates its capacity market differently, and the resulting data from each market have key differences that limit comparisons across RTOs. For example, the time period between the auction and the period when power plants and other resources must be available varies by RTO, and RTOs differ in the manner and extent to which they allow electricity suppliers to procure capacity commitments using mechanisms other than the capacity auction. In addition, these data reflect resource adequacy

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<sup>12</sup>Generating capacity can be presented as installed capacity—the amount of output available from a given generator working at maximum capacity—or it can be adjusted for the probability that a power plant or other resource will be unavailable. RTOs provided data in different formats. When RTOs provided installed capacity numbers, we adjusted them with an outage rate provided by the RTO. These outage rates are an average estimate for the entire RTO and were not based on data for each individual plant.

requirements for the entire region but do not reflect local resource adequacy requirements that result from limitations in the transmission system. Moreover, the data tables represent the amount of capacity commitments procured through capacity markets and related mechanisms, but they do not represent all of the power plants and other resources potentially available in a region. For example, in each region, there are additional power plants and other resources offered into the auction that are not selected by the RTO to make a capacity commitment.

## Appendix II: Data on Regional Transmission Organization (RTO) Market Costs

Comprehensive and consistent data are not available on the total cost to customers of maintaining resource adequacy, but data provided by the four RTOs with capacity markets show the costs associated with each RTO-operated market. As we discuss in this report, owners of power plants evaluate the total revenue they expect to earn through these markets and other sources when determining whether to build or retain power plants and other resources. All four RTOs that provided data on total market costs had the majority of their costs in the energy markets, followed by capacity markets, and the smallest portion in ancillary services markets. From year to year, the costs within each market sometimes shifted by millions of dollars or, in the case of the energy market, billions of dollars. See table 5 for annual costs within each RTO-operated market.

**Table 5: Total Annual Costs in Regional Transmission Organizations (RTO) with Capacity Markets in Millions of Dollars, Adjusted for Inflation, for Available Years**

RTO	Year	Energy Market Costs	Capacity Market Costs	Ancillary Services Market Costs	Total RTO Market Costs	Total RTO Market Costs (in dollars per megawatt-hour)
Independent System Operator (ISO) New England	2011	7,223	1,451	42	8,715	64
Independent System Operator (ISO) New England	2012	5,500	1,252	60	6,812	51
Independent System Operator (ISO) New England	2013	8,349	1,083	158	9,590	71
Independent System Operator (ISO) New England	2014	9,297	1,081	339	10,717	82
Independent System Operator (ISO) New England	2015	5,988	1,124	212	7,325	56

**Appendix II: Data on Regional Transmission  
Organization (RTO) Market Costs**

<b>RTO</b>	<b>Year</b>	<b>Energy Market Costs</b>	<b>Capacity Market Costs</b>	<b>Ancillary Services Market Costs</b>	<b>Total RTO Market Costs</b>	<b>Total RTO Market Costs (in dollars per megawatt-hour)</b>
Independent System Operator (ISO) New England	2016	4,130	1,160	146	5,437	42
Midcontinent ISO	2014	27,433	320	54	27,808	42
Midcontinent ISO	2015	18,086	536	42	18,664	29
Midcontinent ISO	2016	17,680	1,120	53	18,853	29
New York ISO	2009	7,916	1,463	173	9,551	60
New York ISO	2010	9,875	1,714	176	11,764	72
New York ISO	2011	8,937	848	147	9,932	61
New York ISO	2012	6,894	1,583	134	8,611	53
New York ISO	2013	8,941	2,965	152	12,057	74
New York ISO	2014	9,611	3,403	147	13,161	82
New York ISO	2015	6,298	2,595	139	9,033	56
New York ISO	2016	4,834	2,039	191	7,065	44
PJM Interconnection	2008	60,658	7,638	921	69,218	91
PJM Interconnection	2009	30,872	9,808	669	41,349	58
PJM Interconnection	2010	39,637	10,680	705	51,021	68
PJM Interconnection	2011	38,511	8,198	734	47,443	61
PJM Interconnection	2012	30,612	5,508	646	36,766	45
PJM Interconnection	2013	33,670	6,463	1,147	41,280	49
PJM Interconnection	2014	45,569	7,987	911	54,467	65
PJM Interconnection	2015	30,194	9,727	648	40,569	49
PJM Interconnection	2016	24,300	9,400	570	34,270	41

Source: GAO analysis of RTO financial data. | GAO-18-131

Notes: We adjusted RTO market cost data to 2016 dollars using the Gross Domestic Product price index. Each RTO provided data covering different time periods, and the table includes available data for years in which the RTO operated a capacity market for the full year.

Direct comparison of the costs across RTOs with capacity markets is challenging because of the different market designs. For example, for the most recent capacity delivery year (2017/2018) in Midcontinent Independent System Operator (ISO), electricity suppliers procured approximately one-third of the capacity the RTO used to meet the region-wide resource adequacy requirement outside the capacity auction. By contrast, in the 2017/2018 capacity delivery years in PJM Interconnection (PJM) and ISO New England, 8 percent and 3 percent, respectively, of capacity used to meet the region-wide resource adequacy requirement were procured outside the capacity auctions. The costs for resources procured outside the auctions through contracts with power plant owners

or direct ownership by electricity suppliers are not reflected in RTO capacity market cost data provided by the RTOs.

In general, the cost of ensuring resource adequacy is passed on to the final customer through retail rates. While cost data presented above provide some insight into what retail customers pay, final retail costs may be influenced by other factors, such as a customer's specific rate plan, as well as contracts negotiated between electricity suppliers and owners of power plants and other resources.

## Appendix III: Data on Capacity Auction Prices

Total capacity market costs are influenced by the amount of capacity commitments procured and the price of capacity. The sections below provide more detail about how individual regional transmission organization (RTO) capacity prices have varied over time within different zones in each RTO region. As noted earlier in this report, prices may be different in zones of the RTO that have transmission constraints.

### Independent System Operator (ISO) New England Capacity Auction Prices

ISO New England had the same price across the region for its first six auctions. Beginning with the 2016/2017 delivery year, some zones with transmission limitations experienced higher prices. Table 6 presents capacity auction prices for zones without transmission limitations and zones with limitations that had different prices.

**Table 6: Initial Capacity Auction Prices in Independent System Operator (ISO) New England for Capacity Delivery Years 2010/2011 through 2020/2021 in Dollars per Megawatt (MW) Day**

Capacity Delivery Year	Zones Without Transmission Limitations	Boston/Northeastern Massachusetts Zone	Southeastern Massachusetts/Rhode Island Zone
2010 / 2011	150	n/a	n/a
2011 / 2012	120	n/a	n/a
2012 / 2013	98	n/a	n/a
2013 / 2014	98	n/a	n/a
2014 / 2015	107	n/a	n/a
2015 / 2016	114	n/a	n/a
2016 / 2017	105	222 <sup>a</sup>	n/a
2017 / 2018	234 <sup>b</sup>	500	n/a
2018 / 2019	318	n/a	369 <sup>c</sup>
2019 / 2020	234	n/a	n/a
2020 / 2021	177	n/a	n/a

Source: GAO analysis of ISO New England capacity auction data. | GAO-18-131

Note: We converted prices from dollars per kilowatt month to dollars per MW day. These prices reflect the results of ISO New England's initial auction and do not reflect adjustments from subsequent auctions. Prices for new and existing resources are sometimes different. Where a price is not specified, the zone had the same price as the rest of the RTO for that delivery year.

<sup>a</sup>This price represents the price paid to existing resources in the Boston area. New resources in this area received a higher price of \$500 per MW day.

<sup>b</sup>This price represents the price paid to existing resources in the zones without transmission limitations. New resources received \$500 per MW day.

<sup>c</sup>This price represents the price paid to existing resources in the Southeastern Massachusetts/Rhode Island area. New resources in this area received a higher price of \$591 per MW day.

## Midcontinent ISO Capacity Auction Prices

Midcontinent ISO calculates separate prices for each of its zones, with 10 zones as of the most recent auction.<sup>1</sup> Table 7 shows the capacity auction price for each zone in Midcontinent ISO.

**Table 7: Capacity Auction Prices in Midcontinent Independent System Operator (ISO) for Capacity Delivery Years 2013/2014 through 2017/2018 in Dollars per Megawatt Day**

Capacity Delivery Year	Zone 1 <sup>a</sup>	Zone 2 <sup>b</sup>	Zone 3 <sup>c</sup>	Zone 4 <sup>d</sup>	Zone 5 <sup>e</sup>	Zone 6 <sup>f</sup>	Zone 7 <sup>g</sup>	Zone 8 <sup>h</sup>	Zone 9 <sup>i</sup>	Zone 10 <sup>j</sup>
2013 / 2014	1	1	1	1	1	1	1	n/a	n/a	n/a
2014 / 2015	3	17	17	17	17	17	17	16	16	n/a
2015 / 2016	3	3	3	150	3	3	3	3	3	n/a
2016 / 2017	20	72	72	72	72	72	72	3	3	3
2017 / 2018	2	2	2	2	2	2	2	2	2	2

Source: GAO analysis of Midcontinent ISO capacity auction data | GAO-18-131

Note: Midcontinent ISO zones have changed over the course of capacity market operations. Where a price is not specified, that zone did not exist during the given auction. As of the most recent capacity auction, zones included all or part of the following states.

<sup>a</sup>Zone 1 included all or parts of Illinois, Iowa, Minnesota, Montana, North Dakota, South Dakota, and Wisconsin.

<sup>b</sup>Zone 2 included parts of Michigan and Wisconsin.

<sup>c</sup>Zone 3 included parts of Illinois, Iowa, and Minnesota.

<sup>d</sup>Zone 4 included parts of Illinois.

<sup>e</sup>Zone 5 included parts of Missouri.

<sup>f</sup>Zone 6 included parts of Indiana and Kentucky.

<sup>g</sup>Zone 7 included parts of Michigan.

<sup>h</sup>Zone 8 included parts of Arkansas.

<sup>i</sup>Zone 9 included parts of Louisiana and Texas.

<sup>1</sup>Prices for these zones reflect relevant transmission limitations.

<sup>1</sup>Zone 10 included parts of Mississippi.

## New York ISO Capacity Auction Prices

New York ISO administers a series of auctions for each month of the year. According to representatives of New York ISO, the final auction in the series is typically when the most capacity commitments are transacted. Table 8 below provides the auction prices each year for the final auction held for capacity commitments for the month of August.

**Table 8: Capacity Auction Prices in New York Independent System Operator (ISO) for the Capacity Delivery Month of August in 2006 through 2017 in Dollars per Megawatt Day**

Capacity Delivery Month and Year	Zones without Transmission Limitations	New York City	Long Island	Southeast New York <sup>a</sup>
August 2006	100	424	210	n/a
August 2007	114	424	241	n/a
August 2008	90	206	90	n/a
August 2009	114	282	114	n/a
August 2010	56	432	56	n/a
August 2011	2	194	2	n/a
August 2012	63	355	119	n/a
August 2013	188	527	236	n/a
August 2014	193	619	216	408
August 2015	119	511	192	277
August 2016	121	407	147	308
August 2017	73	328	222	323

Source: GAO analysis of New York ISO capacity auction data | GAO-18-131

Note: We converted prices from dollars per kilowatt month to dollars per Megawatt day. These prices reflect the results of the final auction before the delivery month. Where a price is not specified, the zone did not have a separate capacity auction price for the delivery year and was treated as part of the RTO without transmission limitations in that year's auction.

<sup>a</sup>This zone's formal name is the G-J Locality and includes areas in Southeast New York outside New York City.

## PJM Interconnection (PJM) Capacity Auction Prices

PJM has established separate zones based on transmission limitations that could produce different prices. Table 9 shows the capacity auction



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prices for two zones that had different prices starting in the 2007/2008 delivery year and the zones of the RTO without transmission limitations.<sup>2</sup>

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<sup>2</sup>PJM has established different zones for its auctions over time. Since the 2007/2008 delivery year, PJM has continued to add zones that could have different prices.

**Table 9: Initial Capacity Auction Prices in PJM Interconnection (PJM) for Capacity Delivery Years 2007/2008 through 2020/2021 in Dollars per Megawatt Day**

Capacity Delivery Year	Zones without Transmission Limitations	Eastern Mid-Atlantic Area Council	Southwestern Mid-Atlantic Area Council
2007 / 2008	41	198	189
2008 / 2009	112	149	210
2009 / 2010	102	n/a	237
2010 / 2011	174	n/a	n/a
2011 / 2012	110	n/a	n/a
2012 / 2013	16	140	133
2013 / 2014	28	245	226
2014 / 2015	126	137	137
2015 / 2016	136	167	167
2016 / 2017	59	119	119
2017 / 2018	120	120	120
2018 / 2019	165	225	165
2019 / 2020	100	120	100
2020 / 2021	77	188	86

Source: GAO analysis of PJM capacity auction data | GAO-18-131

Notes: Prices are in dollars per Megawatt day. These prices reflect the results of the initial auction and do not reflect later adjustments from subsequent auctions. Where a price is not specified, the zone did not have a separate capacity auction price for that delivery year.

# Appendix IV: Comments from the Federal Energy Regulatory Commission

FEDERAL ENERGY REGULATORY COMMISSION  
WASHINGTON, DC 20426

OFFICE OF THE CHAIRMAN

November 9, 2017

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

Dear Mr. Rusco:

Thank you for the opportunity to provide comments on behalf of the Federal Energy Regulatory Commission with respect to the Government Accountability Office's draft report entitled, "Electricity Markets: Four Regions Use Capacity Markets to Help Ensure Adequate Resources, but FERC Has Not Fully Assessed Their Performance."

The Commission is actively considering issues related to electric capacity markets in both generic proceedings and proceedings pertaining to specific markets. GAO's examination of such issues is a timely contribution to this area of the Commission's work. I generally agree with the findings of the draft report. I also believe that the recommendations set forth in the draft report are constructive, and I am directing Commission staff to develop appropriate next steps to implement them.

Sincerely,

A handwritten signature in blue ink, appearing to read "Neil Chatterjee", with a long, sweeping horizontal stroke extending to the right.

Neil Chatterjee  
Chairman

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# Appendix V: GAO Contact and Staff Acknowledgments

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## GAO Contact

Frank Rusco, (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov)

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## Staff Acknowledgments

In addition to the individual named above, Jon Ludwigson (Assistant Director), Antoinette Capaccio, Eric Charles, Tara Congdon, Cindy Gilbert, Paige Gilbreath, Michael Kendix, Cynthia Norris, Dan C. Royer, Kyle Stetler, and Kiki Theodoropoulos made key contributions to this report.

# Appendix VI: Accessible Data

## Data Tables

**Accessible Data for Figure 6: Power Plant Generating Capacity by Fuel Type and Region of the Country, for 2006 and 2017**

Region	Year	Other Fuel Type	Nuclear	Coal	Natural Gas	Intermittent Renewables
California ISO	2006	13640	4390	2017	32786	3307
California ISO	2017	12536	2240	74	34737	17351
Electric Reliability Council of Texas	2006	1093	4860	16079	64970	2616
Electric Reliability Council of Texas	2017	1386	5020	19953	63122	22249
ISO New England	2006	13562	4587	2788	14543	10
ISO New England	2017	13170	4036	2003	16084	2217
Midcontinent ISO	2006	13675	13319	68178	77369	1969
Midcontinent ISO	2017	14201	13276	65125	72544	18156
New York ISO	2006	10952	5189	2949	22468	369
New York ISO	2017	10531	5445	1133	23905	2035
PJM	2006	22325	33535	79924	67869	340
PJM	2017	19745	34938	61020	81576	10148
SPP	2006	7567	2473	24694	29131	1186
SPP	2017	7401	1977	25621	33111	17711
Southeastern Region	2006	35526	28259	72279	88596	178
Southeastern Region	2017	31054	29593	60215	114963	6304
Western Region	2006	47491	5018	29380	42270	2135
Western Region	2017	49050	5213	29041	51357	20166

**Accessible Data for Figure 7: Percentage of Total Market Costs for Available Years for Regional Transmission Organizations (RTOs) with Capacity Markets**

Regional Transmission Organization	Year	Energy Market Costs	Capacity Market Costs	Ancillary Services Market Costs
ISO New England	n/a	n/a	n/a	n/a
ISO New England	n/a	n/a	n/a	n/a
ISO New England	n/a	n/a	n/a	n/a
ISO New England	n/a	n/a	n/a	n/a
ISO New England	2011	83%	17%	0%
ISO New England	2012	81%	18%	1%
ISO New England	2013	87%	11%	2%
ISO New England	2014	87%	10%	3%
ISO New England	2015	82%	15%	3%
ISO New England	2016	76%	21%	3%
Midcontinent ISO	2014	99%	1%	0%
Midcontinent ISO	2015	97%	3%	0%
Midcontinent ISO	2016	94%	6%	0%
New York ISO	2009	83%	15%	2%
New York ISO	2010	84%	15%	1%
New York ISO	2011	90%	9%	1%
New York ISO	2012	80%	18%	2%
New York ISO	2013	74%	25%	1%
New York ISO	2014	73%	26%	1%
New York ISO	2015	70%	29%	2%
New York ISO	2016	68%	29%	3%
PJM	n/a	n/a	n/a	n/a
PJM	2008	87.63%	11.04%	1.33%
PJM	2009	74.66%	23.72%	1.62%
PJM	2010	77.69%	20.93%	1.38%
PJM	2011	81.17%	17.28%	1.55%
PJM	2012	83.26%	14.98%	1.76%
PJM	2013	81.57%	15.66%	2.78%
PJM	2014	83.66%	14.66%	1.67%
PJM	2015	74.43%	23.98%	1.60%
PJM	2016	70.91%	27.43%	1.66%

**Accessible Data for Figure 8: Percentage of Capacity Commitments by Resource Type Procured in Independent System Operator (ISO) New England's Initial Auction for Capacity Delivery Years 2010/2011 through 2020/2021**

Capacity Delivery Years	Existing generating resources	Other resources	New generating resources	Total
2010 / 2011	89.7%	10.2%	0.1%	100%
2011 / 2012	82.9%	14.0%	3.1%	100%
2012 / 2013	82.5%	13.0%	4.5%	100%
2013 / 2014	85.4%	14.2%	0.4%	100%
2014 / 2015	84.8%	15.1%	0.1%	100%
2015 / 2016	84.5%	15.3%	0.2%	100%
2016 / 2017	85.2%	12.6%	2.2%	100%
2017 / 2018	87.2%	12.7%	0.1%	100%
2018 / 2019	84.7%	12.3%	3.1%	100%
2019 / 2020	84.1%	11.8%	4.1%	100%
2020 / 2021	86.9%	12.4%	0.7%	100%

**Accessible Data for Figure 9: Percentage of Capacity Commitments by Resource Type Procured in PJM Interconnection's (PJM) Initial Auction for Capacity Delivery Years 2014/2015 through 2020/2021**

Capacity Delivery Years	Existing generating resources	Other resources	New generating resources
2014 / 2015	87.5%	12.0%	0.5%
2015 / 2016	85%	12%	3%
2016 / 2017	84.4%	12.4%	3.2%
2017 / 2018	86%	10%	4%
2018 / 2019	88%	10%	2%
2019 / 2020	87.3%	9.4%	3.3%
2020 / 2021	90%	8%	2%

## Agency Comment Letter

### Accessible Text for Appendix IV: Comments from the Federal Energy Regulatory Commission

FEDERAL ENERGY REGULATORY COMMISSION

WASHINGTON, DC 20426

OFFICE OF THE CHAIRMAN

November 9, 2017

Mr. Frank Rusco

Director, Natural Resources and Environment

United States Government Accountability Office

441 G Street, NW

Washington, DC 20548

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Sincerely,

Neil Chatterjee

Chairman



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