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Get What You Need: Reclaiming Consumer-Centric Resource Adequacy

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Introduction

In December, the Federal Energy Regulatory Commission (FERC) issued an order[2] that has brought to a boil a debate that has been simmering in organized wholesale power markets for some time: In a rapidly evolving power system, what will be the best approach to support the financial viability of the resources needed to provide a reliable supply of electricity? This debate has implications for two equally pressing and intimately entwined challenges. The first is adapting markets to leverage available technology, ensuring that consumers and businesses continue to enjoy the level of reliability they want and for which they are willing to pay. The second is transitioning the electric sector's resource base at a pace reflecting growing market and regional preferences for clean energy. Put more succinctly, the challenge is to define and maintain resource adequacy cost-effectively in the future electricity market.

The FERC's Minimum Offer Price Rule (MOPR) order directs the PJM regional transmission organization to re-write its capacity market rules to blunt the effects of state-level clean energy choices. The order mandates a repricing of state-supported clean resources that undermines the competitiveness of those resources. The FERC order further requires PJM to oversize its procurement as if new resources built to meet demand from the states for clean energy, or to reduce peak demand, make no contribution to resource adequacy. Although the FERC order specifically deals with PJM's forward capacity market (the Reliability Pricing Model, or RPM), the issues it raises are also directly relevant for other markets like ISO New England and the New York ISO, which have adopted similar market interventions, and to varying degrees for all organized power markets.

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[2] Federal Energy Regulatory Commission. (2019, December 19). Order establishing just and reasonable rate. (Docket nos. EL 16-49-000; EL 18-178-000). https://www.ferc.gov/whats-new/comm-meet/2019/121919/E-1.pdf

This moment presents an opportunity to refocus resource adequacy on those for whom it is pursued: consumers, businesses and the state governments they elect.

PJM and the other regional ISO/RTO[3] energy markets have delivered enormous consumer benefits in the 20-plus years since organized wholesale markets were first introduced in the United States. That laudable energy market record of service to consumers is now at risk. A mechanism originally conceived simply to ensure an adequate supply of resources has now been given a twisted afterlife to insulate carbon-intensive resources from the commercial consequences of energy choices that consumers, businesses and the states have every right to make. When considered alongside the large surpluses of generating capacity built up in these markets over the years, it becomes clear that these capacity markets, which were once a useful adaptation in response to specific concerns, have over-stepped their mission and outlived their usefulness.

The December FERC order amplifies a recent tendency to frame discussions about resource adequacy in terms of what generation owners need or want. One hears far less about what consumers need and want. This moment presents an opportunity to refocus resource adequacy on those for whom it is pursued: consumers, businesses and the state governments they elect. In this paper we explore four key questions: What constitutes "adequate"? How is the challenge of maintaining adequate resources changing? Who is responsible for securing resource adequacy in organized markets? What would "consumer-centric" resource adequacy look like?

What Constitutes "Adequate"?

Resource adequacy is a concept that goes back to the early days of modern power system design. It was intended to be the point beyond which the incremental *cost* of additional resources would exceed their incremental reliability *value* to consumers in reducing the risk of involuntary service interruptions. The landscape of the power system has changed dramatically in important ways since the concept of resource adequacy entered the lexicon by the 1940s, but there is no reason to question the underlying principle.

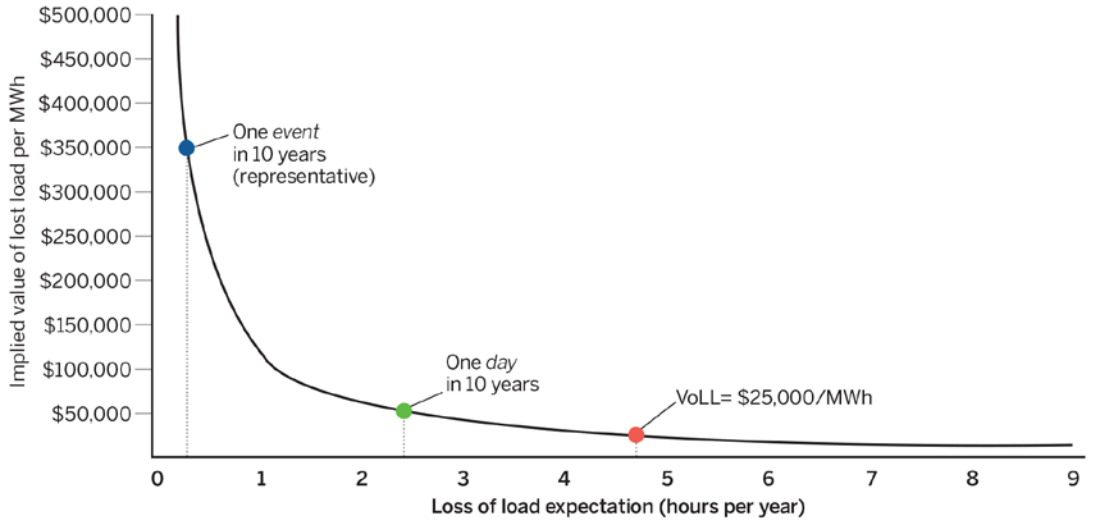
The "1-in-10" proxy rule of thumb commonly used in North America for assessing adequacy also emerged many decades ago. Its origins are obscure, and it has not changed since that time, nor has its benefit-cost validity been rigorously tested, despite massive changes in society and in technology. The rule, which varies in its application, means resources would be considered adequate if the expectation of interruptions caused by supply shortfall were no greater than once every 10 years. It is often phrased as "one day in 10 years," but in PJM's case it is interpreted as "one event;" how much load would be interrupted and for how long are not specified. It is therefore impossible to analyze definitively its costs and benefits to consumers, though reasonable estimates have been made. (See the text box on the following page for a discussion of these concepts.)

[3] An independent system operator (ISO) or regional transmission operator (RTO) is granted an exclusive right to control bulk transmission facilities and regional wholesale markets by the Federal Energy Regulatory Commission.

The Consumers' Perspective: Are More Resources Worth the Cost?

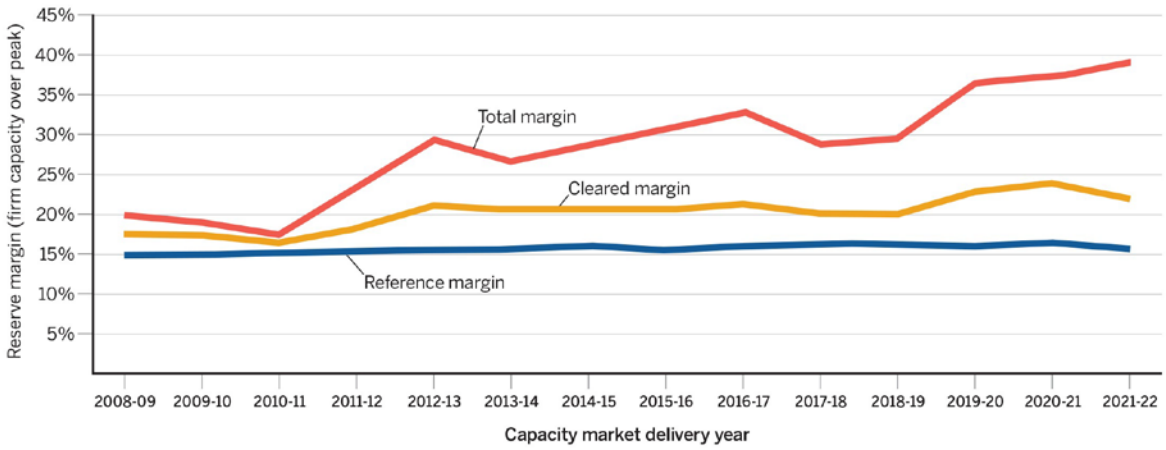
As the old saying goes, there's no free lunch. Consumers have come to expect a certain level of reliability in their electricity service, but how does the supply of generating capacity impact that reliability? One useful yardstick is cost – electricity is a service, and we should expect the benefits the service delivers to consumers to be greater than the cost of delivering them. In assessing the contribution of generation capacity to reliability, grid planners often refer to the concepts of the value of lost load (VoLL) and loss of load expectation (LoLE). VoLL is an estimate of the value consumers lose when their electricity is involuntarily interrupted, in this case due to generation falling short. Using that VoLL, together with the cost of adding new generating capacity to the system, one can calculate an expected frequency of the need to resort to such interruptions (the LoLE) beyond which more capacity is no longer delivering net value to consumers. As shown in the graph here, using PJM's estimate of the cost of adding a new gas-fired power plant, different levels of LoLE correspond to different VoLL assumptions. The popular understanding of the 1-in-10 rule of thumb (one day in 10 years, or an average of 2.4 hours per year of generation shortfall) and its corresponding VoLL of $50,000 per megawatt-hour (MWh) is shown by the middle data point; the application of the rule by PJM in practice in its capacity market (estimated here at about 0.3 hours per year) and its corresponding VoLL of $350,000 per MWh is shown on the left; and the point on the curve corresponding to a VoLL of $25,000 per megawatt-hour (about 4.7 hours per year) is shown on the right. Studies of VoLL by economists over the years have concluded that the value residential consumers place on avoiding temporary service interruptions ranges up to a *maximum* of about $25,000 per MWh.[4]

Figure 1. Comparing the cost with the value of adding resources



[4] Some industrial and critical loads may value continuity and quality of service at higher levels, but such end users will typically maintain backup arrangements to guard against the far higher likelihood of transmission- and distribution-related interruptions. For more detailed information about value of lost load, see Schröder, T. and Kuckshinrichs, W. (2015). Value of lost load: An efficient economic indicator for power supply security? A literature review. *Frontiers in Energy Research, 3*(55), doi: 10.3389/fenrg.2015.00055; and Cambridge Economic Policy Associates Ltd. (2018). *Study on the estimation of the value of lost load of electricity supply in Europe.* (ACER/OP/DIR/08/2013/Lot 2/RFS 10). Agency for the Cooperation of Energy Regulators. https://www.acer.europa.eu/en/Electricity/Infrastructure_and_network%20development/Infrastructure/Documents/CEPA%20study%20on%20the%20Value%20of%20Lost%20Load%20in%20the%20electricity%20supply.pdf

Figure 2. PJM reserve margin expansion since adoption of capacity market



Data source: PJM Interconnection. (2018, May 23). *2021/2022 RPM Base Residual Auction Results*

The rule is further simplified in practice as a target reserve margin of generating capacity over the highest expected system demand. In PJM's case, the target reserve margin (the reference margin in Figure 2, above[5]) is currently set at 15.9%. This target then becomes the baseline for what PJM mandates as "resource adequate." Even more resources clear the auction (which customers are forced to pay for), and even more resources exist (total margin) that customers pay for as well. This one-dimensional, mid-20th century approach to resource adequacy, which forces customers to pay for ridiculously high reserves, is akin to the Army maintaining excess infantry divisions to be called to the front if needed. But just as we're no longer fighting the wars of the 1940s and need an Army prepared for today's threats using today's technology, we also need a power system fit for today's challenges, at a time when consumers have choices that contribute to resource adequacy from behind the meter.

A recent analysis[6] by utility consultant The Brattle Group reverse-engineered the 1-in-10 rule as applied by PJM and others and, based on a reasonable set of assumptions, found a result that implies consumer value on the order of $325,000 per MWh, over 10 times the best estimates of the values typically employed for planning purposes. Viewed from the perspective of consumers' lived experience, the analysis found under the same set of assumptions that the rule could translate to 18 seconds per customer per year of service interruption due to shortages of available resources. This compares to a U.S. average in the range of one to three *hours* of service interruption per customer per year from all causes.[7] Figure 2 illustrates how PJM has increasingly overshot even this level of resource margin since the inception of the RPM. In the past 15 years, PJM has not once initiated supply-related service interruptions — through polar vortexes, heat waves, bomb cyclones and any number of other extreme weather events. The difference between being at or above the adequacy target and dipping below that

[5] PJM Interconnection. (n.d.) 2021/2022 RPM base residual auction results, Table 6. https://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2021-2022/2021-2022-base-residual-auction-report.ashx

[6] See Newell, S., Spees, K., Pfeifenberger, J., Mudge, R., DeLucia, M., and Carlton, R. (2012, June). *ERCOT investment incentives and resource adequacy*, p. 101. Brattle Group. PJM and ERCOT both employ the "one event" interpretation of the standard. http://www.ercot.com/content/gridinfo/resource/2015/mktanalysis/Brattle_ERCOT_Resource_Adequacy_Review_2012-06-01.pdf

[7] Historical data beginning in 2013 on involuntary service interruption. See U.S. Energy Information Administration. (2019, October 1). Annual electric power industry report, Form EIA-861 detailed data files. https://www.eia.gov/electricity/data/eia861/

target for some period of time is thus not the difference between lights on and lights off, as some would have us believe. It is, instead, an incremental change in an extremely low likelihood of limited and controlled supply-related service interruptions. In other words, the resource adequacy standards applied in practice in the PJM capacity market exceed by a wide margin what consumers would consider to be adequate value for their money, and documented distortions in the construction of the auction demand curve[8] contribute further to the underlying problem. The current "adequacy" construct is instead serving the interests of other stakeholders in the PJM market.

Beyond the simple question of the quantity of resources lies the question of the kind of resources used to meet those targets. As has always been the case, how much capacity one needs in a given power system depends on the mix of resources and their capabilities. All megawatts are not the same and do not have the same capabilities. A system with a mix of resources, operating characteristics and flexible demand that complement one another well will need less capacity than one where resources don't play well together.[9] Geography (for example, the difference between an offshore wind system and one that is predominantly installed on land), proximity to renewable resources and seasonal factors all make a difference in how well resources interact. The resource adequacy construct currently employed by PJM and others considers primarily the quantity — not the kind — of reliable capacity.[10] As a result, these RTOs/ISOs are likely inflating the quantity of resources needed, while prolonging a legacy mix of resources no longer economic or fit for a modern power grid and perhaps not attracting the resources with the most grid value.

All megawatts are not the same and do not have the same capabilities.

Cost-effective resource adequacy requires that all resources, both supply-side and demand-side, capable of satisfying consumers' needs be counted, valued and able to participate. The requirements for participation in the revenue streams available from forward capacity markets can be quite arbitrary and rigid. Not all of the options for reliably serving demand lend themselves to the sorts of commitments years in advance on which forward capacity markets are premised. Specific provision should be made for alternatives – including familiar options like seasonal peak-shaving and emerging options like smart flexible loads – that can contribute cost-effectively to adequacy but that may not qualify for the forward capacity market[11]. If this is not done, the need for resources will be greatly overstated *by design*. The FERC order's directives only exacerbate this problem, both by ignoring the contribution of state-driven resources and by raising new barriers to what limited provisions were being made for alternative resources.

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[8] Newell, S.A., Oates, D.L., Pfeifenberger, J.P., Spees, K., Hagerty, J.M., Pedtke, J.I., Witkin, M., & Shorin, E. (2018, April 19). *Fourth Review of PJM's Variable Resource Requirement Curve*. Boston: The Brattle Group. Retrieved from https://www.pjm.com/-/media/library/reports-notices/special-reports/2018/20180420-pjm-2018-variable-resource-requirement-curve-study.ashx

[9] International Energy Agency. (2014). *The power of transformation.* https://www.iea.org/reports/the-power-of-transformation

[10] Nominal capacities of all resources are adjusted when considering their contribution to resource adequacy to reflect the historical risk they won't be available when needed.

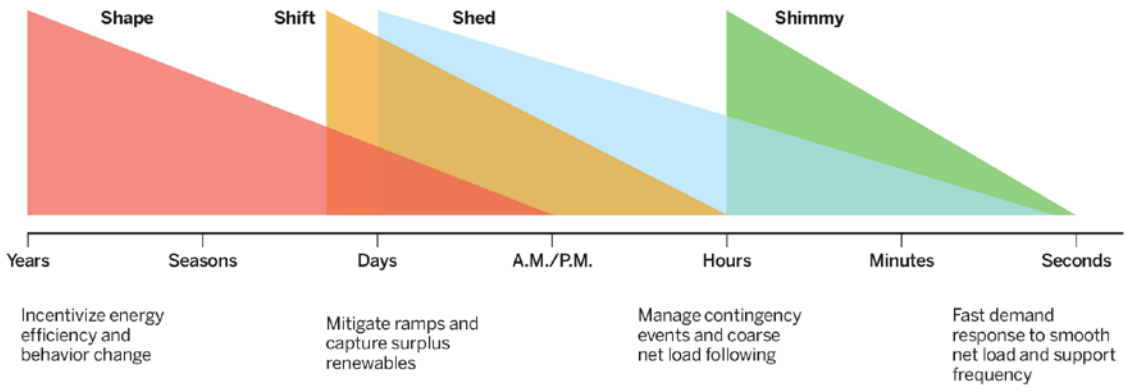
[11] PJM has made such provisions in the past for demand response providers to compete in the RPM, but the FERC's December order effectively closes that option down.

A consumer-centric resource adequacy construct would be designed in a manner that leads to outcomes that much more closely reflect the value to consumers of investments in supply-side and demand-side resources. System operators like PJM (and their regulators) often object that they are put in a difficult position if and when they must explain the rare, controlled service interruptions that would entail, but that comes with the job. As even the decades-old rule of thumb implies, rare instances of controlled, involuntary, supply-related load shedding are a feature of prudently designed and operated power systems, not a bug. Pretending otherwise is a disservice to consumers. Maintaining so much excess generation is a net direct cost to consumers, not a net benefit. The indirect cost may be much greater, as subsidizing a persistent surplus of generation outside the energy market blocks entry of new zero-carbon resources and crowds out more cost-effective demand-side measures. Such measures will be increasingly valuable to consumers for resilience, empowerment and cost in the transition to a modern power system.

How Is the Challenge of Maintaining "Adequate" Resources Changing?

As solar and wind generation underbids coal, oil, nuclear and even gas generators, the grid will see a smaller share of generation that is fully controllable. The old paradigm of dispatching supply to follow inelastic demand will become unsustainable. At the same time, demand-side technologies such as smart meters, flexible end uses, cheaper batteries and real-time load controls can quickly adjust demand to make the most economic use of varying supply. Where we once forecasted load and scheduled generation, increasingly we will forecast generation and schedule load. Fortunately, wind and solar forecasting is becoming much more accurate, giving system operators a better opportunity to anticipate and plan for shifts in variable production. The contribution of variable resources to resource adequacy can be increased significantly by leveraging both sides of the supply-demand interface. Unfortunately, traditional approaches to resource adequacy fail to capture the vast majority of these valuable options.

Figure 3. Flexibility strategies for the demand side

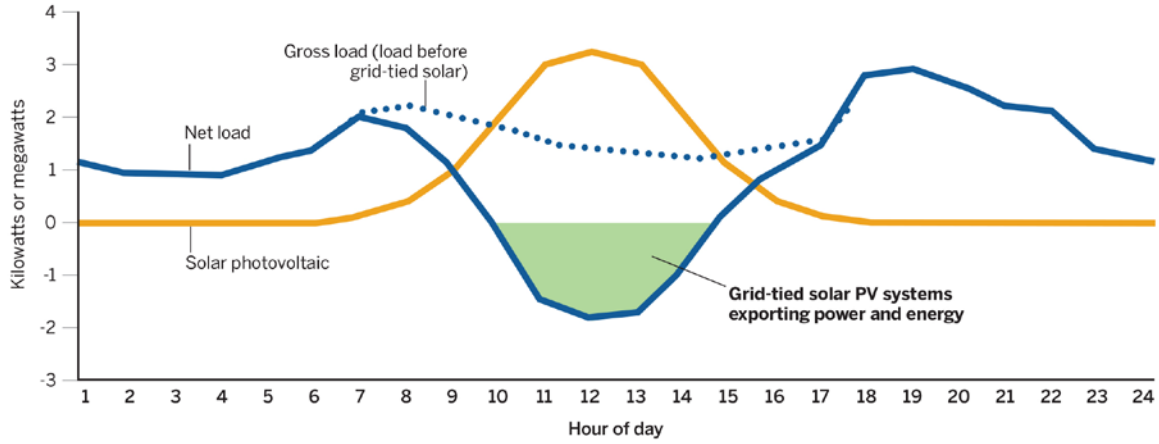


Source: Alstone, P., et al. (2017). *2025 California Demand Response Potential Study — Charting California's Demand Response Future: Final Report on Phase 2 Results*

Capacity markets have had some success in attracting seasonal peak-shaving demand response (though recent reforms have made that more difficult), but as shown in Figure 3 on the previous page,[12] that narrow, limited form of demand flexibility (represented by the "Shed" or "Manage Contingency Events" wedge) represents only one slice, and arguably the least valuable slice, of the rich palette of demand flexibility options, the remainder of which are disadvantaged by a focus on capacity attributes. New opportunities for efficiency, demand response, various storage options and other distributed resources are making the old resource adequacy paradigm obsolete.

While load is becoming more flexible, in most regions it is also growing much more slowly. That will change in the near future with a rise in demand due to the electrification of transportation and space heating, which will change the shape of load. Load shapes are also changing as a result of the rapid rise of behind-the-meter resources such as rooftop solar (see Figure 4[13] below). Batteries are already providing cost-effective frequency regulation in the PJM area under market rules that allow batteries to compete on equal footing with traditional generators. These shifting and less predictable net load characteristics are giving rise to a need for an expanding suite of flexibility services that will continue to evolve as the transition progresses. The current approach to resource adequacy, which leans heavily on large, central station generating capacity, should give way to a focus on resource capabilities available from many different sources. Non-traditional resources can often be more valuable than traditional generation by being faster, more accurate and more resilient. The resource adequacy process should afford them fair market access and fair compensation, reflecting the value they provide to all grid customers.

Figure 4. How variable resources are changing the job of the bulk power grid



Source: Coddington, M., O'Neil, R., and Stewart, E. (2018, January 16-17). *Distributed Energy Resources (DER)*

[12] Alstone, P., Potter, J., Piette, M. A., Schwartz, P., Berger, M. A., Dunn, L. N., Smith, S. J., Sohn, M. D., Aghajanzadeh, A., Stensson, S., Szinai, J., Walter, T., McKenzie, L., Lavin, L., Schneiderman, B., Mileva, A., Cutter, E., Olson, A., Bode, J., … Jain, A. (2017, March). 2025 California demand response potential study — charting California's demand response future: Final report on Phase 2 results. Lawrence Berkeley National Laboratory. https://eta.lbl.gov/publications/2025-california-demand-response

13 Coddington, M., O'Neil, R., & Stewart, E. (2018, January 16-17). Distributed energy resources (DER) [Presentation]. Distribution Systems and Planning Training for Midwest Public Utility Commissions, St. Paul, MN. https://eta-publications.lbl.gov/sites/default/files/4._coddington_stewart_oneil_ders_updated.pdf

Another shift that has taken place — the shift to greater reliance on natural gas-fired generation — represents a different sort of change. In the near term, this has been driven by price competition between natural gas and the ready alternatives, principally coal and nuclear, while in the medium term the ability of gas turbines and gas diesel engines to ramp up and down more quickly affords them advantages as the share of variable renewables grows. This presents several challenges for maintaining resource adequacy. In the near to medium term, increased exposure to the particular characteristics of gas production, transportation and storage infrastructure could reduce the reliability and flexibility of the resource mix if these factors are not adequately accounted for in resource procurement.

PJM and ISO New England several years ago adapted their forward capacity markets with "pay-for-performance" reforms meant to provide stronger incentives for generators to ensure availability during system stress events. More recent proposals (such as ISO New England's Energy Security Improvements, or ESI) seek to reflect the value of critical risk factors such as fuel availability in energy market prices. Although directionally correct, on top of the current forward-capacity market these constitute double payment to generators to deliver what the previous changes to the capacity markets were meant to deliver: energy when it's needed. This cost-on-top-of-cost approach to reform, meant to address the shortcomings of the current resource adequacy mechanisms in the face of changing circumstances, serves to highlight the need to consider a new paradigm for resource adequacy. A consumer-friendly direction looks a lot more like the energy security pricing initiative, but the potential benefits of such reforms are undermined by doubling down on the billions of consumer dollars already being spent on unneeded capacity.

This cost-on-top-of-cost approach to reform, meant to address the shortcomings of the current mechanisms in the face of changing circumstances, serves to highlight the need to consider a new paradigm for resource adequacy.

Variable renewable sources such as wind and solar have very low variable costs of production, allowing them to underbid nearly all other resources when they are able to produce. This is the basis for claims of a "merit order effect" by which renewables drive down wholesale power prices. Renewables are thus said to exacerbate the "missing money" problem, undermining the market revenues upon which investment in needed resources must rely. This critique does not stand up to careful scrutiny. Numerous studies have demonstrated that recent declines in wholesale prices are due in large part to lower natural gas prices and significant over-capacity in the market. Oversupply distorts markets. In the longer term, measures to correct problems with the formation of energy market prices (discussed below) can lead to pricing that reflects the true marginal cost of energy, not simply short-run production costs. Power system resources have always been capital-intensive. The true marginal cost of energy has always been driven by more than just short-run production costs, and the failure to properly price energy has for a long time led to a "missing money" problem. None of these things are new: they simply become more apparent in a market with a high share of renewables, making accurate formation of energy prices all the more important. In short, the low production cost of renewables doesn't threaten resource adequacy; flawed energy price formation does and has always done so.

In Organized Markets, Who Is Responsible for Securing Adequate Resources?

The genius of PJM and other regional ISO/RTOs is that they extract maximum efficiency from the wholesale power system by operating it with regard only to physical constraints, rather than to artificial boundaries drawn around local utility fiefdoms. The value of this model for organizing wholesale energy markets, especially as wind and solar generation become mainstream resources, is once again being validated by the emergence of some features of a regional wholesale market in the Western Interconnection.

But ISO/RTOs are not larger versions of the vertically integrated utilities whose operational responsibilities they supplanted. PJM has no customers or balance sheet on which to support investment in the supply or demand resources needed to serve load reliably. As originally chartered,[14] ISO/RTOs were responsible only for short-term (that is, operational) reliability. Responsibility for identifying and securing adequate long-term supply commitments remained with those with a need to manage the risks inherent in serving retail consumers, and who could, and under any model would, provide the business case for the necessary investments. As provided in the Federal Power Act, it was up to load-serving entities, licensed and regulated by the states, to assess their needs, evaluate the market risks inherent in meeting those needs, and ensure they had access — via self-supply or bilateral contracting — to resources adequate to manage those risks cost-effectively. The entities' ability to recover the associated costs was to be subject either to prudency regulation or, alternatively, to the demands of active retail competition.

When the RPM was introduced in 2006, followed by similar mechanisms adopted in ISO New England, the institutional framework established when these markets were first set up effectively ceased to exist. ISO/RTO-administered mandatory capacity markets were a response to market distortions and flawed market rules that incentivized free-riding by load-serving entities, reducing the bilateral contracting activity needed to maintain adequacy. The market distortions themselves either encouraged market power (for instance, the effective absence of an active demand side) or were crude responses to the challenge of mitigating market power (for instance, low price caps).

Initially proposed as a public interest backstop for self-provision and bilateral contracting, centralized capacity markets like the RPM quickly supplanted the load-serving actors as the front line in securing resource adequacy. Any potential for greater administrative efficiency was offset by the fact that the ISOs/RTOs have all the same incentives to over-insure with the most familiar resources, but they face none of the regulatory or market restraints on over-procurement inherently confronting retail suppliers. Additionally, while a capacity market's competitive auctions seek to replicate the cost discipline that retail providers would face from regulators or from competition, the regional, multi-jurisdictional reach of the ISO/RTO prevents it from replicating the exercise of local preferences for different energy mixes. Without an appropriate, region-wide price on carbon, the result is a race to the bottom. At best, capacity markets provide just enough revenues to support resources with the lowest fixed-cost structure —

[14] See FERC Order No. 2000, Docket No. RM99-2-000 (20 Dec 1999) at https://www.ferc.gov/legal/maj-ord-reg/land-docs/RM99-2A.pdf

Table 1. Capacity markets enable financing of gas plants, but not clean energy

Type of generation	ISO-NE Forward Capacity Auction 12, offer review trigger prices (ORTP) ($/kW-mo)	Share of overnight capital costs locked in at ORTP
Combined cycle	$7.86	63%
Simple cycle	$6.50	65%
Wind	$11.03	10%
Solar PV	$26.32	16%

existing, largely depreciated fossil generators — but do not support the high-fixed-cost/low-variable-cost/zero emission resources that many retail jurisdictions seek and must then procure through other means.[15] (See an example of this problem reflected in auction results in Table 1 above.[16])

Now, following FERC's MOPR order, PJM is compelled to adopt a more actively antagonistic posture toward the state climate and energy policies under which many local retailers operate. (ISO New England had already implemented similar measures through its Competitive Auctions with Sponsored Resources, or CASPR, mechanism.) As a result, the persistent oversupply in these markets will only grow as consumers, businesses, and states on the one side, and the ISO/RTOs on the other, pursue duplicative and potentially conflicting resource objectives. These measures raise the cost of meeting consumer needs, and they delay the transition to the low-carbon resource mix mandated by many states.

Capacity markets, never intended to be permanent, have outgrown their mission and outlived their usefulness. They provide a costly entitlement for existing generation, much of it unneeded, while falling short in providing efficient incentives for new resource investment.

A reformed resource adequacy construct should seek to restore the delineation of authority that framed the original introduction of ISO/RTOs. The Federal Power Act reserves to the states the authority over decisions on long-term resource mix, constrained as applicable by federal jurisdiction over interstate commerce and wholesale transactions. The regional capacity markets were temporary departures from this framework adopted in response to

[15] Competitive state-run procurements are producing 20-year contracts for these high-fixed-cost/low-variable-cost/zero emission resources (solar, onshore wind, offshore wind and combinations with storage), with lower 20-year levelized costs than projected for energy, capacity markets and REC markets. The Federal Power Act leaves these resource mix decisions to the states, and the states are making energy resource choices consistent with their policies that are both efficient and, in many cases, least-cost for their consumers, which is precisely the role that the FPA reserves for the states.

[16] Krich, A. (2019, February 11). ISO-NE markets not structured to consistently procure least cost resources [PowerPoint slides]. Boreas Renewables LLC. https://www.mass.gov/files/documents/2019/10/16/Krich%20presentation.pdf. As cited in Littell, D. (2019, June 20). Value on the table [Keynote presentation]. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/value-table/

exigent circumstances. Capacity markets, never intended to be permanent, have outgrown their mission and outlived their usefulness. They provide a costly entitlement for existing generation, much of it unneeded, while falling short in providing efficient incentives for new resource investment.

We can take advantage of what has been learned in the past 15 years about how to mitigate market distortions to address reliability that customers value in a 21st century market. We can take advantage of the technological advances that make it practical, convenient and cheap for consumers to have their rightful say. Consumers, their retailers and their elected state governments have always borne the ultimate responsibility for the *cost* of maintaining resource adequacy. Knowing what we know today, the time is ripe for them to take back the proper scope of authority over *how* it is maintained.

What Would "Consumer-Centric Resource Adequacy" Look Like?

Given these challenges and opportunities, what are the options to move beyond this contentious moment to a sustainable, consumer-focused resource adequacy framework? PJM's market rules provide an option for individual utilities to assume responsibility for maintaining resource adequacy, called the Fixed Resource Requirement (FRR), but FRR is not an easy path. PJM remains the final arbiter of what constitutes adequate resources, and the rules governing the FRR make it a complex alternative for states wishing to remain in PJM's energy market. The FRR leaves state-regulated retailers in the unenviable position of competing with the larger, more liquid PJM capacity market for needed resources, with states facing a more daunting task in mitigating market power. That said, simply returning to the world prior to the introduction of the current capacity market is not a practical option either. One option, which we will explore here, is establishing conditions under which retail sellers, who are in direct contact with consumers, can again be principally responsible for driving investment in the resources needed to maintain an economic standard of resource adequacy. State commissions with direct jurisdiction over retailers are more responsive to local circumstances and customers, and they can integrate state policy with resource adequacy more effectively than can an RTO/ISO with region-wide obligations and virtually no direct customer contact.

Adequate resource investment, at an efficient cost, relies on access to a range of opportunities to hedge future market risks, including long-term contracts[17]. State-regulated retail providers (both regulated monopoly and competitive) can take back responsibility for resource adequacy if they can foster a level of bilateral contracting (or self-supply) sufficient for them to meet their obligation to their customers. Those conditions will be based on three pillars:[18]

1) Price energy correctly to ensure retailers/aggregators, large wholesale buyers, and wholesale producers have the incentives to enter into long-term contracts when and where needed to manage their business risks, comply with state laws and deliver reliable customer value.

[17] Contracts can reduce the cost of capital for individual investments, but this lower cost is the result of a transfer of long-term risk from investors to, ultimately, consumers. Not all such reductions are a good deal for consumers.

[18] In markets with locational marginal pricing, a fourth pillar is to establish trading in financial transmission rights.

2) Enforce appropriately demanding standards for the financial capacity of licensed retail providers (in both retail competition and monopoly franchise areas) to ensure they have the ability to enter into contracts to manage the risks involved in serving their customers and (in competitive retail areas) to mitigate the risk of default.

3) In competitive retail areas, ensure that the default provider option enjoys no special advantages or attractions relative to competitive providers, to in turn ensure that all retailers have sufficient commercial confidence to enter into such contracts.

Good energy price formation

Good energy market price formation is the foundation for well-functioning markets, including markets that have adopted forward capacity markets, but it is especially important here. Good energy market price formation relies on four critical measures:[19]

1) Raise market price caps to a level as close as practicable to the system-wide value of lost load and allow prices to drop as low as necessary to clear the market.

2) Ensure the marginal cost curve extends to all actions required to balance the system, including actions taken by the system operator outside of economic dispatch.

3) Ensure the demand curve includes all demand on system resources, including demand for ancillary services that compete directly with demand to produce more energy.

4) Ensure that prices reflect not only marginal production costs such as fuel but also, when applicable, non-production costs including the opportunity cost of reserve shortfalls.

The first of these measures — raising price caps — clearly carries risks of market power abuse and must be accompanied by effective market power mitigation. A number of organized markets, with and without forward capacity mechanisms, have developed *ex ante* and *ex post* tools that have proven increasingly effective in practice. The last measure listed — ensuring true marginal cost prices — may rely on administrative scarcity pricing mechanisms that have been developed in a number of markets and that also provide additional market power mitigation. To be effective, they should be implemented alongside the other three measures listed, which is not always the case.

A case in point is the ISO-NE's ESI day-ahead pricing proposal, as modified by the New England Power Pool (NEPOOL).[20] The NEPOOL-adapted ESI incorporates a balancing reserve, a reserve replacement, and a generation availability component into energy pricing.[21] These components price call-options into

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[19] Good best-practice examples and resources on this topic include Pope, S. L. (2014, October). Price formation in ISOs and RTOs: Principles and improvements. FTI Consulting. Retrieved from http://lmpmarketdesign.com/papers/Pope.EPSA_Price_Formation_Oct_29_2014_FINAL.pdf

[20] The ESI resolutions and amendments are posted at the NEPOOL Participants Committee Meeting for April 2, 2020, Agenda Items 6A and 6B, and Attachments F, G & H, which passed the Participants Committee. See Doot, D. T. (2020, March 26). Supplemental Notice of April 2, 2020 NEPOOL Participant Committee teleconference meeting. https://www.iso-ne.com/static-assets/documents/2020/03/npc-20200402-supp.pdf

[21] For a description of the versions of the ESI to be filed with FERC, see Kuser, M. (2020, April 5). ISO-NE sending 2 energy security plans to

the electricity market to ensure resources capable of balancing and providing reserves are available if needed. They are bid day-ahead and settle against real-time energy. As modified by NEPOOL to limit the pricing impact to times when energy is indeed scarce (as in the winter months), this is an example of a reform designed to get energy pricing right. Nonetheless, ESI without broader reform cannot fix the system: While ESI adds appropriate refinements to price formation, it does not address energy price controls and it is additive to the billions charged to ratepayers to maintain underlying over-capacity. Better price formation needs to supplant rather than superimpose one expensive program on top of another, particularly when the existing "pay for performance" reform of the capacity market has been designed to ensure that true marginal costs are not visible in energy price formation.

Financial standards for retailers

While every region will have its own approach to this issue, it is essential that any entity granted a license to serve retail consumers be charged with the responsibility of maintaining sufficient financial capacity to manage the associated risks prudently. This is one aspect of traditional utility regulation that remains crucially important to well-functioning competitive retail markets. While this is in the public interest on its own merits – ensuring retailers can carry on serving consumers in the event of volatile market conditions – it is also essential for maintaining a population of financially sound counterparties for long-term contracts with load-serving entities (LSEs). Retail financial security mitigates risk both for LSEs and for retail customers. The specific standards adopted will need to strike a reasonable balance between sufficiently robust financial capacity and the need to facilitate market entry and workable competition. To ensure there is no hidden subsidy for utility-provided standard offers, the same financial standards should be applied to both.

A fair chance to compete for and retain customers

A consumer-centric solution does not presume either competitive retail markets or regulated monopoly retail franchises. However, where competitive retail markets are in place, wholesale buyers will weigh the market risks of not contracting forward to meet their obligations, against the risks of contracting for customers who then defect to the competition. The scale can tip strongly against contracting forward when a state establishes a default retail service provider that charges a non-commercial rate, particularly when the default retailer also is the "provider of last resort" (POLR). While the role of a default provider is critical in giving confidence to allow retail competition, there is no good reason why the default provider should be enabled to charge less than what it would charge any traditional consumer. Unfortunately, this has been the practice in many states, including in many PJM states. Default providers have offered rates that recover only their direct costs, while the rest of the costs that would normally be included in full retail rates are socialized across their distribution customers. In most cases competitive retailers also do not bill customers. This creates an unstable business model for competitive retailers that, in combination with price caps and loose financial requirements, means no one, not even

FERC. RTO Insider. https://rtoinsider.com/iso-ne-sending-energy-security-plans-ferc-159618/. PJM has proposed reforms similarly designed to improve price formation in their energy market, using a different strategy resembling the approach to administrative scarcity pricing in the ERCOT market, but as with ISO New England's ESI it does not go far enough for these purposes.

the default provider, has any incentive to enter into long-term obligations with wholesale suppliers. The alternative is to establish default service options at rates that reflect the fully loaded rate a utility would normally charge for a traditional flat-rate, all-you-can-eat customer. Default standard offer providers and competitive retailers would thereby have the confidence necessary to undertake forward obligations to manage the risks they assume on behalf of their customers.

Modernize tools to improve transparency and accountability

A resource adequacy framework cannot be consumer-centric if it consistently procures more generation than is needed to deliver a cost-effective level of supply reliability. A better balance is needed between cost and value. Like price formation, the question of what metrics and benchmarks to use to assess resource adequacy is a large and complex one. Metrics like "hours per year" LOLE, or benchmarks like planning reserve margins or "one-in-10" rules of thumb, have come under growing criticism in recent years as more attention has been focused on over-supply in regions with capacity markets. Benchmarks used to force customers to pay for predetermined quantities of large, grid-connected generating capacity years in advance will be increasingly problematic. Customers increasingly have realistic options to reshape their demand or even exit the grid altogether.

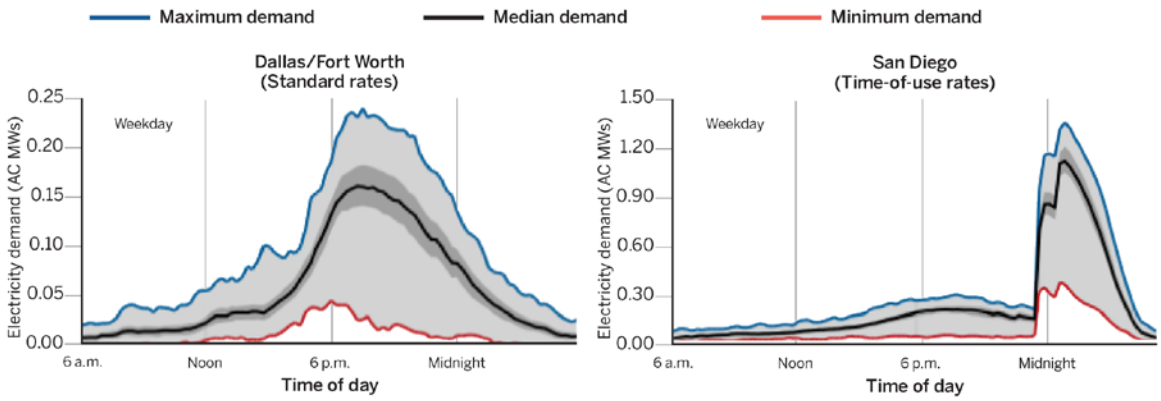
It is long past time to take a critical look at these mid-20th century tools and, where appropriate, to retire them or replace them with tools more suited to the challenges of tomorrow's power grid. In doing so, the following would be appropriate design objectives:

1) That they set risk-adjusted guidelines that rigorously reflect consumers' VoLL for incremental generation investment;
2) That they internalize the contribution that can be made by non-traditional and non-supply-side options, such as seasonal peak shaving, flexible loads or distributed storage;
3) That they take account of changing and potentially price-responsive load curves; and
4) That they serve the interests of consumers first and foremost.

Empower consumers through a role for the demand side in price formation

In a truly consumer-centric resource adequacy framework, consumers will play a central role in determining what resource investments provide the most value for their money. Retail product and service offerings are beyond the scope of this paper, but translating wholesale market information to end-use consumers, and enabling and incentivizing them to act on that information, will offer increasing benefits to all consumers, not just those who choose to get involved. Not only can all consumers benefit when some consumers reduce demand during periods of tight supply (a traditional if historically limited role), but they can create even greater value for all stakeholders as the share of intermittent resources

Figure 5. Accurate pricing can change behavior: Electric vehicle charging rates and usage



Source: Jones, B., Vermeer, G., Voellmann, K., and Allen, P. (2017). *Accelerating the Electric Vehicle Market*

grows. By shifting loads from tight periods to periods when intermittent resources might otherwise be curtailed, as seen in Figure 5,[22] they can dramatically reduce the amount of investment needed to achieve a given level of reliability. While once considered impractical, technology advances in recent years have made this load shifting easy, convenient and cheap. This will be especially true for new, large, flexible loads like electric vehicles and thermal storage. Price formation (together with network tariff design) can enable low-cost and advanced demand-side flexibilities like these to be accurately priced so customers have the option of being compensated for the value of changing when and how they consume electricity.

Ongoing roles for ISO/RTOs in resource adequacy

ISO/RTOs should continue to play an important role in oversight and monitoring of the resource adequacy process to ensure that consistent, transparent and auditable information is available on the state of system resources relative to expected needs. The ISO/RTOs are uniquely positioned to play this role. Otherwise, ISO/RTOs can and should revert to the role for which they are ideally suited: planning and operating the wholesale power grid to deliver an economic, reliable supply of electricity from the available resources, and working with local distribution utilities to optimize the use of demand-side resources and flexibility. This should include a more dynamic process of examining and, when appropriate, expanding or re-defining the slate of ancillary services provided in ISO/RTO markets. The demand for flexibility across the system is going to grow and evolve, with more and different kinds of services (for instance, inertia replacement service) being required to meet consumers' demand for reliable service. ISO/RTOs should also be encouraged to reach beyond their boundaries to improve the effectiveness and efficiency of inter-regional planning and transfers, which could significantly increase the reliability and lower the cost of wholesale power.[23]

[22] Jones, B., Vermeer, G., Voellmann, K., & Allen, P. (2017). Accelerating the electric vehicle market, p. 16. M.J. Bradley & Associates. https://www.mjbradley.com/sites/default/files/MJBA_Accelerating_the_Electric_Vehicle_Market_FINAL.pdf

[23] Should there be a desire to provide for a somewhat more proactive ISO/RTO role in addressing emerging concerns that nonetheless preserves the primary authority of states and LSEs, a good example is the Retailer Reliability Obligation mechanism adopted by the Australian Energy Market Operator, a description of which can be found at https://www.aer.gov.au/retail-markets/retailer-reliability-obligation.

Conclusion

The controversy currently raging over FERC's December MOPR order suggests that the internal contradictions and unrestrained excesses in the current resource adequacy framework in PJM (and in other regions with similar constructs) have reached a critical turning point. Mounting inventories of uneconomic generating capacity are now joined by the requirement that system operators override and ignore states' rights under the Federal Power Act. As FERC's directives begin to bite in coming years, consumers would be forced to pay twice: first for the resources they want with the second payments going to older, uneconomic fossil-fuel generation that would otherwise retire. Capacity markets like PJM's RPM, which at one time addressed specific concerns, are no longer fit for purpose. A new approach to resource adequacy can be centered on the needs and desires of consumers and restore state prerogatives. This "new" approach echoes the original allocation of responsibility and authority in ISO/RTO markets, while acknowledging and addressing the shortcomings that led us to where we are.

Load-serving entities — whether they be competitive retailers or traditional monopoly franchise providers — can take responsibility for managing the long-term risks incumbent in meeting their obligations to their customers for economic and reliable electricity supply.

Load-serving entities — whether they be competitive retailers or traditional monopoly franchise providers — can take responsibility for managing the long-term risks incumbent in meeting their obligations to their customers for economic and reliable electricity supply. LSEs in other regions provide resource adequacy through bi-lateral contracts at the wholesale level making capacity markets unnecessary. At the retail level, competition, or where relevant regulation, will govern the prudence and efficiency with which they carry out that responsibility. The states that license and regulate retail service providers can establish requirements for the mix of resources upon which they rely, within the outer limits set by federal jurisdiction over matters such as interstate commerce, and can do so in furtherance of state-level priorities, such as encouraging zero emission power.

Conditions will have to be established under which this realignment of responsibility and authority can reliably be accomplished. States are well advised to support remediation by the ISO/RTO of wholesale market price distortions that have persisted in the shadow of centralized capacity markets. This remediation will include raising or removing wholesale price controls and implementing or strengthening scarcity pricing. Such measures can be accompanied by advanced market power mitigation tools that have proved effective in other markets.

Where there remains a commitment to consumer choice, the retail competition landscape can be made more robust by removing the explicit and implicit subsidies that favor a default service option and by setting and enforcing adequate standards for the financial strength of retail providers. Where retail service is provided under monopoly franchises, buyer-side market power will have to be mitigated

effectively. In both cases, through retail pricing and the deployment of technology, consumers must be afforded the opportunity to participate in the balancing of supply and demand, and to be compensated for the true value of doing so.

The states and the ISO/RTOs should cooperate on a re-examination of the tools, benchmarks and expectations for assessing resource adequacy. The ISO/RTOs will continue to be responsible for efficiently delivering operational reliability. This will include identifying and maintaining access to the suite of system services needed to optimize the value of the available resources, as well as monitoring and reporting on the state of system readiness.

The ISO/RTO model has been remarkably successful in lowering costs to consumers and facilitating market access for a wide range of innovative new resources. It is possible to strengthen the ISO/RTO market model going forward, enhance customer choice and reduce customer costs, by apportioning authority and responsibility for reliability, and in particular for resource adequacy, so as to respect the diversity of local energy preferences and strengthen consumer focus in organized markets.

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