Put the Money Where the MWhs Are: Why Path C and an Energy-centric Market Will Work for PJM

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Introduction

PJM is facing incredible stresses on its system today, which justify the holistic re-examination of its capacity market design and investment incentives beginning with the recent Powering Reliability Through Market Design (PRTMD) white paper. PJM's paper does an excellent job of articulating the current predicament and how the region arrived here. It then raises the question of what path forward the RTO should take.

In our view, technology advances, constrained transmission, and rapid load growth make PJM's Reliability Pricing Model (RPM) a poor fit for the 21st century. A 3-year forward capacity market mechanism simply cannot add ~30 GW of projected new data center demand by 2030 when it takes five-plus-years for new supply to interconnect. Today, the RPM is delivering neither reliability, nor accurate pricing. Thus, to ensure long-term market stability, **we believe PJM should shift revenues to the energy market and take "Path C."**

We argue that PJM should commit to the development of an energy-centric market, grounded in the tradeable commodity of MWhs of energy rather than administratively defined capacity. An energy-centric design will free PJM, states, and stakeholders from never-ending arguments over capacity market minutiae and free market participants to more quickly leverage new tools at their disposal. In Section 1, we detail why today's capacity market problems are unresolvable and describe the promise of an energy-centric market.

To shift revenues into the energy market and away from the capacity market, PJM will need to reform its markets and interconnection process in parallel. Additionally, states and PJM members will need to adapt to an energy-centric market. In Section 2, we recommend specific "Path C" reforms to take place over several years, including raising scarcity prices, deeper interconnection reform, and changes to long-term energy contracting.

The transition to Path C would be a significant one for the region, which has relied on the RPM for the past two decades. PJM and its stakeholders should be confident that this new market design would be reliable and politically durable – and thus worth the effort. In Section 3, we make the case for why an energy-centric market passes both tests.

1. An Energy-Centric Market is the Best Bet for PJM's Current Challenges and Opportunities

1a. The RPM is No Longer Delivering on its Purpose

PJM's RPM was designed for an electricity system much simpler than the one we now have. Today, new generation and demand-side technologies, constrained transmission, the linkage between capacity accreditation and interconnection, and rapid load growth have rendered the current capacity market unworkable: the two most recent auctions have cleared short of the reliability requirement, and PJM is implementing a Reliability Backstop Procurement (RBP) to compensate for these failures.

At its core, the failure of the capacity market is due to the construct's inability to keep up with, and accommodate, the changing energy landscape. Capacity accreditation has become defined by the "Unforced Capacity" (UCAP) product, a derivative instrument intended to serve as a proxy measure of a resource's reliability contribution. While this may prove useful in resource adequacy assessments, its use in the procurement of capacity has become a stumbling block. **In light of the diversifying resource mix, PJM has worked to adapt the UCAP product, and the Effective Load Carrying Capability (ELCC) calculations that underpin it, but this has only served to disrupt the market's stability:** the uncertain, fluctuating capacity accreditation process has undermined the long-term revenue certainty needed for developers to finance projects. The frequent rule changes and reform processes to which the RPM has been subject over the past few years have only added to the erosion of stability and trust in the market. The capacity market faces a complexity dilemma, where fundamental tradeoffs exist between simplifying the market (to ease regulatory burden and minimize costs) and accurately reflecting reality (to account for the specific contributions of an increasingly diverse resource fleet).

The RPM has also imposed significant constraints on generator interconnection. To bid UCAP into the capacity market, a generator needs to prove that it has "Generator Deliverability," or the ability to export its power to the greater PJM market under stressed grid conditions. Generator deliverability is not an engineering term, it is an *estimate of a generator's expected access* to the transmission system under specific conditions, based on assumptions about load growth and generator dispatch that are far from certain. In PJM, the concept of deliverability is used exclusively to support the functioning of the capacity market, which is itself a derivative of the energy market. Said differently: generator deliverability is two levels of abstraction away from the real product that drives reliability, energy. This nebulous concept has become formalized in the PJM interconnection process, where deliverability studies are now a core source of the complexity, delays, and costs that generators face in navigating the queue. **Paradoxically, the requirement for deliverability, which is aimed at ensuring that suppliers connected to the grid can *deliver*, is the same requirement that is now making it so that suppliers cannot *connect*.**

Finally, the challenge of integrating rapid, large-scale load additions has proven to be too much for the capacity market and the current interconnection construct to bear. As load forecasts ballooned, PJM implemented an emergency interconnection fast-track Reliability Resource Initiative (RRI), then a state-requested price collar on the capacity market, then the Expedited Interconnection Track (EIT) and Bring Your Own New Capacity (BYONC) concepts, and now PJM is issuing Reliability Backstop Procurement (RBP) and Interim Resource Adequacy Service (IRAS) proposals. **It is clear that the capacity market is no longer incentivizing construction of the resources needed to meet the moment.** In particular, the RBP demonstrates a lack of faith that near term capacity auctions will fix the forecasted shortfalls. Further, PJM's creation of "two tracks" for both the capacity market and interconnection queue has created an array of unanswered questions around how developers should position

themselves and how RBP procurements will interact with future BRAs. Notably, all these efforts have failed to address the real objective, expediting the connection of new supply.

Resource adequacy is an important measurement of PJM's reliability position and capacity accreditation is a fundamental part of that calculation. However, tying an evolving capacity accreditation methodology to a financial instrument intended to provide a durable investment signal is proving too unstable for the current era of rapid load growth. In other words, **if the definition of capacity keeps changing, and the capacity market clearing prices are uncertain, the future cash flows from capacity payments become unknowable**. At the same time, accreditation requirements are serving to slow the process of studying new resource additions. As a result, the capacity market is contributing to *expanding* the gap between the region's actual reliability needs and the resources capable of meeting them. While the question of how to solve the "missing money" problem has been debated for years, the increasing complexity of the generation mix and the realities of today's transmission-constrained grid make the energy-centric model the right choice for PJM today.

1b. An Energy-Centric Market Will More Effectively Meet the Moment

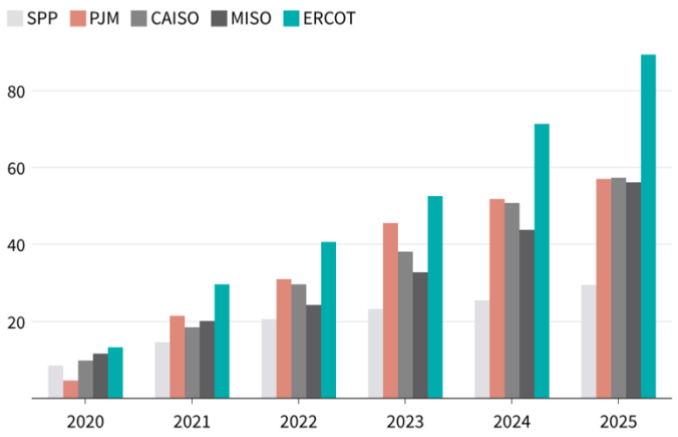
An energy-centric market offers two important advantages that are particularly useful for the current challenges PJM is confronting: **stability**, and **acceleration of new resource entry**. Together, these two characteristics can re-establish the RTO's position as a favorable place for generators to develop and operate.

Energy markets are based on a set of core inputs, including transparent uniform pricing, centralized dispatch, and strong scarcity signals, which combine to realize a least-cost generation mix. This market structure is more closely tied to operational reality, and has fewer parameters to set and dispute, making it less subject to intervention and more stable. Energy-only markets in ERCOT, Alberta, and Australia have all endured for more than two decades. Furthermore, market stability is enhanced when accompanied long-term contracting, which would benefit from contracting around the tradable commodity of a MWh of energy.

An energy-centric market can also unlock the speed to power and faster new resource entry that the region desperately needs. This is because an interconnection process freed from the cumbersome studies of full deliverability imposed by capacity market participation requirements can proceed much faster than today's study process. It would also offer developers greater clarity on interconnection timelines and costs, thus increasing throughput and project success rates. This is borne out by the data from Texas: ERCOT's energy-only market and connect and manage interconnection process have yielded the most new generation in the past five years of any grid region, even larger grids such as PJM.

ERCOT added significantly more generation between 2020 and 2025 than other market regions

Cumulative additions of new, operational generation facilities (GW)



ERCOT is the third-largest US market region by peak demand, while PJM is the largest.

Source: EIA 860 Summer Capacity

RMI

We detail what a reformed interconnection process could look like in an energy-centric market, as well as the corresponding transmission planning enhancements, in Section 2.

2. Enabling Reforms for an Energy-Centric Market

To shift to an energy-centric market, PJM will need to reform the energy market and its interconnection processes. States and market participants will need to adapt how they contract for energy outside – or coordinated with – PJM's market. For an energy-centric market to succeed, expected future energy market prices must provide adequate revenue to incent needed new generation to build. In practice, the potential for higher, more volatile energy prices will induce Load Serving Entities (guided by, or overseen by their states) to contract with generator owners, directly or through third parties, thus providing risk mitigation for consumers and long-term investment stability for generators. To take Path C, therefore, PJM must shift more market revenues to the energy and ancillary service (E&AS) markets so that the capacity market is not needed to incent new generation. In parallel, PJM must simplify and speed its interconnection process, which has been stymied by capacity market-induced deliverability requirements.

An energy-centric market in PJM could be developed on the shoulders of the energy-only markets that have preceded it; PJM need not replicate other models exactly. Thus, shortcomings that have been identified in other markets could be corrected, and recommendations under consideration elsewhere (for example, the recent paper developed for Australia's National Electricity Market, co-authored by PJM Board Chair Paula Conboy, Recommendations to Reform the NEM) could be incorporated into PJM's design.

In this section, we suggest both reforms at the PJM level and actions states should consider to support effective long-term contracting and leverage their increased power in an energy-centric market.

2a. Energy and Ancillary Service Reforms

As a foundational aspect of this new market design, PJM must increase scarcity revenues in the energy market, so that revenue during times of scarcity is adequate to incent new generation and demand participation. PJM generators need scarcity revenues (i.e. the number of hours when PJM hits its scarcity prices multiplied by the scarcity price) that would be adequate to incent new generation without capacity payments. Economic principles suggest that the scarcity price should approach the value of lost load (VOLL). While quantifying VOLL with any accuracy and precision is challenging due to many reasons, PJM's effective scarcity price of ~$3,700 is well below VOLL estimates; for example, Brattle's 2024 study for ERCOT suggests a VOLL of $35,000/MWh. However, lower scarcity prices may be sufficient. Given load growth projections, the number of scarcity hours is expected to grow unless the system adds significant new generation. In its stakeholder process, PJM should include the question of where to set the scarcity price as an important item for education and discussion.

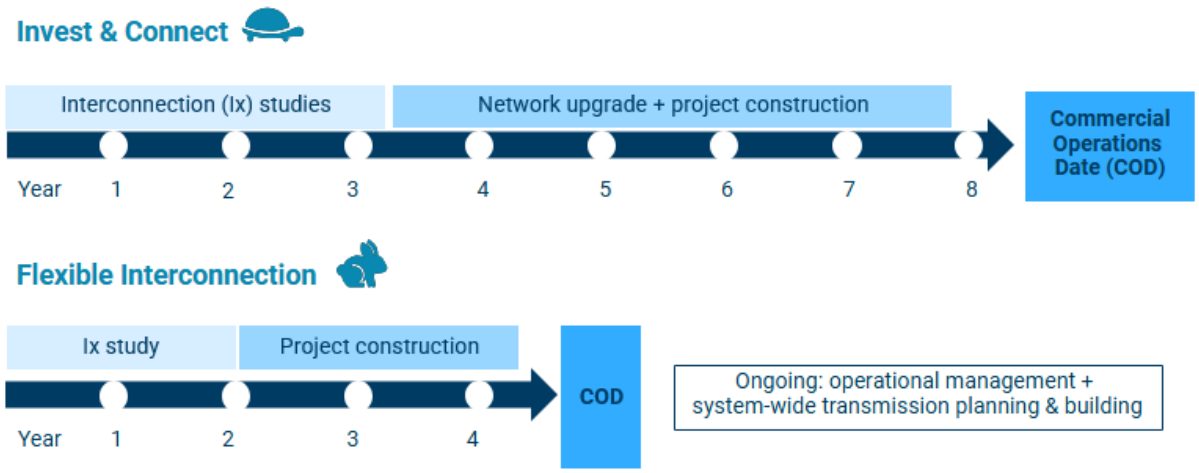
Ancillary service markets already play an important role in operational reliability, but further changes will likely be needed in the shift toward an energy-centric design. PJM's Reserve Certainty Senior Task Force (RCSTF) is currently considering a set of reforms, including to the Operating Reserve Demand Curve (ORDC) that informs how often scarcity prices trigger. Because the scarcity price and ORDC together determine how often scarcity prices trigger and, therefore, scarcity revenues, these efforts should continue with the aim of moving PJM along Path C.

2b. Interconnection Reforms

An energy-centric market should be paired with a more flexible interconnection paradigm that enables resources to connect based on the level of transmission service they actually need. As noted in the whitepaper, PJM has made strides in expediting the study of interconnection requests, but the

conversion of these agreements into commercially operating projects has continued to stall. PJM has historically operated under the assumption that all generators and loads will require firm service; however, that is becoming less universally the case in today's fast-changing, transmission-constrained grid. There is both reliability and affordability upside to connecting faster and more flexibly – particularly if the resource adequacy contributions of these resources are properly accounted for – and the interconnection study process must reflect that.

Rather than starting from the premise of a firm service requirement, PJM should adopt a **flexibility-first framework**, where generators can be studied for, and granted, a minimum (perhaps provisional) service level, based on a reliability-only study to ensure the interconnection would not adversely impact the grid under normal operating conditions. In other words, the generator could connect and produce at its Maximum Facility Output (MFO) under normal and/or single element outages and have the option to firm up its service over time via additional study and network upgrades if desired. This would enable an interconnection process that is significantly faster than the existing method, as shown in the illustrative diagram below, comparing ERCOT's interconnection approach to other regions.



PJM is currently considering a new suite of interconnection reforms, including unifying interconnection studies for generation and large loads into a coordinated process. This presents an opportunity to move toward a more flexible framework that studies generation and load together while recognizing that different resources require different levels of service. To realize this potential, a joint process must include viable pathways for generators seeking faster, non-firm, energy-only service, and for flexible large loads willing to accept interruptible or otherwise non-firm service. It should also enable integrated studies of electrically proximate generation and load, recognizing the efficiencies of such co-location. Through this unified process or some other venue, PJM must find ways to accommodate faster, more flexible routes to interconnection. This would reduce unnecessary network upgrades, lower interconnection costs, and bring both new generation and load online faster.

A flexible-first interconnection approach is much easier to implement in an energy-centric market. Reducing generators' dependence on capacity revenues would make more flexible interconnection pathways a more viable commercial choice for developers, and allow PJM to more cleanly separate interconnection from firm deliverability studies. Flexibly connected resources could still support reliability, while near-term system constraints are managed through redispatch, curtailment, and flexible load.

Meanwhile, **longer-term congestion and emerging reliability needs are better addressed through proactive, robust transmission planning in PJM's existing Regional Transmission Expansion Plan (RTEP), rather than through project-by-project network upgrades.** RMI recently described the opportunity for system-wide transmission efficiency in interconnecting large loads; the same applies for generation. By shifting more transmission planning and build-out from project-sponsored network upgrades to the RTEP process, PJM can compare transmission solutions across multiple needs, capture economies of scale, and select transmission portfolios that provide reliable electricity supply at the lowest overall system cost.

2c. Long-term Procurement Reforms

Several of the existing energy-only markets have established or are contemplating a long-term market mechanism to facilitate the durable investment signal needed to encourage development of long-lived assets such as generators. This long-term procurement could take a variety of forms, from a more decentralized, every-LSE-for-itself approach, to state-driven procurement constructs, to a centralized market operated by the RTO. Many ideas for such a construct have been developed, including Peter Cramton's Forward Energy Market, and others referenced in Appendix C of PJM's PRTMD paper. This procurement could be regular, ongoing, or take the form of a backstop triggered by need, as in CAISO. The choice of the best approach for the PJM region should be made in the stakeholder process to come, with the close engagement and involvement of states.

States and LSEs have historically relied on PJM to ensure resource adequacy and, through the capacity market, cost controls. Essentially, they have been price takers dependent on the intricacies of the capacity market, reliant on complex assumptions they trust PJM to get right. With an energy-centric market, it will be essential for states and LSEs to take a more active role in managing their own resource adequacy, and potential exposure to scarcity prices. While this entails greater responsibility for states, it offers the corresponding opportunity to have more of a say in which technologies (both generation and demand-side resources) should be procured to ensure LSEs can meet demand during scarcity events. Arguably, this is a role that states should have been playing all along; it is not realistic to expect PJM to answer the difficult question of what technologies are best suited to meet resource adequacy (i.e. what can provide power or reduce demand during scarcity hours) in a way that satisfies all of its diverse states and customers. A shift of revenues to the energy market allows individual states and market participants to choose for themselves how best to hedge against scarcity pricing.

To make an energy-centric market work for them, most PJM states and/or LSEs will need to modify how they hedge in the energy market. With higher scarcity prices, energy prices can be more volatile, and long-term contracting becomes even more important to ensure ratepayers are protected from price spikes. Generally, states will achieve more price stability by having LSEs procure a mix of longer (3+-year) and shorter term contracts (<1 year) for energy. Of course, some PJM states already conduct auctions for contracts of this type – but with the larger role of the energy market, all PJM states will likely want to adapt their policies. Importantly, as discussed by Margarita Patria and Alexander Vanderhoof in a separate white paper, this transition does not require states to abandon existing default-service procurement frameworks. Rather, these can be building blocks: default-service programs already manage wholesale price risk through competitive procurement and laddered contracts, and several PJM jurisdictions have incorporated longer-term contracts alongside conventional shorter-term procurement.

3. An Energy-Centric Market Will be More Durable & Better Support Reliability

3a. Political durability

Fundamentally, no market design can solve the politically unpopular problem that high prices are sometimes necessary to attract new supply in a period of fast-growing demand. "The solution to high prices is high prices" will never be a campaign slogan. Energy economists have long debated whether a capacity market or an energy-centric design is better-suited to solving this aspect of the "missing money" problem, and how best to smooth out the high prices. However, for two reasons, we find that recent developments tilt this debate decisively toward an energy-centric design, which would improve the political durability of PJM's markets.

First, constantly changing capacity market assumptions and contested rule changes lead to market distrust. As described above, PJM and its stakeholders continually update (and litigate) capacity market definitions and design. While an energy market still requires some limited administrative assumptions (PJM cites Cramton and Stoft on this point), with today's generation, storage, and demand-side technologies, capacity constructs require ever more complex assumptions to incorporate this diversifying supply mix. As evinced by the debates over minimum offer price rules (MOPR), the capacity market has become a subject of vehement disagreement among PJM stakeholders. The continuous updating of the many complex rules and inputs suggests that these controversies will continue as long as the capacity market is PJM's central resource adequacy construct. The comparative simplicity of the energy market provides a crucial advantage for political durability. While the scarcity price and ORDC characteristics will still yield disagreements, those parameters are generally technology-agnostic and therefore, less divisive.

Second, energy markets empower states and LSEs while the capacity market forces PJM to make decisions on behalf of all market participants. Under Path C, states (through their LSEs) will have agency to protect their customers through forward energy contracts using their own best judgement. Today, stakeholders argue about the relative value of gas generators, batteries, renewables, and virtual power plants and must live with PJM's answer (through capacity accreditation). With forward energy procurements, states would have the ability to answer those questions for themselves, and the flexibility to meet resource adequacy in the ways that best fit the needs and policies of their jurisdiction. The consequences of their decisions would also be better cabined to their own jurisdictions, rather than spread across the region as a whole: if LSEs in one state took on risky forward energy contracts, exposing their customers to scarcity prices, the cost implications would be largely limited to that state; in that case, state actors should be held accountable instead of implicating the entire PJM market. Similarly, if states contract with innovative resource adequacy solutions that prove cost-effective, they will reduce costs and potentially provide models for other PJM states. With empowered states – particularly if they are engaged throughout the development of an energy-centric market model – we believe the market construct will prove more durable.

3b. An Energy-Centric Market Will Improve Reliability

Energy-centric markets have a demonstrated ability to maintain reliability. In the US today, most electricity markets now do not include forward capacity markets. GridLab, together with Joshua Rhodes, recently authored a report describing how Texas pairs its energy-only market with transmission planning to ensure adequate generation supply, and that generation can reach load. ERCOT's experience offers two lessons learned that have applicability in PJM: first, if the investment

signal can be made more durable, it will incent adequate generation build; and second, effective transmission planning ensures load can be served reliably.

In PJM, an energy-centric market would be more likely to achieve continued reliability for the following reasons:

- **An energy-centric market will be more likely to send a consistent and durable economic signal.** As described above, shifting from the current besieged capacity construct to an energy-centric market design will likely improve the political durability of PJM's markets. This durability will lead to more consistent pricing and the needed long-term, stable market signal required to incent development. Instead of uncertain accreditation changes, developers will see more predictable scarcity pricing. When forecasts suggest scarcity pricing will be more likely (which is the case today), those forecasts will incent LSEs to sign higher-priced forward energy contracts that flow through to new generators. In short, a more durable, energy-centric market design can provide the predictable price signals that the RPM has failed to create.
- **Disconnecting "deliverability" from interconnection will accelerate generator build times.** The paramount failure in PJM over the past decade was slowing new entry just as demand was exploding, and PJM's interconnection woes are inextricably linked to the capacity market. An energy-centric market coupled with removing deliverability requirements in interconnection studies would speed new entry considerably, as demonstrated in markets like ERCOT.
- **An energy-centric market will empower states to meet their policy goals without impacting other states.** Today, state energy policies interact with the capacity market in nuanced, sometimes conflicting ways. In an energy-centric market, states would be able to more easily achieve their policy goals through forward energy contracting; further, states will themselves take on any risks (through scarcity price exposure) associated with their goals without impacting other PJM states. This will alleviate a central source of tension in PJM market design – as accommodating state policies was at the core of the MOPR disputes – supporting both durability and reliability.
- **An energy-centric market would empower demand-side resources.** Demand response, flexible large loads, distributed energy resources, and VPPs would be highly valued under a paradigm reliant on responsiveness to wholesale market prices, including scarcity pricing. FERC Order 2222 was specifically intended to remove barriers to DER aggregations participating in wholesale markets, including PJM's capacity market, yet creating the rules and processes necessary to fit these resources into the existing market construct has taken years and has yet to pay dividends. In the most recent RPM auction, the first in which PJM's O2222 rules were in effect, there was a complete absence of DER participation. Instead of translating diverse demand-side capabilities into a supply-side capacity market product, an energy-centric market would reward demand-side resources more directly and immediately. In its PRTMD paper, PJM identifies an example: at $10,000/MWh, scarcity prices likely exceed some "compute heat rates" (per Hans Royal) and would induce voluntary data center curtailment. Of course, other "virtual power plants" based on residential demand response will likely be willing to reduce load at much lower prices. Taking demand response off the sidelines and better valuing it in the market would bolster regional reliability in the near term.
- **By focusing more transmission planning in the RTEP process, PJM will likely build more needed regional transmission.** Today's over-reliance on interconnection network upgrades (for generation and load) is inefficient, because it is designed to meet deliverability requirements for only one generator (or one cluster), and often unfair, because interconnecting customers sometimes pay for large upgrades with system-wide benefits. By associating transmission more

clearly with system-wide benefits and reliability, the RTEP process may be better prioritized by PJM stakeholders.

- **PJM would still perform resource adequacy modeling and assessment**, and thus have a finger on the pulse of both near and longer term reliability. States would oversee more of the procurement that ends up realizing system sufficiency, giving them the ability to ensure that procurement meets their needs and respects their policies.

Conclusion

In its Powering Reliability through Market Design paper, PJM acknowledges the region is at a crossroads. And in the ensuing workshops, we heard many voices urging PJM to pick a road to travel down, quickly. The region needs a durable, stable market design, in which market participants can make long-term investment decisions with relative confidence that the market structure will endure and that new entrants can efficiently join. The PJM capacity market as it exists today is not up to that task.

PJM should commit to the development of an ***energy-centric market***, and put its money where its MWhs are, so to speak. Refocusing revenues on energy & ancillary service markets offers the opportunity to better incent and accelerate the deployment of the diverse suite of energy resources that PJM could be relying on to meet the large-scale, rapid load growth at its door. An appropriately structured forward energy contracting regime would shield ratepayers from price volatility and provide a durable investment signal for generators.

PJM should give stakeholders the opportunity to develop this best-fit market for the region, by focusing the stakeholder process to come on Path C, and the underlying reforms – to both markets and planning – that must accompany it. As PJM ramps up these Path C reforms, the BRA should continue to exist. Once the reforms take hold, the BRA could shift into a residual market (putting the "R" back in BRA, as it was initially conceived) or be replaced by an alternative forward energy procurement construct. For design and implementation considerations, we would look to states and stakeholder input; we are eager to further discuss such questions in what we hope will be a robust, productive, and focused stakeholder process.