

## FAQs related to EKPC and Daymark’s proposal for reform of PJM’s capacity market

May 12, 2023

***Introduction:** EKPC and Daymark appreciated the engagement with our proposal at the April CIFP-RA meeting. To continue to advance the dialog on the EKPC design concept, we tracked questions that arose and are documenting them, along with responses, in this FAQ document. EKPC and Daymark continue to be open to questions and feedback on the design. (There is one item, noted as “new,” below that arose from the additional thinking spurred by questions.) We anticipate the design further evolving as we continue to engage with the PJM and stakeholders. We welcome continued discussion on all the elements of the design.*

### Definitions

Q-1. Is capacity a call option on energy?

Capacity is the planned for capability of a resource (physical asset) to deliver energy or provide ancillary services to firm load.

Capacity as defined above is not a call option on energy. Call options give the buyer the right, but not the obligation, to buy the underlying asset at a strike price specified in the option contract in exchange for an upfront payment. Investors buy call options to hedge against rising prices. As structured, capacity buyers purchase energy from the associated generators (assuming they are dispatched), not at a fixed strike price, but at the prevailing market price. In the capacity market context, then, buying capacity provides no energy price hedge and consequently, as energy call options, are at best at-the-money (ATM), with no intrinsic economic value beyond time value. The option value is about zero. Selling a set of zero-valued energy call options would not support the net going forward costs of the capacity resources, and would thus fail to achieve the revenue and resource adequacy goals of the capacity market.

### Market clearing

Q-2. Clarify how an offer would be structured and how the capacity market is cleared.

- a. Qualified ICAP is capacity that meets the minimum qualification requirements of Base Capacity or Emergency capacity (refer to slide 7 of April 2023 EKPC presentation, “Reform of PJM’s Resource Adequacy Market Design”<sup>1</sup>), limited to the lesser of tested maximum dependable output or CIR.
- b. Accredited UCAP is the maximum amount of UCAP that can be offered into the capacity market. Accredited UCAP is the average of a resource’s hourly Adjusted ICAP.
- c. Each resource with Qualified Base Capacity (BC) ICAP must offer a quantity-price pair, Accredited BC UCAP MW and \$/MW-year into the market. Offers do not need to be in terms of \$/MW-day, as done

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<sup>1</sup> Available in posted materials for April 19, 2023 CIFP-RA meeting.

today—the important thing is that the product of these values equals the annual revenue a seller wants to be willing to provide BC for the delivery year.

- d. Each resource with Qualified Emergency Capacity (EC) ICAP may offer a quantity-price pair, Accredited EC UCAP MW and \$/MW-year. The product of these values is the average annual revenue a seller wants to be willing to provide EC over the three-year commitment period.

Resources must offer BC UCAP and may offer EC UCAP. Resources that have both BC and EC UCAP values may offer both into the market.

- e. PJM will gather the submitted BC and EC offers and for each translate the unit-specific UCAP into as many as 365 daily 24-hour Adjusted ICAP schedules (could be fewer if PJM puts similar days together) using the planning data from the accreditation model.
- f. PJM will clear the market to simultaneously meet both the BC and EC resource requirements. The clearing model finds the solution that minimizes the total cost of satisfying all hourly BC and EC resource requirements, where the BC and EC resource requirements are specified as two sets of hourly demands derived from the reliability planning model, transmission constraints are modeled using a planning-level topology, and a resource can clear a BC or an EC position, but not both.
- g. The BC resource with the highest offer price cleared in any hour sets the BC clearing price; the EC resource with the highest offer price cleared in any hour sets the EC clearing price.

Q-3. What profiles are used in capacity market clearing? (e.g., solar)

PJM will clear the market using the hourly Adjusted ICAP of each resource. Recall, from Q-2, PJM takes the offered UCAP values and translates them into equivalent hourly Adjusted ICAP schedules.

Adjusted ICAP is the Qualified ICAP of a resource as modified in each hour to reflect the weather correlated production profiles (renewable resources) or outage rates and ambient air adjustments used in the reliability model.

For example, the Accredited UCAP of a solar resource reflects the hourly production profile used in the reliability model. The Accredited BC UCAP that a solar resource offers into the market is reflected in the clearing process by its equivalent hourly Adjusted ICAP. In each hour, the resource requirement is compared to the sum of the Adjusted ICAP values of all offered resources in that hour. If the hour in question is in the night, a solar resource's contribution to that hour is zero and it could not be used to meet that hour's requirement. During the day, however, it could contribute to meeting demand and, depending on its offered price, may be selected to meet that hour's requirement.

Q-4. How are EC resources dispatched in the energy market and how would they impact DA/RT market prices?

EC resources offer Available ICAP into each hour of the day-ahead and real-time energy markets at the greater of either \$800/MWh or variable operating cost. The EC resources would be held out of the

energy market until energy prices exceeded \$800/MWh at which point they would be dispatched and be eligible to set price.

- Q-5. Does the proposed clearing model build in linkages between days or just clear each day like a separate 24-hour period?

The market clears an annual resource requirement represented as a set of 8760 hourly requirements. We do not propose modeling inter-temporal constraints—. We do not see benefits to adding this complexity. Intertemporal constraints are most relevant in the context of resource scheduling and real-time operations, but do not materially impact resource adequacy in the planning time-frame. (Note that we do not expect the capacity market to address all flexibility-related incentive issues; some, if not most, are best left to the energy and ancillary services markets)

- Q-6. Does the proposed hourly clearing approach have the potential to compensate resources with different impacts on reliability at the same price? For example, suppose that the only hours that bind in the hourly clearing are afternoon hours. Further, suppose that there are two resources with the same UCAP—the first is only available at night and the second is only available in the afternoon. In this case, do these resources receive the same price in the EKPC/Daymark design? Why shouldn't the afternoon resource (and any resource that helps address the binding hours) get paid more? This seems possible only if there is some price differentiation. Might not need 8760 pricing but maybe separate pricing by season and time/hour-of-day?

First, we must clarify that we are proposing an annual clearing, not an hourly clearing. BC and EC resources will each clear an annual position with annual obligations for which they will receive an annual clearing price per MW.

PJM will, however, as explained in Q-2, reach that clearing outcome by finding the solution that meets all hourly BC and EC resource requirements for the delivery year. In practice, the optimal solution requires the resource requirement constraint to bind each hour. The question implies that some hours are more important than others. This is not true. Firm load must be satisfied in all hours, or there is a reliability failure for the year – recall that the reliability measure is an annual measure of performance. Consistent with this paradigm, the market clearing ensures that there are sufficient resources in each hour to meet the annual resource requirement, which is a function of the planned-for firm load.

In the example posited in the question, there are two resources with the same UCAP—the first is only available at night and the second is only available in the afternoon. If both resources clear, then they receive the same capacity price—both contribute to meeting resource adequacy in the year. Recall that in our market model, clear means that a resource is amongst the lowest cost set of resources offered that meets the annual resource requirement in at least one hour. Whether a resource requirement in the night or in the afternoon, all must be satisfied to meet the annual resource adequacy requirement. For this reason, we do not propose *a priori* identification of “reliability hours.” The energy and ancillary services markets provide unambiguous signals to resources regarding the value of reliability in any given hour.

The signals that the capacity market sends are for the efficient allocation of investment capital. In any hour, invested capital is sunk and there are no real-time opportunities for new investments to address an hourly need. The goal of the capacity market is to ensure sufficient revenues are available on an annual basis to get the needed capacity to meet long-term resource adequacy.

## Accreditation

Q-7. How does accreditation differ for BC and EC resources?

The methodology is the same, but the data inputs are different, producing different accredited values. As a reminder, a resource's accredited value is the maximum amount of capacity that it can offer into the capacity auction, or "Accredited UCAP." This "Accredited UCAP" number is the average of the hourly "Adjusted ICAP" values, which are the qualified ICAP modified to reflect weather correlated ambient air reductions and outages (for thermal resources) or weather correlated production profiles (for intermittent renewable resources) in each hour.

The difference in Accredited UCAP comes from using different weather correlated ambient air reductions and outages or production profiles in the calculation of Adjusted ICAP for each resource. Accredited BC UCAP uses expected weather conditions and outage rates, etc.; Accredited EC UCAP uses extreme or outlier weather conditions and outage rates.

Q-8. Clarify requirements modeling versus energy market performance obligation.

The Requirement, as we use the term, is how much capacity needs to be purchased to serve the firm load in the region consistent with resource adequacy standard. The requirements calculation is based on modeling of the load forecast and resource performance to establish the minimum Adjusted ICAP that would need to be secured in each hour of the delivery year to reliably serve the planned-for firm load.

The Adjusted ICAP is a planning model construct. In the delivery year, each resource with a capacity market position must offer into the DA and RT energy markets all Available ICAP, which is the operations timeframe analog to Adjusted ICAP. The rules governing energy offers depend on the type of capacity: BC vs EC. BC energy is priced at variable operating costs, much as today. EC energy is priced at the minimum of \$800/MWh or variable operating cost.

A capacity resource whose Available ICAP offered into the energy markets in each hour of the delivery year match the Adjusted ICAP used in the reliability planning model used for requirements and accreditation, will earn capacity revenues equal to its Accredited UCAP x Clearing Price.

Q-9. Could a resource qualify to be both Base and Emergency?

Yes, a resource can qualify as both Base Capacity (BC) and Emergency Capacity (EC), assuming it meets the resource qualification requirements for both.

To briefly recap resource qualification requirements, BC and EC resources must each:

- be fully deliverable to firm load

- demonstrate maximum ICAP via periodic testing (qualified ICAP is limited to CIR value) and
- meet any NERC winterization requirements.

EC must also satisfy the following additional requirements:

- be available to PJM to dispatch within 2 hours of notification
- have a firm fuel source that allows for continuous operation for at least 24 hours, or equivalent technical capability
- have firm fuel supply and delivery contracts
- have demonstrated ability to operate through extreme temperature/humidity conditions, and
- have demonstrated financial capacity to absorb non-performance penalties

A resource that meets all the criteria listed above could offer make both BC and EC offers into the capacity market; however, it will clear against only one demand curve – BC or EC -- and will receive the capacity clearing price and the delivery/performance obligations of the resource category it clears.

Q-10. What qualifies as a firm fuel delivery contract?

A firm fuel delivery contract provides for both firm (uninterruptible) supply and firm delivery from energy source (e.g., wellhead or mine) to facility, and requires the parties to comply with any applicable regulatory (e.g., NAESB) requirements. We acknowledge that current available “firm” supply arrangements with natural gas suppliers will create challenges for natural gas facilities, just as they do currently; however, desirable revisions to gas scheduling protocols are outside of the scope of this reform effort. We welcome further discussion on this topic.

Q-11. What is the definition of “verifiable firm fuel source?” Note that one pipeline may be more firm than multiple, depending where you are on the system.

See response to Q-10. We concur with the observation that resources served by one pipeline may have had fewer fuel interruption issues than some served by more than one.

Q-12. Is there a minimum on-site fuel inventory requirement?

No, but EC resources are required to be able to operate continuously for 24 hours.

Q-13. How would a resource demonstrate its ability to operate through extreme conditions?

For new resources or existing resources that have made capital investments designed to improve extreme weather performance, this qualification would be demonstrated through engineering

specifications. For resources with an operating history, this qualification would be demonstrated through engineering specifications (for hot and cold weather and extreme humidity) and through a record of successful performance in extreme (hot and cold and extreme humidity) weather conditions. We anticipate that more detail will be needed to define the appropriate engineering specifications that need to be demonstrated and the weather conditions that should be considered.

Q-14. How would a resource demonstrate financial capacity?

As with other credit risk management policy requirements for participating in the markets, a resource would have two potential routes to demonstrating financial capacity: a “minimum capitalization” route and a “collateral alternative” route. Rules could be established to allow financial capacity to be demonstrated via parent guarantee, cash collateral, LoC, or minimum capitalization. In any event, a collateralized penalty exposure provision would have to be developed that recognizes the timing of non-performance in the 3-year delivery period, the amount of EC capacity payments remaining in the 3-year delivery period, and the maximum non-performance penalty exposure for rest of period, etc.

Q-15. What resources can provide the EC product?

The proposed EC product is technology neutral in that any resource that can meet the EC resource qualification requirements can qualify to provide the EC product. We anticipate peaking resources, combined cycles, some DR, hybrid ESS/solar, perhaps thermal-steam boilers, may all be able to make investments and arrangements to qualify.

## Notification/start-up requirements

Q-16. Is the EC 2-hour requirement from a cold start? With EC being 2-hour notification / startup, do you see this excluding coal and nuclear plants?

It is not a cold start requirement. It is a requirement to be available for dispatch within 2 hours of notification by PJM. The design does not assume that the resource is in an off-line state when notified, or that PJM has no role to ensure resources are able to address system needs beyond issuing a two-hour notification. The expectation is that PJM will give additional instruction and posture the system as needed to meet emerging conditions, preferring not to rely on units self-scheduling. Self-scheduling can have unpredictable impacts on the system, include potentially exacerbating constraints and creating operational challenges. Resources that are following PJM instructions would be deemed to have performed as required under the rules and, to the extent applicable, would receive uplift if the cost of following PJM’s instructions exceeds the prevailing market price.

In addition, the rules and the obligations on the resource and PJM system operator are structured to minimize incentives to self-schedule. That said, this proposal does not explicitly preclude a resource from self-scheduling, reflecting its own assessment of market conditions. Self-scheduled resources would receive the prevailing LMP for any energy produced prior to notification, but unlike resources following PJM instructions would be ineligible to receive uplift for startup no load or operating costs in

excess of the LMP. The exception to this would be if such a resource self-scheduled and the system conditions ultimate are those that align with the EC commitment obligation.

Resources that earn most of their revenues from the energy markets are not apt to find the EC product profitable, even if they otherwise qualify.

- Q-17. PJM requires Fast Start to be 1 hour. Does the proposed design incent more of the same? In the future we might have something that can start faster (storage with renewable). Is there a risk the market design won't incent that?

The EC market will incentivize resources capable of meeting the two-hour notification requirement amongst the other EC qualifications, which we suggest is a reasonable interval between notice and release to dispatch for EC resources. This interval is also consistent with the real time (RT) commitment process. This interval could be shortened or lengthened in future, if experience suggests either that a shorter window is necessary or that a longer window would be feasible. To the extent that the requirement is set at two hours, there will be no explicit incentive in the capacity payment for resources capable of a more rapid start—this incentive stays in the E&A markets.

## Demand Response

- Q-18. Is Demand Response contemplated as a resource type?

Yes.

- Q-19. Would DR, which currently has an \$1800/MWh energy offer, qualify as EC?

EC resources would be required to offer into the market at \$800/MWh or at their variable operating cost, whichever is greater. If \$1800/MWh is the variable operating cost of DR, it could offer into the market as an EC resource at that amount, provided it met the other EC resource qualification requirements.

- Q-20. If DR participates as BC, how would the variable energy cost be determined for the offer? For DR, there is a different energy strike price based on notification time.

DR could participate as BC and, if cleared as a BC resource, offer into the energy market at whatever the appropriate energy strike price is per the relevant DR program rules.

## Performance requirements and penalties

- Q-21. Why do 3 non-performance events result in the resource being removed as EC for that DY, rather than the remainder of its multi-year commitment?

**NEW** -- This is a good question. After considering it, we have amended our proposal to state that such a resource should be removed for the remainder of the 3-year term, and that it should be required to re-

qualify (through the prequalification process) before participating in another capacity procurement as EC.

- Q-22. If PJM gets accreditation right, then resources should be held accountable only for what they can perform (e.g., wind, solar, gas...), so all should have a must offer requirements.

All resources that clear as BC or EC must offer their Available ICAP into the DA and RT markets in each hour throughout the year.

- Q-23. What constitutes “availability”?

In our proposal, “availability” is demonstrated by offering properly into the DA and RT markets and then by following PJM’s dispatch instructions. Importantly, if a resource offers correctly into the energy market and is not scheduled by PJM, it is available for performance measurement purposes.

### **Emergency capacity**

- Q-24. With EC having to offer in at \$800/MWh, any idea how many hours they would likely run through the year?

Conceptually, EC resources would run whenever the price exceeds \$800/MWh, which has been chosen as a price that puts them on before the 30-minute reserve shortage price is hit.

Based on annual averages in PJM from 2014 through 2022, you would expect to see a PJM-wide average of 4 hours annually—however, these hours are primarily found in 2014 (Polar Vortex) and 2022 (Winter Storm Elliott)

Such operation is consistent with the idea that these are Emergency Capacity resources.



**Hourly RT LMP above \$800/MWH**

Year	AEP	Ohio	New Jersey	Western	Dominion	Chicago	
2014		7	9	11	14	19	8
2015		0	0	0	0	0	0
2016		0	0	0	0	0	0
2017		0	0	0	0	0	0
2018		0	0	0	0	1	0
2019		0	1	0	0	2	0
2020		0	0	0	0	0	0
2021		0	0	0	0	0	0
2022		21	21	26	21	22	16
<b>Total</b>		<b>28</b>	<b>31</b>	<b>37</b>	<b>35</b>	<b>44</b>	<b>24</b>
<b>Average</b>		<b>3</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>3</b>
<b>Median</b>		-	-	-	-	-	-

Q-25. Would just the capacity payment cover an EC resource’s annual costs if they don’t get much E&AS?

The EC capacity price is the EC resource’s primary income stream; i.e., the expectation is that the majority of an EC’s going forward fixed costs would be recovered through the EC price. In most years (if the past 9 years are instructive), EC resources may rarely run. Several years may pass without them being called on to run at all to address emergency reliability conditions, and they may then run only a handful of hours when called.

Q-26. Is EC something that needs to run an extended amount of time or just be there in an emergency?

EC resources are there for emergencies, such as those caused by extreme weather events. To qualify as ECs, resources must be able to show that they can operate for 24 hours continuously. There is no guarantee that EC resources would never be called on for periods greater than 24 hours; however, as shown in the table provided in the response to Question 3, above, based on historical experience, the expectation would be that periods in which prices remained elevated above \$800 for more than 24 hours would be rare.

Q-27. EC is committed for 3-year periods, but the clearing is 1 year. How does an EC resource recover its net avoidable cost?

The intention is to procure EC in staggered tranches, so that in any given year, approximately 2/3 of capacity would be in its second or third year of obligation, and approximately 1/3 of capacity would be offering into the market for a new 3-year term (note that offering for a three-year term is optional—EC

resources are permitted to bid for one or two years, if they prefer). The simplest approach to ensuring cost recovery for EC resources is to set the three-year price for each resource based on the year 1 clearing price for that resource.

- Q-28. Could resources with regulatory constraints related to environmental impacts function as emergency capacity?

Yes, this kind of resource is potentially well-suited to serve as EC. Generally speaking, environmental constraints limit how much resources can run and/or permit resources to run only under emergency conditions. EC capacity, by construction, is limited to run as the system is becoming short to stave off emergency conditions. Adding EC capacity could support the renewable transition by retaining resources to protect system reliability while renewables are used to meet energy needs during most hours.

## Fixed Resource Requirement

- Q-29. How would this proposal affect the Fixed Resource Requirement (FRR)?

Currently, a Load Serving Entity is eligible to elect the FRR alternative if it is an investor-owned utility, an electric cooperative, or a public power entity. The Load Serving Entity must be able to demonstrate that they have sufficient resources available to meet the full reliability requirement for the FRR service area, which is generally the projected future demand for electricity plus a reserve margin. Such an election is for a minimum of five consecutive delivery years. Parties demonstrate their ability to meet the reserve requirement on an annual basis by committing sufficient resources to meet the reliability requirement to their FRR plan. If an FRR plan's capacity commitment is insufficient for a delivery year, the Load Serving Entity will be assessed an FRR Commitment Insufficiency Charge for the shortage. Capacity resources committed to an FRR plan continue to be subject to the same Capacity Performance requirements that apply to resources committed through PJM's capacity market if they are called upon in an emergency.

Under our proposal, the following changes to the FRR would apply:

- a. Whereas today, entities that elect the FRR alternative must cover their whole capacity requirement, under our proposal, it would be possible to cover a portion of the requirement, with a residual amount to be procured in the capacity market. Entities wishing to satisfy capacity requirements through an FRR would now have two capacity requirements: Base Capacity and Emergency Capacity. An entity could choose to have an FRR for one or both types of capacity—and for only a portion of either. Any requirement not satisfied through the FRR would need to be satisfied in the capacity market.
- b. Under our proposal, for FRR entities, a penalty will apply for resources that do not provide the planned amount of capacity.
  - i. For BC, the penalty for occasional non-performance will be a requirement to pay the capacity clearing price allocated to the hours of non-performance. The penalty for a

resource not being available at all (for example, due to delays in Commercial Operation Date) would need a somewhat higher penalty (perhaps in the neighborhood of 1.2 or 1.5 times the capacity clearing price) reflecting the fact that the non-availability of this resource could have impacted capacity market clearing prices.

- ii. For EC, non-performance penalties would be the equivalent of non-performance penalties for EC resources that cleared in the capacity market., including, after three occurrences, being disqualified as EC.

## Comparisons with other capacity market designs

- Q-30. If the existing market is “BC,” are we just paying more to a subset of existing resources? Consider an alternative ... pay those that aren’t there all the time more if they are there in an emergency. This is CP bonus payments in another form.

The BC resources are largely the existing resources. Amongst the existing set of resources, some may meet the high qualification bar to be EC. We expect that many EC resources will be new or will come from capital improvements and changes to fuel arrangements at existing plant that were uneconomic under the existing rules. EC resources will be paid more than BC resources because they cost more and are subject to stricter performance obligations.

This proposal does not include anything like CP bonus payments. Non-performance reduces the capacity charges to firm load.

- Q-31. In PJM, prices for historical CP vs Base product did not materially differ. How would BC and EC differ?

There may be a variety of reasons for the fact that the introduction of CP pricing did not increase capacity pricing materially in PJM, compared to the base product. Among them may be that by the time CP was fully phased in, most units had already invested in reliability upgrades.

Whatever the reason for the lack of significant price differentiation for CP, we believe that EC resources will necessarily require a higher price than BC resources. See response to Q23.

Also, to the extent that EC resources are not needed, or all resources perform like EC resources, the proposed design allows the procured EC requirement to vary at PJM’s discretion. This reduces the risk of over or under procuring resources that are not economically increasing reliability.

## Implementation

- Q-32. What are the “core” changes that would be needed in the near term in this proposal, and what could be handled in the long term?

Core elements are: 1) setting the BC and EC requirements (note that this is an extension of the methods PJM are currently developing); 2) qualifying EC resources; 3) setting Accredited UCAP and Adjusted ICAP schedules for sub-periods during the year (these values are lifted from other supporting models and

there is flexibility about what the sub-periods are); 4) modifying the DAM clearing engine to simultaneously clear BC and EC; 5) implementing capacity payments and penalties as proposed

Things that could be handled in the longer term: 1) finalizing the granularity of the Adjusted ICAP schedules. We propose hourly schedules, but other windows could be used 2) Establishing a staggered schedule for the purchase of EC in 3-year tranches 3) refining fuel security requirements for EC resources.