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## WHOLESALE ELECTRICITY MARKETS IN THE TECHNOLOGICAL AGE

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### EXECUTIVE SUMMARY

The U.S. power industry, a major underpinning of the national economy, has experienced significant regulatory and market transitions over its long history. The unique nature of electricity provision is one susceptible to various forms of market failure, giving rise to a complex regulatory structure. Some failures are sufficiently pervasive as to support the widespread view that the industry is a “natural monopoly.” Thus, the industry’s early development included utilities being granted exclusive franchises in exchange for tight state regulation.

In the 1990s, efforts to introduce competition into the electricity industry reached full-swing, giving rise to organized wholesale markets operated by independent system operators (ISO) and regional transmission organizations (RTO). RTO/ISOs developed complex market rules to account for systemic market failures. The performance of RTO/ISOs continues to be affected by this confluence of evolving market rules, market conditions and technological development.

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Some observers are critical of the performance of organized markets. Market outcomes have sometimes proven politically unpopular or prompted interventions from states to “correct” for perceived deficiencies. These include actions to subsidize construction of new power plants or keep unprofitable power plants online. Some parties also charge that organized markets do not evolve with technological change.

Despite these criticisms, the development of organized markets has brought large economic efficiency gains compared to the “unorganized” model.<sup>1</sup> RTO/ISOs have exhibited strong reliability performance and provide incentives for market participants to engage in reliable behavior. The open-access organized market model is better positioned to reduce barriers to entry, lower transactions costs, provide clear investment signals to investors that spur innovation and compensate resources fairly and efficiently in a manner consistent with market fundamentals. RTO/ISOs in states that have restructured or replaced monopoly regulation of generation with independent merchant ownership have seen more efficient behavior from market participants than RTO/ISOs areas with predominantly regulated monopoly utilities.

While organized markets offer a substantial upgrade in electricity-system structure, significant performance challenges

1. This refers to bilateral-only markets, where regulated utilities exchange electricity based on customized deals between two parties.

remain.<sup>2</sup> Compared to a perfectly designed market, this paper finds that current organized markets can be improved in ways that enhance market performance.

- *Enhancing price formation.* Improvements in organized market design can ensure prices better reflect market fundamentals. This can reduce the need for RTO/ISOs to take “out-of-market” actions – that is, administrative mechanisms designed to deal with constraints that aren’t represented in the commercial network model – that distort price signals, as well as the need for side payments with such payments known as “uplift.”
- *Reducing artificial barriers to entry and exit.* Administrative barriers to entry preclude the full participation of all resources. Removing these would bolster competition. Market-design improvements also could better reflect resource needs at local levels, which would avoid administrative barriers to exit that currently compensate for market deficiencies.
- *Remedying incomplete markets.* Certain ancillary services are not fully represented in existing markets. Creating market products that match discrete services would value these services more appropriately. Similarly, transmission-planning processes can hinder effective competition from transmission substitutes or advanced transmission technologies. Reforms should allow all capable products to compete to supply transmission-system needs.

These market-design reforms could yield substantial market-efficiency gains. Much of this benefit would derive from taking better advantage of the value of advanced energy technologies. Achieving these goals would require proactive leadership from the Federal Energy Regulatory Commission, the RTO/ISOs and their stakeholders, as well as constructive engagement from the states through a form of “cooperative federalism.”

## BACKGROUND

Technological advances in the 1970s and 1980s helped give rise to electricity competition and, ultimately, spurred development of organized wholesale electricity markets. As these markets developed, they in turn accelerated innovation and the deployment of advanced energy technologies. This interplay underscores the virtuous circle between competition and technological advance.

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2. This paper applies a theoretical framework of efficient, competitive wholesale electricity markets to evaluate contemporary RTO/ISO performance.

## Evolution of organized markets

Energy regulation began at the state and local levels in the late 19th century. Local authorities granted private companies exclusive franchises in exchange for being granted oversight of their rates and services. These regulated monopoly utilities owned all aspects of electricity production, transfer and final delivery (generation, transmission and distribution). State legislatures later pre-empted local regulation by creating state public utility commissions (PUCs) to regulate rates based on the cost to serve customers.

In the traditional system, utilities usually operate their own electricity systems and incorporate exchanges with other utilities. These take the form of bilateral trades in which the prices and terms for each transaction are set via negotiation between two parties. The benefits of trade became apparent and utility transmission systems became interconnected across state boundaries. Amendments to the Federal Power Act (FPA) in 1935 gave the Federal Power Commission, later renamed the Federal Energy Regulatory Commission, authority to regulate wholesale (sales for resale) electric utility rates in interstate commerce.

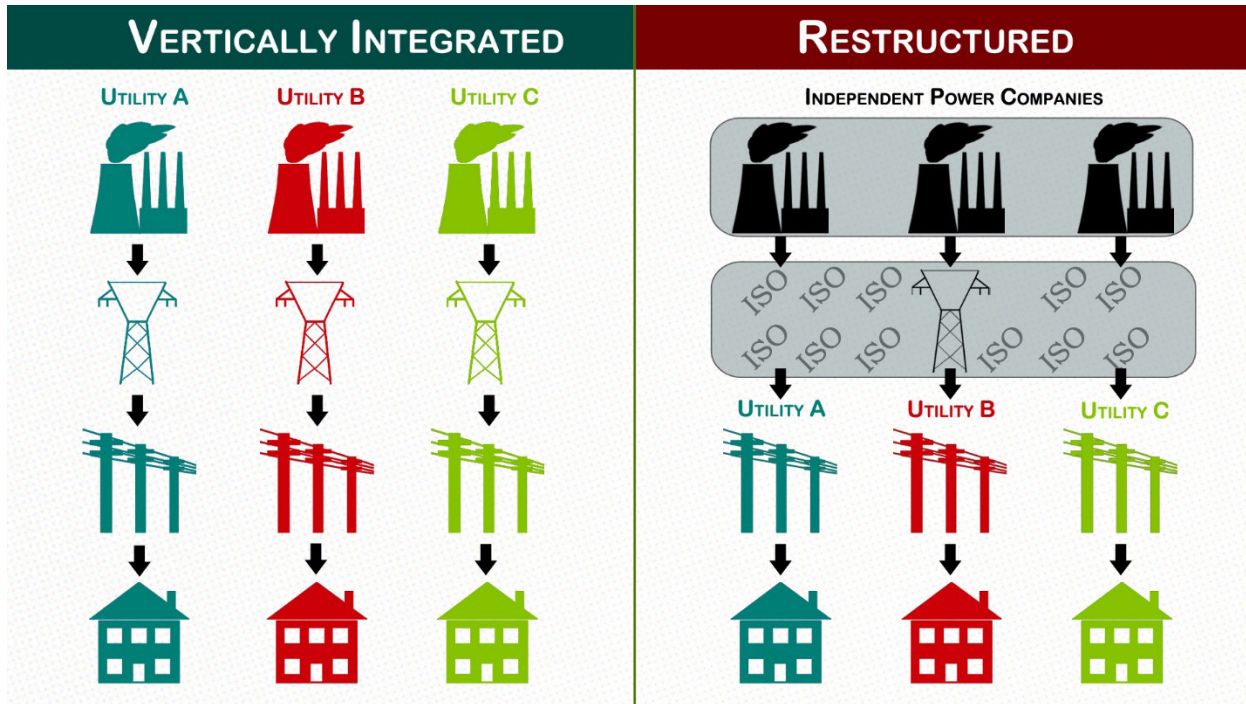
Congress took the first step toward electricity competition by passing the Public Utility Regulatory Policy Act (PURPA) of 1978. The law helped create a market for some forms of nonutility electricity producers by requiring utilities to buy power from lower-cost independent producers. This also gave rise to the broader concept of generation independent of regulated monopolies. Sometimes inaptly described as “deregulation,” this “restructuring” allowed generators and transmission owners to compete in an open wholesale marketplace. Restructuring limited the monopoly-utility model to distribution services, leaving customers to choose their electricity supplier. It also fostered a competitive market to determine wholesale rates in lieu of cost-of-service regulation.

During the 1990s, about half the states initiated restructuring; Texas, Illinois, Ohio and most mid-Atlantic and Northeast states ultimately retained it. While the decision to restructure rests with states, it involves reliance on competitive wholesale markets under FERC authority.<sup>3</sup> Competition requires generators to have open access to the transmission system, but regulated utilities initially could restrict other entities from using their transmission lines. The Energy Policy Act of 1992 amended the Federal Power Act to give FERC authority to grant transmission access on request. In 1996, FERC issued the “open access” rule (Order No. 888), which required transmission owners to provide nondiscriminatory transmission access. This encouraged the development of centrally organized electricity markets, where independent

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3. The exception is most of Texas, which operates on a transmission system not interconnected with other states.

FIGURE I: STRUCTURE OF THE U.S. ELECTRICITY INDUSTRY



system operators (ISOs) would operate the transmission system to facilitate open-access competition.<sup>4</sup>

In 1999, FERC issued Order No. 2000, which encouraged utilities to join an ISO or RTO. RTO/ISOs are independent, nonprofit organizations responsible for wholesale-grid reliability and transmission planning and operation.<sup>5</sup> States and industry participants have formed seven jurisdictional RTO/ISOs voluntarily, six of which fall under FERC’s jurisdiction. RTO/ISOs now manage more than two-thirds of the nation’s electricity volume and continue to expand.

All restructured states joined an RTO/ISO, as did many regulated-monopoly utilities. California ISO (CAISO), the Southwest Power Pool (SPP) and the Midcontinent ISO (MISO) consist primarily of traditionally regulated states. New York ISO (NYISO), New England ISO (ISO-NE) and the PJM Interconnection (PJM) cover entirely or primarily restructured states. The Electric Reliability Council of Texas (ERCOT) also serves a restructured territory, but is not under FERC’s jurisdiction.

RTO/ISOs use centrally operated, organized markets to balance supply and demand in real time. They also send

long-term price signals to balance the supply and demand of generation and transmission-infrastructure investment. Some RTO/ISOs use capacity markets to “patch up” deficiencies in the short-term markets to ensure there are adequate resources to meet infrastructure-planning needs. Markets enable grid operations and infrastructure investment to respond nimbly to changes in market fundamentals, such as declining natural-gas prices or shifts in electricity demand.

RTO/ISOs ostensibly are technology-neutral.<sup>6</sup> Their markets are intended to select any kind of supply and demand resources that provide grid reliability at the lowest cost. A technology-neutral market architecture allows new technologies to compete on a level playing field and can foster innovation through competition.

### Advent of the ‘Technological Age’

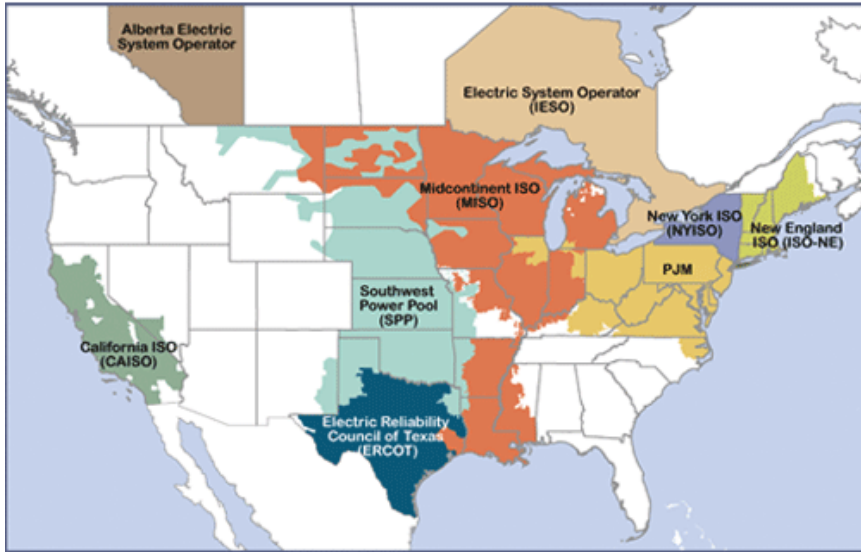
Technological advances helped enable competitive electricity markets. These include advances in generation technology, such as more efficient natural-gas power plants that reduced economies of scale, which helped diminish characteristics that supported the “natural monopoly” perspective. Advances in digital technology have helped markets operate, especially through software that enables complex optimization to determine the least-cost operation out of hundreds of heterogeneous generators across a transmission system.

4. Sometimes RTO/ISOs are themselves referred to as “organized markets”; technically, they actually are market facilitators. The term “organized markets” in this paper refers to the various markets facilitated by RTO/ISOs.

5. The difference between an ISO and RTO is largely semantic these days. The terms can be used interchangeably in most contexts.

6. They do not explicitly discriminate against any type of technology.

FIGURE 2: U.S. AND CANADIAN RTO/ISO TERRITORIES



Source: Federal Energy Regulatory Commission

Markets also provide price signals that communicate the value of electricity services, which can steer efficient investments in innovation and deployment of cutting-edge technology. For example, restructuring drove increases in the operating efficiency of nuclear plants and the adoption of advanced technology that increased output and reduced outage times.<sup>7</sup> Similarly, cost-reduction incentives encouraged merchants to pursue greater efficiency in fossil-fuel plants.<sup>8</sup>

The signals conveyed by market prices have spurred development of new advanced-energy services and technologies. Merchant demand-response providers have developed creative business models that provide more economic and reliability benefits to the grid than regulated-utility demand-response programs have.<sup>9</sup> New storage technologies have been developed in response to organized markets' transparent price signals. State-of-the-art storage technologies, including flywheels and advanced batteries, targeted early deployment in organized markets that had fair-entry rules and prices that accurately reflect resource value. For example, changes in PJM's frequency regulation market contributed to two-thirds of the utility-scale storage deployed in

2014.<sup>10</sup> Such examples illustrate how open access and future market prices are critical in driving energy innovation.

Numerous advances have been made in technologies with unconventional characteristics. Many technologies that qualify as distributed energy resources (DERs) have witnessed dramatic cost declines this decade. Energy storage can serve as a supply and demand resource and presents an incredible diversity in configurations and applications. Some of these technologies can create economic value through unconventional applications. This includes the ability to serve as a non-transmission alternative (NTA), such as demand response or energy storage, which substitutes for the need to expand transmission infrastructure. Unconventional technology characteristics can present challenges for defining market rules that must account for market failures.

## CHALLENGES OF WHOLESALE ELECTRICITY COMPETITION

The FPA and PURPA grant FERC authority over the rates, terms and conditions of wholesale power sales and the construction and operation of transmission lines. The FPA requires FERC to set wholesale rates that are "just and reasonable" and "not unduly discriminatory or preferential."<sup>11</sup> "Just and reasonable" rates are justified on the basis of cost

7. Fan Zhang, "Does Electricity Restructuring Work? Evidence from the U.S. Nuclear Energy Industry," *Journal of Industrial Economics* 55, no. 3: 397-418, 2007. [http://www.iaee.org/en/students/best\\_papers/fan\\_zhang\\_2006.pdf](http://www.iaee.org/en/students/best_papers/fan_zhang_2006.pdf)

8. Catherine Wolfram, "The Efficiency of Electricity Generation in the United States after Restructuring," *Electricity Deregulation Choices and Challenges*, 227-54, 2005. <http://oxfordindex.oup.com/view/10.7208/chicago/9780226308586.003.0006>

9. Devin Hartman "Pathways to competition in demand response," *R Street Institute*, July 2016. <http://www.rstreet.org/policy-study/pathways-to-competition-in-demand-response/>

10. Energy Storage Update, "PJM leads the US fast-frequency regulation market," April 20, 2015. <http://analysis.energystorageupdate.com/market-outlook/pjm-leads-us-fast-frequency-regulation-market>

11. Lawrence R. Greenfield, "An Overview of the Federal Energy Regulatory Commission and Federal Regulation of Public Utilities in the United States," Federal Energy Regulatory Commission, December 2010. <http://www.ferc.gov/about/ferc-does/ferc101.pdf>

or competitive market outcomes. FERC applies the latter to its oversight of RTO/ISO rules. Undue discrimination can take several forms, including unreasonable restrictions on market participation from a class of technology. Nondiscriminatory rates permit differential treatment of market participants only for good reason. For example, two resources may receive different compensation for producing energy on the basis that one is located in an area with greater market value for electricity.

FERC and the courts have interpreted the FPA's flexible provisions in a manner that aligns well with economic principles, as the platform has enabled the progressive development of competitive wholesale electricity markets. Before gauging how well the organized markets have performed, we first need a definition of a well-functioning market.

### Defining a well-functioning market

A perfectly competitive market requires a variety of conditions that very few markets in any segment of the economy come close to satisfying. In addition, there are several reasons electricity presents uniquely thorny challenges for perfect competition, including:

- Electricity must be produced and consumed instantaneously, given major limitations to economical storage;
- Electricity production and consumption is very difficult to balance, given physical limitations to its generation and transfer;<sup>12</sup>
- Electricity markets require a reliable transmission grid to function, but the transmission network contains extensive “network externalities” (one participant’s usage imposes unaccounted costs on others) that undermine its reliable operation; and
- Adequate supply and demand resources to support grid reliability is a “common good” that private actors will chronically undersupply.

The nature of electricity does not satisfy the conditions necessary for a well-functioning marketplace. This means that efficient, competitive outcomes will not occur automatically. This makes institutions and rules necessary to facilitate a competitive electricity marketplace.

Obstacles to electricity competition create inefficiencies, but corrections can yield reasonably efficient outcomes. “Just and reasonable” rates merely must be workably competitive, not perfectly competitive. Generally, workably competitive

markets have firms with limited market power and exhibit few barriers to entry or exit.<sup>13</sup> Remaining market failures, such as network externalities and the public good of reliability, require sophisticated institutions and an independent centralized coordinator. Basic, and sometimes detailed, regulation is appropriate to ensure efficient market outcomes by setting rules and overseeing market structure and participant behavior. Interventions to correct market failures must be specifically tailored to the problem to minimize unintended consequences.

### Achieving a well-functioning market

A fundamental assumption of competitive electricity markets is that market participants make operating and investment decisions based on market prices.<sup>14</sup> In particular, forward price expectations primarily drive resource investments.<sup>15</sup> This makes the determinants of price formation critical for efficient electricity markets. The success of organized markets depends on the quality of their design. Market design sets the rules for how markets operate and participants interact. It provides incentives for competitive behavior and shapes the processes that guide market outcomes.

Facilitating efficient operational and investment decisions is accomplished through adherence to principles of sound market design:

- Foster competition through nondiscriminatory, open-access market participation from all resource types.
- Align market and reliability requirements.
- Develop transparent market operations and prices that reflect the marginal system cost and value of resource scarcity.
- Minimize out-of-market actions that undermine efficient price formation, while ensuring that necessary out-of-market costs are allocated on the basis of who causes those costs.
- Minimize transaction costs.
- Enhance product substitution and market liquidity.
- Mitigate problematic market power.

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13. Samuel A. Newell, et al., “Developing a Market Vision for MISO: Supporting a Reliable and Efficient Electricity System in the Midcontinent,” Midcontinent Independent System Operator, Inc., (2014).

14. Hogan, William W. “Electricity Market Design and Efficient Pricing: Applications for New England and Beyond,” (2014). [https://www.hks.harvard.edu/fs/whogan/Hogan\\_Pricing\\_062414r.pdf](https://www.hks.harvard.edu/fs/whogan/Hogan_Pricing_062414r.pdf)

15. Independent Market Monitor for the ERCOT Wholesale Market. “2015 State of the Market Report for the ERCOT Wholesale Electricity Markets,” Potomac Economics, LTD., (2016).

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12. Devin Hartman, “Physical characteristics of energy,” R Street Institute, August 2016. <http://www.rstreet.org/policy-study/physical-characteristics-of-energy/>

**TABLE I: CONDITIONS FOR EFFICIENT, COMPETITIVE ELECTRICITY MARKETS**

Condition	Description	Electricity Industry Application
Freedom of entry and exit	Producers and consumers must face no artificial barriers to enter or exit the marketplace.	Barriers to rapid entry include high capital costs and long lead times to construct new facilities. This restricts the ability for new supply to respond quickly to price signals.  Transmission owners can discriminate against market participants seeking access to their system. To rectify this, FERC requires open transmission access, which is implemented more effectively in organized markets than bilateral-only areas.  RTO/ISO rules can create artificial barriers to entry, especially for unconventional technologies. RTO/ISOs also prohibit some resources from exiting the market until reliability-preserving adjustments can be made to accommodate the exit.
Perfect information	The full characteristics of a product are observable to all market participants.	Lack of information can lead to inefficient investment and operational decisions by incumbent and prospective participants. If one party has greater information access than another, they can capture excess profits at others' expense.
Participants are price takers	Market power exists if a change in production or consumption by one actor significantly impacts the market price.	Market power is often highly concentrated in bilateral-only areas. Supplier market power is common in organized markets at the local level, where there are transmission constraints. If left unmitigated, market power can result in a reduction in supply and/or large increases in prices relative to competitive levels.
Product homogeneity	All units of production from producers must be identical. In other words, one producer's product is a perfect substitute for another's.	Electrons are electrons, but the value of different services to produce them differ widely. A variety of services are necessary to support the grid. For example, an electric system must have enough total ramp capability (the rate at which electricity generation can increase or decrease) to balance supply and demand. Power plants differ greatly in their ramp capabilities.
Costless transactions	Market transactions incur no costs, otherwise some efficiency-improving exchanges will not occur.	Grid operation imposes transactions costs. RTO/ISOs lower overhead costs for system operation by displacing the roles of multiple utilities as their own grid operator. Membership in RTO/ISOs carries fixed transactions costs, such as administration and legal fees. The complexity of RTO/ISO market and administrative rules adds to this, as members expend resources to participate in stakeholder processes.
Rivalrous and excludable goods	Markets allocate rivalrous <sup>1</sup> and excludable <sup>2</sup> (or "purely private") goods efficiently. Markets underprovide nonrivalrous and nonexcludable goods because producers cannot capture the full benefits of the good.	The operating reliability of the grid and transmission security are pooled services where one user cannot prevent another from benefiting. This nonrivalrous, nonexcludable nature makes them "public goods." Resource adequacy, which is the state of sufficient resources to meet maximum demand, is rivalrous but nonexcludable (a "common good"). These characteristics cause private actors to underprovide the service.
Welfare-maximizing motives	Producers and consumers seek to maximize their profit and well-being, respectively, through market participation.	This generally occurs in restructured environments, where market outcomes directly determine market participants' profits. However, monopoly utilities pass market revenues and costs onto ratepayers, removing an incentive to participate efficiently in the marketplace. This is why merchants have stronger incentives for cost control, innovation and risk management than regulated utilities.
Absence of externalities	An externality exists when costs or benefits of a market transaction accrue to an unaccounted third party. These unaccounted effects cause the market to overproduce (external costs) or underproduce (external benefits) a good or service.	Network externalities are widespread on the shared transmission system. This happens where one participant's usage imposes costs on others, because overloading facilities undermines reliable grid operation.  Pollution is a pronounced externality. While RTO/ISOs do not have an explicit environmental mandate, their markets accommodate public-policy initiatives intended to account for environmental costs (e.g., emissions pricing or power-plant operating restrictions).

1. One party's use of a good reduces its quality or availability to others.  
2. Suppliers can limit receipt of their product to those parties who pay for it.

Organized market design should facilitate efficient, competitive outcomes by fully reflecting electricity supply and demand. This underscores the importance and challenge of facilitating complete economic integration of unconventional supply and demand resources. Optimal market design changes with the state of technology. For example, rules that did not create a barrier to entry in the past may do so for new technologies. Market design also affects the research and development of technologies. Incomplete price formation can dampen the signal to innovate. Furthermore, if a prospective technology requires regulatory reform to gain market access, it faces a regulatory risk that could stunt its development (e.g., artificial risk inflating the cost of capital).

Regulatory policy objectives should adhere to sound market-design principles in a forward-looking manner. The state of

existing and emerging technologies should be accounted for in market design to ensure market rules encourage innovation and do not inadvertently discriminate against emerging resources. Anticipatory market design requires forward-looking analyses. Insufficient information on the implications of market design under evolving long-term technological conditions may render market-design flaws undetectable or lead to suboptimal reforms.

Proactive market design is consistent with the FPA. This stands in sharp contrast to industrial policy supported by the "infant industry" argument. That position supports the view that public policy should be sufficiently partial to new technologies to provide protection through their developmental stages. That sort of industrial policy is based on the idea that new technology entrants require assistance in the

initial period to overcome high costs or performance deficiencies until they can compete in the long run. In practice, this approach raises a host of problems, including:

- The creation of “rent-maintenance” behavior, where the infant industry seeks continued partial treatment even after it has matured.
- The inability of policymakers to know when to end industry protection or how much protection to provide.
- Deterred innovation as a result of artificially rewarding an inferior product and encouraging technologists to seek preferred regulatory treatment, rather than making product enhancements.
- A policy distraction from superior ways to correct for any market failure, such as removing artificial barriers to entry to “level the playing field.”

The infant industry argument posits preferential treatment for nascent technologies, which contradicts the FPA and, often, cost-benefit analysis. Rather, proactive market design is supported by cost-benefit analysis, which holds that current or proposed market designs should be evaluated based on their expected costs and benefits, not simply retroactive analyses that are not representative of future costs and benefits.

A well-functioning market enables new entrants to compete successfully once they are more efficient, customer-responsive and innovative than incumbents.<sup>16</sup> This is an appropriate aim for proactive market design. In economic terms, market design should encourage dynamic as well as static efficiency. This means that market design should reflect the long-term drivers of market efficiency, not just the immediate future.<sup>17</sup> Specifically, this puts the lens on enhancing the incentives to innovate.

Strengthening market-design rules to stimulate dynamic efficiency via innovation generally drives improvements in static market performance, as well. Enhancing competition and price information benefits static and dynamic performance.<sup>18</sup> Better price information mitigates innovation risk and improves the quality of decisions to innovate.<sup>19</sup>

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16. Ken Costello, “Utility Involvement in Distributed Generation: Regulatory Considerations,” National Regulatory Research Institute, February 2015. <http://pubs.naruc.org/pub/536EF3DF-2354-D714-510E-B20295D42469>

17. A static perspective focuses on allocative efficiency, where market prices should reflect marginal costs. A dynamic perspective looks at productive efficiency, or how firms introduce new products or new processes of production.

18. One exception is that the economics literature often finds that market power can be associated with increased dynamic efficiency, where firms are more prone to undertake research and development when having a dominant market position.

19. Peter Cramton, “Innovation and Market Design,” National Bureau of Economic Research, February 2009. <http://www.nber.org/chapters/c8186.pdf>

## ORGANIZED MARKETS EXCEL, BUT NEED IMPROVEMENT

The RTO/ISOs and their independent market monitors (IMMs) employ a variety of services to help ensure markets operate more efficiently. These services intend to reduce barriers to entry and exit, overcome imperfect information, mitigate the exercise of market power, appropriately compensate heterogeneous services and efficiently achieve grid reliability. These services include:

- *Market administration.* Organized markets provide well-defined, standardized product definitions that create discrete markets which otherwise may not materialize.<sup>20</sup> They also reduce the transaction costs of trading. Together, this facilitates increased liquidity and efficiency gains from trade. Centralized administration is necessary to facilitate energy and ancillary service price formation, which is the foundation of a well-functioning electricity market.
- *Resource commitment and dispatch.* RTO/ISOs provide centralized scheduling of resource operations across their footprints. This ensures transmission security, which is a public good that private forces alone would underprovide. It also addresses network externalities that uncoordinated transactions create. RTO/ISOs use sophisticated algorithms that lower the costs of operating the transmission system beyond what bilateral-only areas provide.
- *Resource adequacy.* FERC-jurisdictional RTO/ISOs in restructured states use capacity markets to provide an increased revenue stream to resources to ensure a sufficient quantity remain in operation. ERCOT elects to use scarcity pricing instead, which has the advantage of more accurately reflecting the value of resource adequacy.
- *Transmission planning.* Transmission planning retains some natural monopoly characteristics but is amenable to at least some degree of competition. RTO/ISOs conduct centralized transmission planning that incorporate competitive processes to varying degrees. Centralized transmission planning thus far has revealed superior cost savings compared to an uncoordinated planning model for large projects. Decentralized transmission planning may offer better results for localized transmission needs.
- *Market and operational transparency.* RTO/ISOs release information on market conditions, which is essential for market participants to transact

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20. Creating electricity market products that reflect distinct economic services can remedy incomplete markets, where a market would not materialize despite private benefits outweighing costs. This includes the creation of particular ancillary-service products, such as frequency regulation and operating reserves.

efficiently. Prices in organized markets better reflect underlying fundamentals than in bilateral-only areas, in part because of superior transparency. Still, not all information is accessible. For example, generator and transmission outages and interconnection-process updates are major market-price drivers, but have varying levels of transparency.<sup>21</sup>

- *Monitoring and market-power mitigation.* RTO/ISOs and/or their IMMs employ ex ante and automated practices to counteract attempts by market participants to exercise market power. Monitoring and mitigating market power relies on transparency of resource cost, offers, operating status and other information unavailable in bilateral markets. These entities also evaluate market performance and recommend rule changes to internal stakeholder processes and to FERC.
- *Informational support.* RTO/ISOs provide technical information critical to regulatory and broader public-policy development. There’s much room for improvement here, especially in organized markets that span regulated states. Information from organized markets has great value to researchers, who can evaluate market performance, identify concerns and recommend remedies.

RTO/ISOs use a variety of markets that represent different characteristics of supply and demand. All RTO/ISOs use energy and ancillary-service markets to reflect the short-run marginal costs of operating the power system. Energy markets use locational marginal pricing (LMP) to reflect the marginal cost to serve load (demand) at specific locations on the grid. LMP reflects three marginal-cost components: system marginal energy cost, transmission line loss and transmission congestion. The system marginal energy cost represents the supply/demand baseline, which does not vary across the footprint. Line losses are relatively small across an RTO/ISO. Transmission congestion is the difference maker. Congestion occurs when there is insufficient transmission capacity to run all least-cost resources. This tends to drive up LMPs in high-demand areas where transmission capacity is limited (e.g., New York City) and drive down LMPs in areas with an abundance of inexpensive generation that lack the transmission capacity to get to higher demand areas (e.g., wind power in the Midwest).

Short-term market prices offer signals to guide resource planning and investment decisions. Specifically, existing or prospective resource owners will retain or build resources if revenues from energy and ancillary-services markets exceed their resource cost. Otherwise, they will retire or opt not to build the resource in question. The Electric Reli-

21. Newell, 2014.

**TABLE 2: TYPES OF ORGANIZED WHOLESALE ELECTRICITY MARKETS**

Market	Purpose	Method
Energy market	Facilitate efficient actions by market participants in the short term (e.g., generation and demand response) and guide long-term investment decisions. Operated “day ahead” and in real time.	Uses short-term supply and demand to form prices that reflect the location-based marginal value of bulk energy.
Ancillary services markets	Facilitate efficient long-term investment decisions to ensure sufficient capacity to operate the system reliably in the future.	Uses short-term supply and demand to form prices that reflect the marginal value of specific energy services, such as frequency regulation and operating reserves.
Capacity markets (ISO-NE, NYISO, PJM, MISO only)	Facilitate efficient long-term investment decisions to ensure sufficient capacity to operate the system reliably in the future.	Uses an auction to procure a level of future capacity deemed necessary for grid reliability.

ability Council of Texas (ERCOT) relies exclusively on this model, employing robust “scarcity pricing.” Scarcity pricing is a mechanism to send price signals in the real-time market when there is a systemwide shortage of power reserves. This provides increased revenue to keep enough facilities in operation to meet resource-adequacy needs.<sup>22</sup> This revenue shortfall is often referred to as “missing money.”

Capacity markets present one option to address the “missing money” of short-term markets. They set a procurement target for the amount of capacity needed to meet expected future demand reliably. This amount is then held in an auction, with the lowest offers need to meet the target paid the market price. If facility operators aren’t taking in enough revenue in the short-term markets, they offer their shortfall “missing money” into the capacity markets.

Capacity markets are limited in their ability to provide adequate resources efficiently. These limitations include poorly accounting for things like transmission constraints and the transient value of resource adequacy (e.g., system resource needs are much higher on a hot summer day than a mild fall day), all of which can be reflected more accurately in the short-term market. Because of these limitations, capacity markets require extensive and controversial administrative rules.

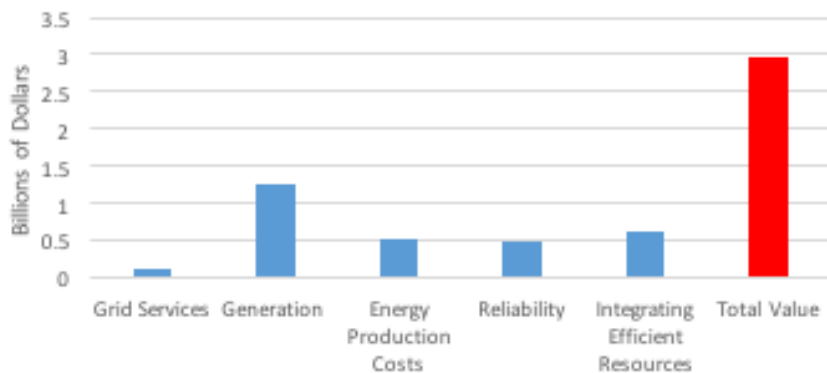
Generally, IMMs have concluded that, in recent years, energy and ancillary-service markets have had competitive aggregate structures, market-participant behavior and outcomes.<sup>23</sup> The structures of local energy and ancillary-service markets and capacity markets are often not competitive and rely on mitigating market power to deliver competitive results. Miti-

22. In particular, short-term markets that reflect short-run marginal costs do not provide sufficient revenue for many resources to cover their long-run marginal costs. Additional revenue is necessary to provide the common good of resource adequacy.

23. See recent annual state of the markets reports issued by the IMM of each RTO/ISO.



FIGURE 3: THE VALUE PROPOSITION OF PJM



Source: PJM

gation can be more challenging in capacity markets.<sup>24</sup> IMM measures of competition are behavior-focused and do not detect if market design inhibits competition by discriminating against certain resource characteristics.

Current IMM approaches to evaluating competition examine the ability to exercise market power (structure); attempts to do so (conduct); and the efficacy of market-power mitigation to achieve competitive outcomes. This is a critical measure of static-market performance, but can overlook dynamic aspects. It tends to evaluate the behavior of incumbents and conventional new entrants, but does not detect whether there are artificial deterrents to entry by new and unconventional actors. Expanded, recurring analyses of artificial barriers to entry may identify factors that limit dynamic efficiency. They also may create an opportunity for expeditious remedies.

### RTO/ISOs create large net benefits

Given the scale and complexity of market failures, organized electricity markets function quite efficiently overall. The organized markets have improved market efficiency that far outweighs their implementation costs. They have created new trading opportunities that were not realized in bilateral-only markets.<sup>25</sup> LMP better reflects market fundamentals than bilateral-only areas, and organized markets provide superior price transparency and liquidity relative to bilateral-only areas. Organized markets do not replace bilateral transactions altogether. Rather, bilateral trading can complement organized markets, while the efficiency and transpar-

ency of organized markets benefit bilateral markets.<sup>26</sup> The evidence for this is that prices in the real-time market drive prices in bilateral markets.

Conservative estimates of the benefits of RTO/ISOs suggest they far exceed their costs. For example, in 2015, MISO estimated its benefits at between \$2.4 and \$3.3 billion, compared to \$267 million in costs.<sup>27</sup> Such estimates likely understate benefits considerably, as they do not fully account for outages and extreme system conditions.<sup>28</sup> Strong net benefits accrue in MISO as well as CAISO and SPP, despite being comprised predominantly of regulated utilities. Regulated utilities generally pass their organized market revenues and operating costs through to ratepayers, and their resource investments must be approved by state regulators to receive cost recovery. This removes the incentive to follow market signals, closely manage risk and costs, and to innovate.

Favorable value propositions have helped forge RTO/ISO expansion, as the trend of utilities joining RTO/ISOs has increased since the 2000s. In 2013, MISO integrated utilities spanning most of Arkansas, Louisiana, Mississippi and some of Texas. CAISO expanded outside of California in 2014, while SPP has also grown recently. A recent study of CAISO's full transformation into a multistate entity estimated the benefits to California ratepayers alone will be \$55 million a year in 2020, escalating to \$1 to \$1.5 billion per year by 2030.<sup>29</sup>

24. This is because determining a competitive offer in energy and ancillary service markets (short-run marginal cost) is much easier than determining the "missing money" (net of going-forward cost and expected future energy and ancillary service revenues) of an incumbent or new entrant.

25. Erin T. Mansur and Matthew White, "Market Organization and Market Efficiency in Electricity Markets," working paper, April 23, 2007. [http://public2-prod.gsb.stanford.edu/sites/default/files/documents/2007\\_05-04\\_White.pdf](http://public2-prod.gsb.stanford.edu/sites/default/files/documents/2007_05-04_White.pdf)

26. State of North Carolina Utilities Commission, "Rebuttal Testimony of Joseph Bowling," Application of Virginia Electric and Power Company, d/b/a Dominion North Carolina Power, for Authority to Transfer Functional Control of Transmission Assets to PJM Interconnection, LLC, Docket No. E-22, Sub 418, Dec. 22, 2004. [http://www.monitoringanalytics.com/reports/Reports/MMU\\_Orders\\_and\\_Responses/20041222-rebuttal-testimony-joseph-bowling.pdf](http://www.monitoringanalytics.com/reports/Reports/MMU_Orders_and_Responses/20041222-rebuttal-testimony-joseph-bowling.pdf)

27. Midcontinent ISO, "2015 Value Proposition," accessed Aug. 18, 2016. <https://www.misoenergy.org/Library/Repository/Communication%20Material/One-Pagers/One%20Pager%20-%202015%20Value%20Proposition.pdf>

28. Newell, 2014.

29. The Brattle Group, et al., "Senate Bill 350 Study: The Impacts of a Regional ISO-Operated Power Market in California," presented to the Joint State Agency Workshop on the Proposed Regionalization of the Independent System Operator, July 26, 2016. [https://www.caiso.com/Documents/Presentation-SenateBill350Study-Jul26\\_2016.pdf](https://www.caiso.com/Documents/Presentation-SenateBill350Study-Jul26_2016.pdf)

The RTO/ISO value proposition is stronger in restructured states, where market participants have an incentive to follow market signals for operation and investment. The incremental benefit of restructuring is clearest in decisions to operate resources more efficiently and to base investment decisions on market value. For example, a recent PJM study highlights the determination of new resource investments or retirement of legacy facilities based on economic merit in a manner that drives innovation.<sup>30</sup> This indicates a propensity to use advanced management techniques and technologies in a productive manner.

Markets with participants that have incentive to follow price signals allow technologies to demonstrate their value to prospective suitors on the basis of cost, risk and market value. Market value drives dynamic efficiency most productively when markets effectively price operational attributes of technological innovations. Improved market design and enhancing competition in incomplete markets would magnify this effect and bolster the RTO/ISO value proposition.

### Incomplete market design

RTO/ISO market design is advanced but remains incomplete.<sup>31</sup> Better market design would involve improved price formation and reduced barriers to entry and exit. Such actions are central to enhancing the performance of organized markets, while simultaneously expanding market access for advanced technologies and ensuring market participants have appropriate incentives to use advanced technology. Improved price formation and competitive conditions also facilitate innovation in advanced technologies.

## ENHANCING PRICE FORMATION

“Generation” (sellers) and “demand” (buyers) participate in organized markets by submitting offers and bids to sell or buy an electricity product in an organized marketplace. The RTO/ISOs run computerized market models that accept the lowest-cost offers needed to meet demand, while respecting the physical constraints of power plants, demand response and the transmission system. An RTO/ISO has discretion to commit and dispatch resources that did not clear a short-term market, if needed to maintain reliable grid operations.

Under a market design with perfect price formation, RTO/ISOs would not need to commit or dispatch resources beyond those scheduled in the markets. Technical and operational

limits constrain market outcomes, which makes administrative interventions necessary to maintain short-term reliability. These include software limitations that prevent RTO/ISOs from modeling all physical characteristics of generation and transmission. For example, voltage constraints may require operation of certain generators to avoid reactive power losses.<sup>32</sup> Operating these generators can require manual, out-of-market intervention by RTO/ISOs because voltage constraints are not accurately reflected in models used to clear markets.

RTO/ISOs provide “make-whole” payments, also known as “uplift” payments, to ensure the financial solvency of resources used outside short-term market processes. For example, if a resource did not clear the day-ahead energy market, but the RTO/ISO decides it is not necessary to operate, they will commit the unit and compensate it through uplift. Wholesale customers are billed to finance uplift.

Uplift is not a market. Rather, it can inhibit market performance by excluding a resource that may have influenced the market price. Failure to make uplift payments and their causes transparent and to price them into short-term markets can undermine price signals, efficient resource utilization and investment signals. Fluctuations in uplift charges may create financial uncertainty and depress market liquidity.<sup>33</sup>

Uplift is a reflection of incomplete market design. Market design improvements that would reduce uplift and enhance market performance include:

- *Removing or modifying price caps.* Price caps are an artificial constraint that suppress market prices during the most critical times, when demand is very high relative to available supply. Distorting price signals during scarcity periods undercuts market incentives for resource adequacy. Concerns over market power, which is acute in scarcity periods, should lead to examination of market power mitigation practices, not an artificial substitute.
- *Enhancing transparency.* RTO/ISOs generally do not fully disclose the cause or location of uplift payments. The magnitude of uplift is difficult for market participants to see due to this lack of timely information.<sup>34</sup> The absence of relevant information creates a barrier

30. PJM Interconnection, “Resource Investment in Competitive Markets,” May 5, 2016. <http://www.pjm.com/-/media/documents/reports/20160505-resource-investment-in-competitive-markets-paper.ashx>

31. William W. Hogan, “Electricity Market Structure and Infrastructure,” Brookings Institution, *Acting in Time on Energy Policy*, Chapter 6, pp. 128-161, May 2009. [http://belfercenter.ksg.harvard.edu/publication/19046/electricity\\_market\\_structure\\_and\\_infrastructure.html](http://belfercenter.ksg.harvard.edu/publication/19046/electricity_market_structure_and_infrastructure.html)

32. William H. Hogan, “Markets in Real Electric Networks Require Reactive Prices,” *The Energy Journal*, 14(3):171-200, July 1993. [https://www.researchgate.net/publication/46523259\\_Markets\\_in\\_Real\\_Electric\\_Networks\\_Require\\_Reactive\\_Prices](https://www.researchgate.net/publication/46523259_Markets_in_Real_Electric_Networks_Require_Reactive_Prices)

33. Federal Energy Regulatory Commission, “Staff Analysis of Uplift in RTO and ISO Markets,” August 2014. <http://www.ferc.gov/legal/staff-reports/2014/08-13-14-uplift.pdf>

34. Susan L. Pope, “Price Formation in ISOs and RTOs: Principles and Improvements,” FTI Consulting, October 2014. <http://docplayer.net/14545572-Price-formation-in-isos-and-rtos-principles-and-improvements.html>

to entry.<sup>35</sup> It also undermines the market predictability needed for operational, hedging and investment decisions and inhibits identification of underlying causes of uplift and development of remedies.

- *Improving resource integration.* Resources with certain characteristics are not modeled in market operations, distorting market outcomes. This especially affects unconventional resources, creating uncertainty in their market value and sometimes leading to their underutilization. For example, some forms of demand response cannot set LMP. Combined-cycle generation technology is often not fully represented in models either, as these generators have operating characteristics that result in cost curves the models were not designed to accommodate. Software advances enable these issues to be addressed. For example, RTO/ISOs can upgrade their models to account for short-term costs, such as startup costs, which current models exclude. This is especially important for inflexible fast-start resources (e.g., natural-gas-fired combustion turbine) that many existing models cannot accommodate.<sup>36</sup>
- *Reducing the need for administrative interventions.* Minimizing the need for grid operators to intervene manually centers on better representation of resource scarcity and system constraints in market models. For example, the NYISO IMM recommends including transmission constraints that are excluded in the day-ahead energy market models.<sup>37</sup> Grid operators sometimes commit resources if demand in the day-ahead market was less than their forecast demand through a process called reliability unit commitment (RUC). This creates a perverse effect of suppressing a scarcity signal. Incorporating the RUC requirement as a need for increased reserves is one option to represent this in the market.<sup>38</sup>

Completing shortage pricing. At times of extreme system stress, market prices should reflect the value consumers place on avoiding an involuntary loss of service. Failure to do so can result in emergency grid-operator interventions and muted investment price signals. Short-term markets that better reflect scarcity would reduce the importance of

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35. Monitoring Analytics LLC, "Comments of the Independent Market Monitor for PJM," Federal Energy Regulatory Commission Docket No. AD14-14-000, Feb. 23, 2016. [http://www.monitoringanalytics.com/reports/Reports/2016/IMM\\_Comments\\_Docket\\_Nos\\_ER16-873\\_20160223.pdf](http://www.monitoringanalytics.com/reports/Reports/2016/IMM_Comments_Docket_Nos_ER16-873_20160223.pdf)

36. Federal Energy Regulatory Commission. "Order Directing Reports," Docket No. AD14-14-000, Nov. 20, 2015. <https://www.ferc.gov/whats-new/comm-meet/2015/111915/E-2.pdf>

37. David B. Patton, et al., "2015 State of the Market Report for the New York ISO Markets," Potomac Economics, May 2016. [http://www.nyiso.com/public/webdocs/markets\\_operations/documents/Studies\\_and\\_Reports/Reports/Market\\_Monitoring\\_Unit\\_Reports/2015/NYISO%202015%20SOM%20Report\\_5-23-2016-CORRECTED.pdf](http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2015/NYISO%202015%20SOM%20Report_5-23-2016-CORRECTED.pdf)

38. Hogan, 2014.

capacity markets and other unnecessary, complex and reinforcing administrative efforts.<sup>39</sup> Shortage pricing is generally implemented systemwide, but this does not reflect locational scarcity in transmission-constrained areas. Complete shortage pricing should reflect the value of lost service and the probability it will occur at a local level.

Price formation improvements directly enhance market performance and provide indirect benefits by reducing political risk. Maintaining political confidence in markets is an abstract but critical objective for efficient, competitive electricity markets. Heightened political confidence reduces the risk of out-of-market interventions that rattle investor confidence, which is especially problematic for resource adequacy investments.<sup>40</sup>

## REDUCING BARRIERS TO ENTRY AND EXIT

Artificial barriers to entry take many forms. This should not be confused with natural barriers to entry, such as high capital costs, which do not reflect market-design flaws. Various RTO/ISO rules unintentionally discourage or prohibit participation from unconventional or emerging technologies. Detecting these requires technology-specific inquiries, but several cases are already diagnosed.

Sometimes the definition of a product precludes certain resources or greatly limits their value. For example, some capacity markets use products that are year-round services that must be available around-the-clock. Capacity markets base their procurement targets on anticipated maximum annual demand (e.g., summer peak). Resource-adequacy needs fluctuate throughout the day and by season. An annual, 24/7 product ignores this transient value of resource adequacy. This limits or precludes resources whose performance varies by season or time of day, such as seasonal demand-response products (e.g., air-conditioning cycling).

Technical requirements to provide an electricity product can create artificial barriers to entry. These can take the form of eligibility barriers or qualification criteria and performance requirements. For example, RTO/ISOs have differing rules on the minimum resource size to qualify for particular markets, which sometimes discriminate against smaller resources.

Transmission interconnection standards are another technical policy that can create barriers to entry. FERC has historically adopted new standards for new technologies and DERs may be ripe for such reform. Interconnection policies are designed to ensure safety and reliability, but excessive

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39. Hogan, 2014.

40. Political intervention can severely undermine investment incentives by dramatically shifting the value proposition of private investment.

requirements may provide an unnecessary barrier to entry. Given the distribution-level nature of DERs, reforming FERC-jurisdictional interconnection standards may best be done in coordination with state distribution-level standards. This could provide prospective DER developers with a transparent development process.

ISO-NE has a rule that artificially deters the development of small DERs. Some electricity generated by DERs does not reach the bulk-transmission system (i.e., consumed on-site or within its distribution system). This reduces the need for transmission services. The ISO-NE rule does not credit DERs for this reduced impact on the transmission system. This effect could be viewed similarly to a demand reduction, as is the case in CAISO. Instead, the entities buying wholesale power on behalf of end-use customers must “reconstitute” this generation into their estimates of peak load. Since peak load provides a basis for determining transmission-grid costs, the reconstitution practice diminishes the incentive to invest in DERs.

Improved transparency of DER installations and generation profiles would benefit RTO/ISOs and inform potential market-design reforms. Lacking such information may lead RTO/ISOs to view DERs more as a liability than asset. This is more prone to result in discriminatory practices, such as ISO-NE’s reconstitution rule. Enabling and accelerating business models that facilitate or aggregate DERs, which act as an intermediary for DERs to interface with the grid, could reduce barriers to entry and enhance transparency.

Artificial barriers to exit can result from various market-design flaws that make an administrative fix necessary to preserve reliability. When the planned retirement of a generator would result in local reliability problems (i.e., an area with transmission constraints), an RTO/ISO provides financial compensation through a reliability must-run (RMR) contract until new resources are committed to enable the unit to retire. This need reflects insufficient local-price formation and creates a barrier to exit for an incumbent. The result is a barrier to entry for competitors through use of an out-of-market process to meet reliability needs. The preferred solution is usually the most expeditious, given the undesirability of subsidies, and often results in a transmission upgrade. Certain advanced technologies, including demand response and energy storage, could otherwise serve as more cost-effective substitutes for local transmission upgrades.

Market enhancements to obfuscate RMRs include location-specific operating-reserve markets and better definition of capacity zones that reflect local transmission constraints. The ERCOT IMM has proposed the former. NYISO has made strides in defining capacity-market zones reflective of highly transmission-constrained areas (e.g., New York City). Either approach is likely to deliver a strong investment

signal, given the lack of generation and transmission investment in areas with persistent local reliability problems. Each is more efficient and transparent than RMRs and far more likely to encourage new investment.<sup>41</sup>

## INCOMPLETE MARKETS

Processes to procure transmission planning and certain ancillary services may be considered incomplete markets, in that these services aren’t procured through competition among all possible substitutes.

Certain ancillary services are not fully represented in market processes. Black-start capability, reactive power and ramp capability are distinct services that could benefit from the formation of standardized products. Ramp is valued implicitly when sudden price movements reward fast-responding resources, but this does not reflect the system value of reserving enough ramp capability in real time to mitigate price spikes. To address this, MISO has forged a path ahead and pursued a ramp capability product. Black-start and reactive-power services would be small markets, but at least competitive, market-based solicitations for reactive power appear to have merit.<sup>42</sup>

While successes in other ancillary services offer a roadmap to value the remaining services, no such example exists for transmission planning. No domestic region has developed competitive mechanisms to rely exclusively on merchant-transmission investments.<sup>43</sup> This leaves RTO/ISOs or other entities to conduct centralized transmission planning. RTO/ISOs conduct systemwide transmission-planning processes with their stakeholders. These identify transmission-system additions and improvements for reliability requirements, market benefits or public-policy accommodations (e.g., renewable portfolio standards). The RTO/ISOs use competitive bidding processes to select the provider of the transmission project.

RTO/ISOs are in different stages of implementing disparate frameworks for competitive transmission planning. PJM, ISO-NE and NYISO solicit competitive solutions to RTO/ISO-identified needs. CAISO, ERCOT, MISO and SPP go a step further and specify solutions. This limits competition to the financing, ownership and construction of predeter-

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41. David B. Patton, “Operator Actions and Price Formation,” Potomac Economics, FERC Technical Conference on RTO Price Formation, Docket No. AD14-4, Dec. 9, 2014. <http://www.ferc.gov/CalendarFiles/20141209083803-Patton,%20Potomac%20Economics.pdf>

42. Federal Energy Regulatory Commission, “Payment for Reactive Power,” Docket No. AD14-7, April 2014. <http://www.ferc.gov/legal/staff-reports/2014/04-11-14-reactive-power.pdf>

43. Special cases of merchant transmission expansion exist.

mined solutions,<sup>44</sup> and precludes competition from NTAs. These practices have not facilitated effective competition from nonincumbent transmission owners, which remains highly contentious and routinely has led to litigation.

Areas for improvement in competitive-transmission processes are highlighted by recommendations from the PJM IMM:

- Ensure that the goal of transmission planning is to incorporate transmission-investment decisions into market-driven processes.
- The creation of a mechanism to facilitate a direct comparison or competition between generation and transmission alternatives.
- Implementation of rules to permit competition to provide financing of transmission projects.
- Establishment of fair terms of access to rights of way and property, in order to remove barriers to entry and permit competition between incumbent and merchant transmission providers.
- Enhancement of the queue management process for merchant transmission investment to remove competitive barriers.<sup>45</sup>

The shortcomings in transmission-planning processes hinder effective competition from new entrants, as well as NTAs and advanced-transmission technologies. Many of these offer more economical solutions to conventional transmission expansion. Advanced technologies that allow electricity-flow control, such as phase-angle regulators and high-voltage direct current, can enhance transmission management and avoid or defer transmission infrastructure expansion. Further study and the development of trials could demonstrate the value proposition of these technologies. Competitive process integration is needed to ensure they can compete with conventional transmission-planning proposals.

FERC Order 1000 attempted to give NTAs comparable consideration in transmission-planning processes. However, it did not provide a comparable cost-recovery mechanism and ambiguity exists over what procedures constitute “comparable consideration.”<sup>46</sup> RTOs would need to convene an open

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44. Johannes Pfeifenberger, “Emerging Business Models for Non-Incumbent Transmission Projects,” The Brattle Group, March 12, 2015. [http://www.brattle.com/system/publications/pdfs/000/005/127/original/Emerging\\_Business\\_Models\\_for\\_Non-Incumbent\\_Transmission\\_Projects.pdf?1426514558](http://www.brattle.com/system/publications/pdfs/000/005/127/original/Emerging_Business_Models_for_Non-Incumbent_Transmission_Projects.pdf?1426514558)

45. Monitoring Analytics LLC, “2015 State of the Market Report for PJM: Generation and Transmission Planning,” March 10, 2016. [http://www.monitoringanalytics.com/reports/PJM\\_State\\_of\\_the\\_Market/2015/2015-som-pjm-volume2.pdf](http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2015/2015-som-pjm-volume2.pdf)

46. Order 1000 merely required transmission owners to give comparable consideration of proposed NTAs, but not if another party fails to propose an NTA. Incumbent transmission owners have no incentive to invest in NTAs, because they diminish opportunities to expand rate-based transmission assets.

competition for transmission alternatives early in their planning processes, not after a specific project has been decided. Developing a cost-recovery vehicle for NTAs is complicated by the fact that NTAs may not be FERC-jurisdictional, while the transmission projects they should be competing against are. This has led to suggestions to amend the FPA to allow NTA cost recovery at a FERC-jurisdictional rate when NTAs present a lower-cost alternative to a transmission project.<sup>47</sup>

## PERFORMANCE TAKEAWAYS

The value of organized markets is illustrated by their strong net benefits, and further refinements could yield additional benefits. Among the largest areas for improvement are remedying incomplete market design and enabling fair market access for advanced energy technologies. Many of these technologies have fundamentally disparate characteristics from conventional resources, which provided the basis for early market designs and most subsequent improvements.

The complexity of electricity services and extent of market failures both require sophisticated institutional arrangements, which has resulted in increasingly complex rules and poses substantial participatory challenges for industry stakeholders. This can constrain representation in RTO/ISO stakeholder processes and bias initiatives toward the interests of preferred or well-resourced stakeholders. At times, incumbent interests are at odds with market improvements, such as those that increase competition from unconventional resources. Several RTO/ISOs have an incentive to build or retain membership, and occasionally alter the content or prioritization of their reform agenda based on incumbent interests.

## ENHANCING THE PERFORMANCE OF ORGANIZED MARKETS

Improved market design, transmission planning, information, stakeholder-governance processes and cooperative federalism would enhance the performance of organized markets, especially with regard to their treatment of advanced technologies. FERC and RTO/ISO stakeholders are the catalysts of any market design, information requirements or transmission-planning reforms. FERC should take lead in engaging states on areas where the nexus between wholesale and retail electricity intersect.

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47. Scott Hempling, “Non-Transmission Alternatives: FERC’s ‘Comparable Consideration’ Needs Correction,” ElectricityPolicy.com, May 2013. <http://www.electricitypolicy.com/articles/5633-%E2%80%98non-transmission-alternatives%E2%80%99-ferc%E2%80%99s-%E2%80%98comparable-consideration%E2%80%99-needs-correction>

## FERC's agenda

Under Chairman Jon Wellinghoff, FERC established the Office of Energy Policy and Innovation (OEPI) to address emerging issues that affect wholesale interstate energy markets.<sup>48</sup> This institutional reform enhanced FERC's capacity to pursue proactive market design in the advanced-energy age. The office has provided reports that increase transparency of wholesale market performance and initiated inquiries and policies consistent with its mission.

Recent OEPI-led actions indicate FERC's interest in engaging in proactive market design. Most notably, FERC began holding technical conferences and releasing whitepapers on price formation in 2014.<sup>49</sup> The first regulatory outcome came in June 2016, when FERC issued Order 825, requiring better alignment of payment-settlement intervals with resource-dispatch intervals and adjusted the trigger for scarcity pricing.<sup>50</sup> In April 2016, FERC launched an inquiry into whether barriers exist to energy-storage participation in the organized markets.<sup>51</sup>

It remains unclear if FERC will seek to rectify all achievable improvements to price formation and eliminate artificial barriers to entry and exit. The most important step for organized markets is to change the priority from compensating for deficiencies in energy pricing to removing impediments to efficient prices.<sup>52</sup> Political support may augment FERC's desire to pursue contentious topics. Engagement with FERC is also warranted to ensure the policy agenda is aligned with sound principles of market design and does not stray into preferential treatment for politically preferred resources. The push for market enhancements should not only come from FERC, but also organically through the RTO/ISO stakeholder processes.

## RTO/ISO stakeholder governance processes

RTO/ISO stakeholder processes develop rules that are presented to FERC for approval. Market participants and other affected parties can provide input and vote on rule change proposals. FERC does not shy from rejecting proposals that

have cleared an RTO/ISO's stakeholder process, but the commission generally has expressed a preference for this consensus-seeking mechanism. At times, FERC defers to proposals approved in a stakeholder process.

The governance structures of stakeholder processes vary by RTO/ISO. All have legislative committee approaches to rule-change development, with representation spread unevenly, often by sector-weighted votes. The voting thresholds require super-majorities in most situations.<sup>53</sup> This can stymie market reforms that lack the support of a heavily weighted constituency. The structure results in the interests of market incumbents dominating stakeholder process outcomes. Incumbent interests often run counter to reforms that seek market enhancements, especially those calling for expanded competition from advanced technologies. This produces gridlock at the expense of proactive market design and transmission-planning protocol reforms.

Stakeholder processes have sometimes driven proactive market design, and at other times, have held it back. For example, MISO has, with the support of stakeholders, undertaken numerous refinements to its energy and ancillary service markets, such as "look-ahead" software operation features and a ramp-capability product. This has situated MISO with one of the best operating market designs in the world for integrating variable energy resources like wind. On the other hand, MISO's capacity market poorly aligns market and reliability needs. Despite the MISO IMM's repeated recommendations for market design changes, such as a sloped demand curve and defining capacity-market zones consistent with transmission constraints, decisive stakeholders have resisted such reforms.<sup>54</sup> This has had well-known adverse effects on the economic signals for resource adequacy for years.

As market-design expert Peter Cramton noted in 2003:<sup>55</sup>

Electricity designs should be largely the work of experts focused solely on the objectives of the market. The compromise inherent in the design should reflect the optimum balance among competing design objectives, rather than a distributional compromise among those with conflicting interests... The experience to date with electricity restructuring provides

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48. Federal Energy Regulatory Commission, "Office of Energy Policy and Innovation," accessed Aug. 18, 2016. <http://www.ferc.gov/about/offices/oeipi.asp>

49. Federal Energy Regulatory Commission. "Notice Inviting Post-Technical Workshop Comments," Price Formation in Energy and Ancillary Services Markets Operated by Regional Transmission Organizations and Independent System Operators, Docket No. AD14-14-000, Jan. 16, 2015. <http://www.ferc.gov/CalendarFiles/20150116172031-AD14-14-000TC.pdf>

50. Federal Energy Regulatory Commission, "Order No. 825: Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators," Docket No. RM15-24-000, June 16, 2016. <http://www.ferc.gov/whats-new/comm-meet/2016/061616/E-2.pdf>

51. Federal Energy Regulatory Commission, "Electric Storage Participation in Regions with Organized Wholesale Electric Markets," Docket No. AD16-20-000, April 11, 2016. [http://www.eenews.net/assets/2016/04/19/document\\_daily\\_07.pdf](http://www.eenews.net/assets/2016/04/19/document_daily_07.pdf)

52. Hogan, 2014.

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53. E4TheFuture and Synapse Energy Economics, "Regional Energy Markets: Do Inconsistent Governance Structures Impede U.S. Market Success?," July 2016. <http://e4thefuture.org/the-future-of-net-metering-utilities-and-solar-companies-align/>

54. David B. Patton, Pallas LeeVanSchaick and Jie Chen, "2015 State of the Market Report for the New York ISO Markets," Potomac Economics, May 2016. [http://www.nyiso.com/public/webdocs/markets\\_operations/documents/Studies\\_and\\_Reports/Reports/Market\\_Monitoring\\_Unit\\_Reports/2015/NYISO%202015%20SOM%20Report\\_5-23-2016-CORRECTED.pdf](http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2015/NYISO%202015%20SOM%20Report_5-23-2016-CORRECTED.pdf)

55. Peter Cramton, "Electricity Market Design: The Good, the Bad, and the Ugly," *Proceedings of the Hawaii International Conference on System Sciences*, January 2003. [http://www.energytoolbox.org/gcre/bibliography/154\\_cramton-electricity-market-design.pdf](http://www.energytoolbox.org/gcre/bibliography/154_cramton-electricity-market-design.pdf)

numerous examples of basic market flaws not only surviving the design process, but also enduring for an extended period after the flaws are identified. Typically, some group of market participants benefits from the flaws, and if the group is large enough, it can block moves to correct the problem.

Conditions in 2016 resemble those of the early 2000s. Market-design problems whose fixes are unpopular with key market stakeholders still go unresolved for extended periods, as seen in the priority recommendations from the RTO/ISO IMM that go unaddressed for numerous years on end.<sup>56</sup>

A reevaluation of stakeholder processes would be worthwhile. In the meantime, FERC must be cognizant of these shortcomings and proactively identify priority improvement areas. Congressional hearings that shed sunlight on issues may even provide FERC the political impetus to pursue the most serious market-design flaws that have reached an impasse in RTO/ISO stakeholder processes.

### Cooperative federalism

Better understanding and cooperation between the states and FERC could improve relations and organized market performance. Dialogue between FERC, RTO/ISO and state officials should center on the role of markets. The complexities of RTO/ISOs have contributed to poor understanding of the performance of organized markets and the implications of political interventions. This has fueled cases where state policymakers have felt a need to intervene to correct for perceived problems, including through subsidies for new power plants and natural gas pipelines and bailouts for unprofitable power plants.<sup>57</sup> In the most extreme cases, damaging proposals have been brought forth to reregulate merchant assets. Improved recognition of the role and value of markets to achieve public-policy objectives is an absolute necessity, as evidenced by recent comments of the NYISO IMM.<sup>58</sup>

RTO/ISOs increasingly recognize the need to better communicate the relationship between market performance and public policy. ISO-NE notes that some efforts to meet state policy goals may undermine market confidence and inhibit future investment in competitive resources.<sup>59</sup> PJM reached a similar conclusion in an insightful report stating that its

ability to handle a changing resource mix efficiently and reliably is threatened if policy actions materially distort price outcomes in energy and capacity markets.<sup>60</sup>

Improved dialogue could reveal further opportunities for federal-state collaboration. Better federal understanding of state policy objectives could align policy with the principles of proactive rate design. Areas with shared state-federal jurisdiction, or unclear jurisdiction, need priority attention. These have particularly important implications for DERs and NTAs, where efficient resource development is contingent upon complimentary state and federal policy. Officials should work together to determine if the jurisdictional “bright line” should be clarified in the FPA.

Cooperation between FERC and state public utility commissions in regulated states is especially important. States approve utility investments in these areas, but wholesale markets can provide information on whether these investments are prudent. In some cases, markets highlight the need for investments in advanced technologies that utilities do not have an incentive to pursue and therefore will not propose to their state regulators. Better use of market and other RTO/ISO information can help state regulators gauge whether utility investment decisions are prudent.

The RTO/ISO markets covering primarily regulated states generally do not send sufficient market signals for resource adequacy because state processes are deemed the provider of adequate resources. This deters competition, while improved scarcity pricing or capacity markets could increase merchant entry that ultimately would benefit ratepayers. States should not view proactive market design as a threat to sovereignty, but rather, as an opportunity to uphold the public interest. Ultimately, states should comprehensively revisit the value proposition of restructuring.

### CONCLUSION

A limited amount of government intervention in electricity markets is needed to foster competitive conditions and correct some persistent market failures. Historically, regulation substituted for competition entirely. Technological advances made late in the last century have rendered monopoly regulation of generation unnecessary. Some states seized the opportunity to reduce the role of government, introduce competition and drive innovation by restructuring their power industry. This helped lead to the productive development of organized wholesale electricity markets.

Organized electricity markets have demonstrated the ability to allocate resources more efficiently than bilateral-only markets. They have responded to shifts in market forces and

56. This is not to say all IMM recommendations are reasonable, but rather that remedies to some fundamental problems they identify do not gain stakeholder traction for long periods of time, if at all.

57. States also often appear impatient with the pace of advanced technological deployment and sometimes enact policies that undermine the development of advanced technology in the long run.

58. David Patton, “Comments of Potomac Economics Ltd.,” New York Public Service Commission Case 15-E-0302, 2016. <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B368952B4-595E-46F5-BCEB-06A0879268C3%7D>

59. ISO-NE, “2016 Regional Electricity Outlook,” 2016. [http://www.iso-ne.com/static-assets/documents/2016/03/2016\\_reo.pdf](http://www.iso-ne.com/static-assets/documents/2016/03/2016_reo.pdf)

60. PJM Interconnection, 2016.

technology relatively swiftly. Generally, organized markets in restructured areas facilitate competition from emerging technologies most effectively and efficiently, with organized markets in traditionally regulated areas outperforming bilateral-only markets. Organized markets have also spurred development of technological innovation and creative business models. By contrast, regulated utilities resist competitive forces and have little incentive to innovate.

Organized markets have greatly matured since the 1990s but remain a work in progress. They have considerable room to improve, especially with regard to price formation, remedying incomplete markets and removing barriers to advanced energy technologies. Improved information and analyses could help identify market-design flaws, as well as to evaluate and prioritize the remedies. The vehicles for market enhancements should improve to ensure beneficial reform concepts reach fruition. While FERC has recently embarked on some appropriate initiatives, the RTO/ISO stakeholder processes themselves should also prioritize the most productive market enhancements.

Competition is the driving force behind a more efficient, advanced electricity system. Proactive market design and competitive transmission planning reforms will efficiently accelerate the deployment of advanced technology and signal investments in innovation. Policymakers must remain disciplined and only support reforms consistent with well-functioning electricity markets.

#### **ABOUT THE AUTHOR**

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