

Education on Capacity Resources and Related Key Work Activities (KWAs 4, 5, and 6)

Pat Bruno, Market Design

Andrew Levitt, Market Design

Paul Scheidecker, Capacity Market Operations

RASTF – April 11, 2022

Overview of Capacity Resources

Qualification

What qualifies as capacity and what are the requirements to participate in the capacity market?

Accreditation

How do we determine the reliability value of resources that qualify?

Obligations

What are the obligations imposed on Capacity Resources?

- Capacity Resources
 - **Generation Capacity Resources** (Existing / Planned; Internal / External)
 - **Demand Resources** (Existing / Planned)
 - **Energy Efficiency Resources** (Existing / Planned)
- Aggregate Resources (i.e. commercial aggregation)
- Seasonal Capacity Performance Resources (i.e. facilitated aggregation)
- Qualifying Transmission Upgrades (Existing / Planned)

Other ways to participate in RPM (on the demand side):

- Price Responsive Demand (PRD)
- Peak Shaving Adjustment (PSA)



Generation Capacity Resources: Qualification and Accreditation

- RPM qualifications and requirements for Generation Capacity Resources are presented in PJM Manual 18 Section 4.2.
 - Section 4.2.1, existing internal
 - Section 4.2.2, existing external
 - Section 4.2.3, planned internal
 - Section 4.2.4, planned external
- Rules and procedures for determination of generating capability are described in PJM Manual 21

PJM Manual 18: <https://www.pjm.com/~media/documents/manuals/m18.ashx>

PJM Manual 21: <https://www.pjm.com/~media/documents/manuals/m21.ashx>

- The unit is pre-certified by PJM as meeting the generation deliverability test. PJM's certification process for internal generating resources is described in the Tariff and Operating Agreement.
- The resource owner or operator submits the required operating and maintenance information into PJM's eDART and eGADs systems.
- The resource owner or operator performs winter and summer testing as described in PJM Manual 21 to verify the net capability of each unit.

- The unit resides in the Capacity Exchange resource portfolio of a signatory of the PJM Operating Agreement. This is accomplished by having an “Approved” Capacity Modification in Capacity Exchange.
- The relevant portion of the unit was not specified in any FRR Capacity Plan for the Delivery Year.

Same as existing internal requirements plus...

- Seller has obtained a determination that the Pseudo-Tie required for its External Generation Capacity Resource is feasible
- For transmission outside PJM, obtained Long Term Firm Point to Point service
- For transmission service within PJM, obtained Network External Designated Transmission Service.

- External capacity without firm transmission service confirmed must establish an RPM Credit Limit prior to an RPM Auction.
- The resource owner provides a letter of non-recallability
- A communication path (acceptable to PJM Dispatching/Operations personnel) must be established between the PJM Dispatchers and the operator of the unit.
- Seller executes an External Resource Must Offer Agreement.

- The planned unit's start date of Interconnection Service is on or before the start of Delivery Year.
- A Facilities Study Agreement has been executed for planned generation resources greater than 20 MWs and an Impact Study Agreement has been executed for planned generation resources less than or equal to 20 MWs, for the unit to participate in the Base Residual Auction.
- An Interconnection Service Agreement (ISA) or Wholesale Market Participant Agreement (WMPA) has been executed for the unit to participate in an Incremental Auction.

- A planned unit with an Interim ISA can offer only into the BRA or Incremental Auction for which the Interim ISA is valid.
- A Capacity Modification for the planned unit has been submitted and in “Provisionally Approved” status in Capacity Exchange.
- Planned Generation Capacity Resources must establish an RPM Credit Limit prior to an RPM Auction.

Same as planned internal requirements plus...

- Must satisfy the same requirements for existing external generation capacity
- Must provide evidence to PJM it has been studied as a Network Resource, or such other similar interconnection product in the external Control Area.

- **Unlimited Resources**

- Generating units with the ability to operate continuously across all hours of an operating day without interruption if needed, including nuclear and fossil-fired steam units, combined cycle units, combustion turbine units, etc. (i.e. generation that is not an ELCC Resource)
- Accreditation is based on the level of output that the unit can provide under site conditions expected at the time of PJM system peak load

- **ELCC Resources**

- A Generation Capacity Resource that is a Variable Resources, Limited Duration Resource, or a Combination Resource
- Accreditation is based on effective load carrying capability (ELCC) analysis

- **ICAP** is the installed capacity of a generating unit
- ICAP is capped at Capacity Interconnection Rights (CIRs)
- ICAP ratings are set based on the generator site conditions coincident with the dates and times of the last 15 years PJM summer peaks
 - Site conditions include ambient air temperature, barometric pressure, etc.

- **UCAP** is Unforced Capacity
- UCAP is the ICAP reduced for forced outages
- $UCAP = ICAP * (1 - EFORD)$
- This calculation sets the accredited capacity value for all Unlimited Resources

EFORD (Equivalent Demand Forced Outage Rate): Probability that a generator will fail in whole or in part when needed; Final EFORD based on forced outage data from prior October through September period

Capacity Value of Renewables and Storage from June 1, 2023: Effective Load Carrying Capability

Effective Load Carrying Capability (ELCC) compares hourly output profile of a resource to simulated hourly system conditions of the target year to identify the capacity value.

- *Resources with hourly output consistently at or close to maximum during times of simulated system shortage receive a high capacity value.*
- *The simulation uses many years of weather data and monte carlo analysis with many forced outage scenarios to derive a probabilistic result.*
- *ELCC shares the same analytical framework as other “loss of load probability” analysis, albeit with hourly granularity. PJM’s implementation of ELCC aligns with the pre-existing PJM resource adequacy analyses where practical.*
- *1 PJM ELCC capacity value MW provides the same LOLE improvement as 1 “MW of perfect generation available 24x7” (vs. original ELCC formulation, which was “MW of additional load”).*
- *PJM uses “average-total” ELCC, as distinct from a “marginal ELCC” approach (next slide).*

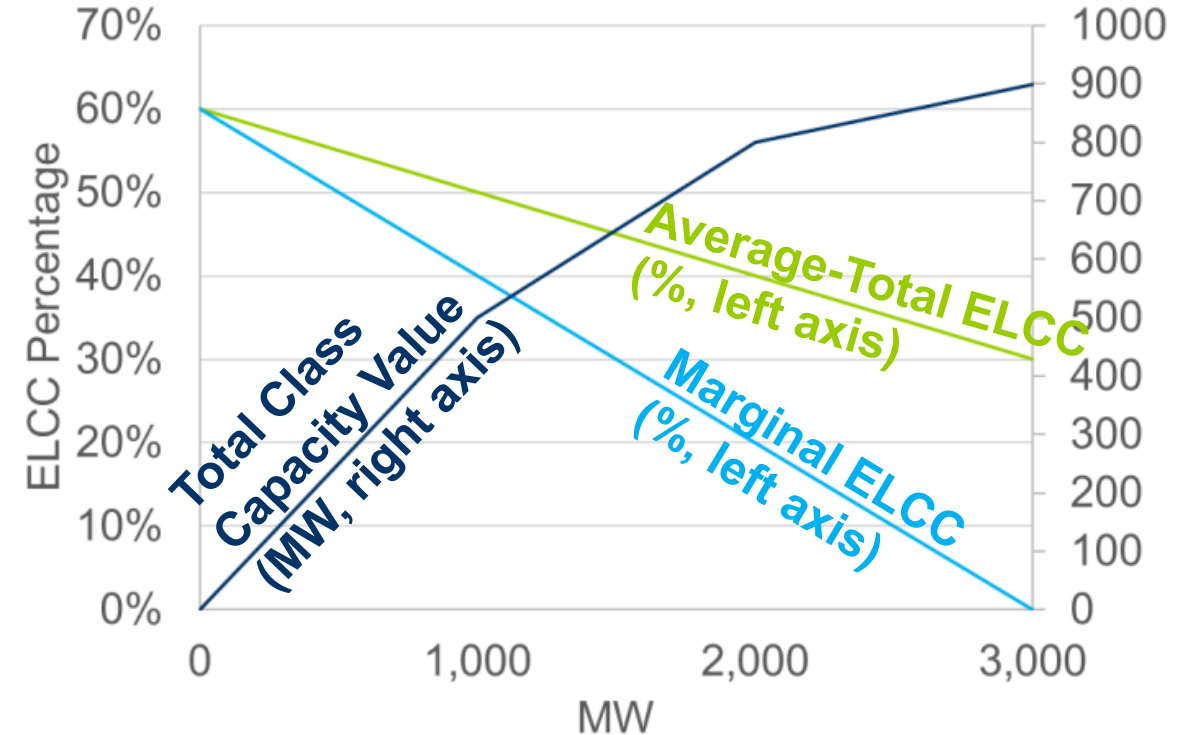
The ELCC model includes all ELCC Resources in the expected resource mix for the target year. The hours of simulated system shortage depend on the characteristics of this resource mix—shortage occurs during periods of: extremely high load; rather high load plus extremely high outages; and (in the future) rather high load plus extremely low wind and solar output.



Average-Total ELCC vs. Marginal ELCC

- ELCC analysis can identify the equivalent capacity value of all ELCC Resources, or of an entire class, or of a small increment of a class (the latter is the marginal value).
- An average-total approach like PJM’s derives class ratings by allocating all of the reliability value of the aggregate of all ELCC Resources using an allocation factor*.
- Marginal sets ratings with the marginal value.

	Total ELCC of Fleet	Avg-Total ELCC Rating	Marginal ELCC Rating
1 MW	0.6 MW	60.00%	60%
1,000 MW	500.0 MW	50.00%	40%
1,001 MW	500.4 MW	49.99%	40%
2,000 MW	800.0 MW	40.00%	20%
2,001 MW	800.2 MW	39.99%	20%
3,000 MW	900.0 MW	30.00%	0%
3,001 MW	900.0 MW	29.99%	0%



*These factors are based on further ELCC analysis.



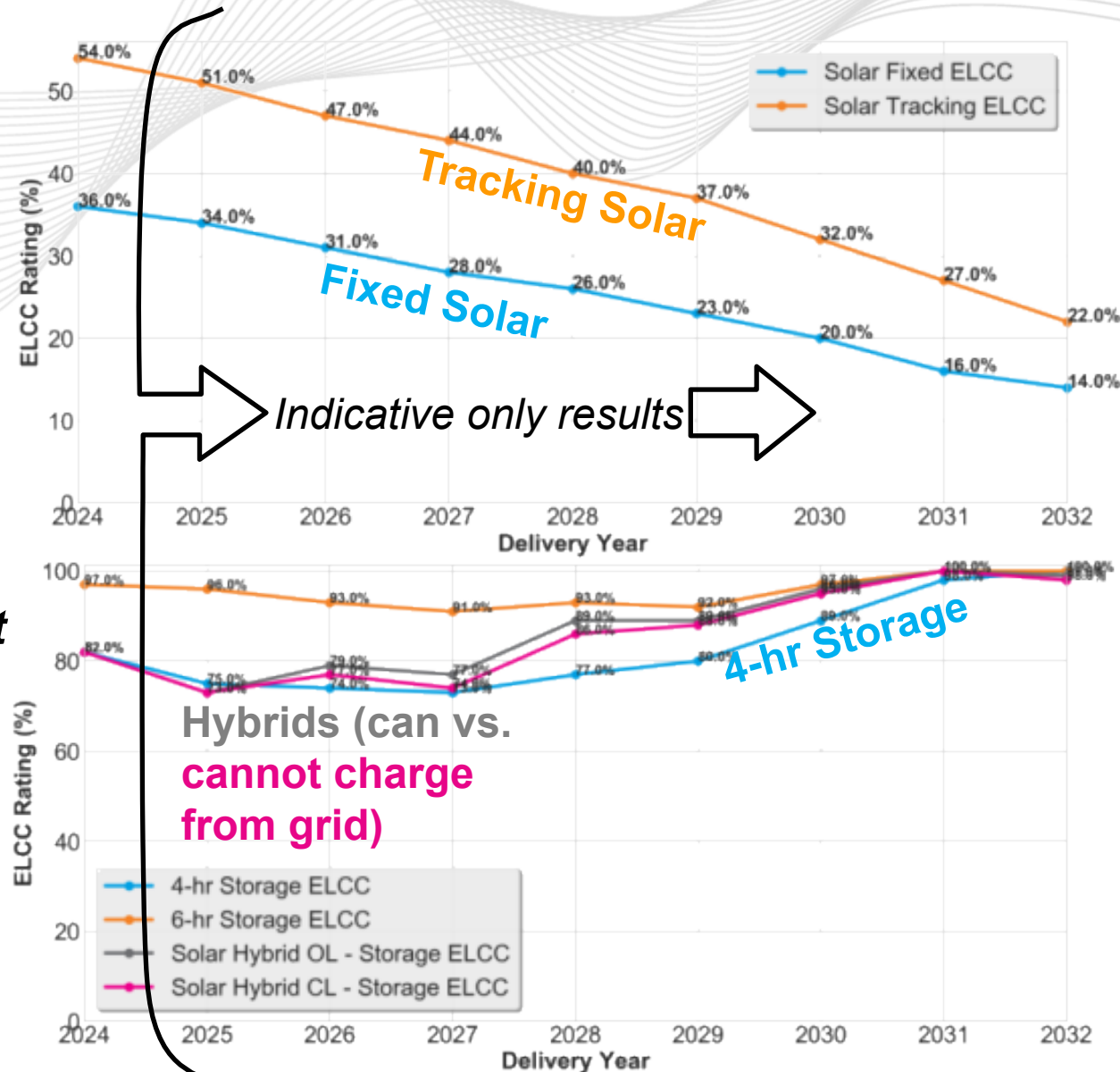
ELCC Procedure in PJM

- Starting June 1, 2023, PJM applies ELCC to all renewables and storage.
- ELCC ratings and capacity values recalculated annually for all auctions in the upcoming calendar year. ELCC report includes 10 years of results; t+5y thru t+10y are indicative only.

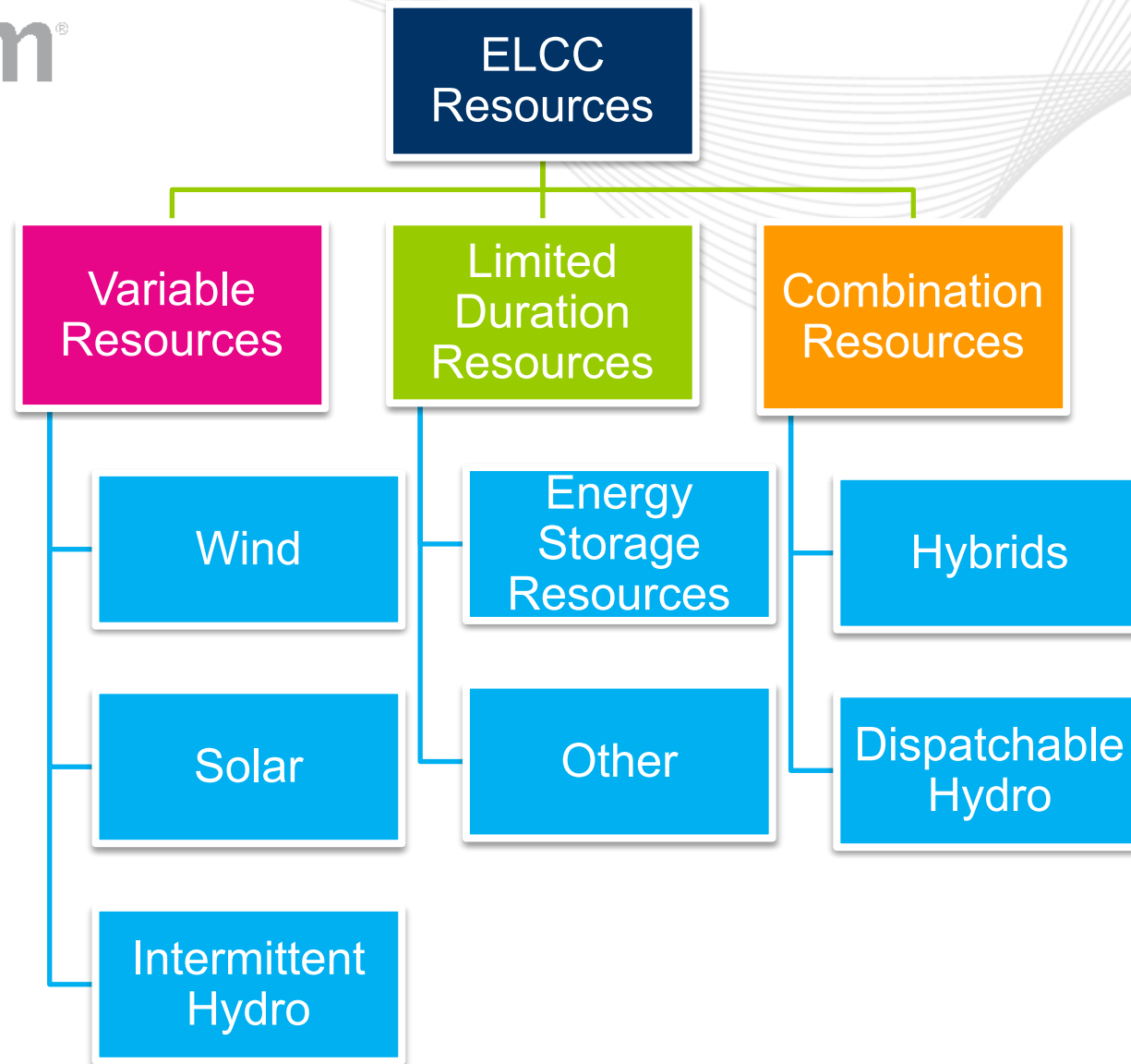
Capacity value =
Nameplate * Class Rating * Performance Adjustment

*“Performance Adjustment” is often close to 100%.
 Capacity value cannot exceed CIRs*

- Class-based approach includes, among others:
 - Onshore and offshore wind
 - Fixed and tracking solar
 - Dispatchable and intermittent hydro
 - Storage and hybrids



<https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2021.ashx>



- Variable Resources produce as high as they can (given wind/solar/water availability) almost all the time → historical output is evidence of energy availability.
- Other resource categories are assumed fully available up to max power all the time, and have output simulated based on physical limits.
 - *I.e., historical output is ignored.*
 - *Forced outages accounted for outside ELCC.*

Recall that: ELCC compares hourly output profile of a resource to simulated hourly system conditions to identify the capacity value.

1. Aggregate historical hourly output of Variable Resources since June 1, 2012 is used in ELCC Model.
 - Actual curtailments are included as-is.
 - Backcasts used for units in service after June 1, 2012. These are derived from unit configurations (e.g., wind turbine make and model, latitude and longitude) together with historical weather data.
2. ELCC model uses hourly profiles from (1) to derive “ELCC Class Rating”.
3. **Capacity Value of Variable Resources includes a unit-specific Performance Adjustment multiplier based on unit’s historical hourly output during peak shortage risk hours under rolling 10-year window (the “200CPx2” hours).**
 - Backcasts used for units not in service for 10 years.

1. Simulate hourly output based on physical capabilities and conditions in the simulation (e.g., high load, low wind and solar, high forced outages of Unlimited Resources).
 - Forced outages of Limited Duration Resources not included.
2. Derive Class Rating based on above.
3. **Apply (1-EFORd) multiplier to capacity value on a unit-specific basis downstream of model.**

1. Each hybrid and dispatchable hydro plant is quite distinct relative to others in its class.
2. Hourly output of each hybrid and dispatchable hydro plant is simulated based on actual plant characteristics
 - *For dispatchable hydro: water storage capability, discharge limits, and cascading relationships on a river.*
 - *For hybrids: actual relative size of gen and storage, internal plant limits like ability to charge from grid vs. not.*
3. Dispatchable hydro capacity value does not use a class rating, but instead uses a unit-specific ELCC analysis, which is then reduced by $(1-EFOR_d)$.
4. Hybrid capacity value is accredited based on the rating of the components, which are then summed. Performance factor applies to the components in the same way they would apply to standalone equivalents.

Demand Resources: Qualification and Accreditation

Demand Response is a consumer's ability to reduce electricity consumption at their location when wholesale prices are high or the reliability of the electric grid is threatened

Common examples of demand response include:

- Raising the temperature on a thermostat so the air conditioner does not run as often
- Slowing down or stopping production at an industrial operation
- Dimming/shutting off lights
- Customer owned generation that offsets load

Basically any explicit action taken to reduce load in response to short-term high prices or a signal from PJM

Wholesale Service	Demand Response	Price Responsive Demand (PRD)	Energy Efficiency
Capacity	Yes	Yes	Yes
Energy	Yes		
Day Ahead Scheduling Reserves (30 min) *	Yes		
Synchronized Reserves (10 min) *	Yes		
Regulation *	Yes		

Load Management (Emergency DR) is associated with Capacity and Energy.

Economic DR is associated with Day Ahead Scheduling Reserves (30 min) *, Synchronized Reserves (10 min) *, and Regulation *.

* Ancillary Service

New Peak Shaving Adjustment to PJM long term forecast started for 2022/2023 BRA

Firm Service Level Customers (FSL)

- Nominated Value = Peak Load Contribution – Firm Service Level
 - Annual capability is determined as the lesser of the summer and winter period capabilities
 - Excess summer capability may be offered as summer period CP

Guaranteed Load Drop Customers (GLD)

- Nominated Value = Guaranteed Load Reduction Amount
 - Annual capability is determined as the lesser of the summer and winter period capabilities
 - Excess summer capability may be offered as summer period CP

Nominated DR Value represents the ICAP Value of a DR Resource.

- All CSPs offering into an RPM Auction must provide to PJM a comprehensive DR Sell Offer Plan that encompasses both “existing” and “planned” DR
- A DR Sell Offer Plan documents the total DR Sell Offer quantities in a zone/sub-zone that a CSP intends to offer into an RPM Auction

$$**UCAP = ICAP * Forecast Pool Requirement**$$

DR Sell Offer Plan requirements are found in Attachment C of Manual 18



Energy Efficiency Resources: Qualification and Accreditation

- Installation of more efficient devices or equipment or implementation of more efficient processes/systems exceeding building codes, appliance standards, or other relevant standards at the time of installation as known at the time of the commitment to the capacity market.
- Designed to achieve a continuous reduction in electric demand at the End-Use Customer's retail site that is not reflected in the peak load forecast prepared for the Auction.

Recognized EE Installations


May Qualify

- Lighting
- Air Conditioner/Heat Pump – replacements or tune-ups
- Chiller replacements
- Appliance replacements (refrigerators)
- Motor replacements
- Variable Frequency Drives
- Building Weatherization
- Manufacturing process improvements

Permanent 

Not User Controlled 

Exceeds standards 

Demand Reduction during EE Performance Hours 

Won't Qualify

- Removing devices (e.g., delamping)
- Behavioral changes
- Reducing load by switching off devices
- Behind the meter generation (back up generator, cogeneration, Combined Heat & Power (CHP), renewable generation)
- Programmable Thermostats
- Fuel switching
- Replacing conventional compressor-driven chillers with absorption chillers (powered either by a dedicated heat source or waste heat from an industrial process).
- Appliance recycling programs (unless tied to replacement)

- Nominated EE Value is expected average demand reduction (MW) during the defined EE Performance Hours in the Delivery Year.
 - EE Performance Hours in the summer are between hour ending 15:00 EPT and hour ending 18:00 EPT during June 1 through August 31 (not including a weekend or federal holiday).
 - Winter performance hours are between the hour ending 8:00 EPT and hour ending 9:00 EPT, and between the hour ending 19:00 EPT and hour ending 20:00 EPT, during January 1 through February 28, not including a weekend or federal holiday).
 - The Capacity Performance value is the lower of the expected average load reductions during the EE Performance Hours and winter performance hours.
 - Excess summer capability may be offered as summer period CP

Nominated EE Value represents the ICAP Value of an EE Resource.

- M&V Plans due 30 days prior to start of each auction
- Post-Installation M&V reports due 15 days prior to start of each Delivery Year

$$UCAP = ICAP * Forecast Pool Requirement$$

EE M&V requirements are found in Sections 3 and 4 of Manual 18B

Aggregate Resources and Seasonal Capacity Performance Resources

- Capacity Resources which may not, alone, meet the requirements of a Capacity Performance product, may combine their capabilities and offer as a single Aggregate Resource
 - Applies to Intermittent Resources, Capacity Storage Resources, Demand Resources, Energy Efficiency Resources, and Environmentally-Limited Resources
- Resources being combined must reside in a single Capacity Market Seller account

Summer-Period CP Resources

- Summer Period DR
- Summer Period EE
- Capacity Storage Resource
- Intermittent Resource
- Environmentally-Limited Resource

- Available June-October & May of DY (summer-period)
- If clear, Auction Credit & commitment for summer-period only

Winter-Period CP Resources

- Capacity Storage Resource
- Intermittent Resource*
- Environmentally-Limited Resource*

* May request additional CIRs for winter-period for DY and offer additional ICAP value in winter-period

- Available November-April (winter-period)
- If clear, Auction Credit & commitment for winter-period only

Price Responsive Demand (PRD)

- Price Responsive Demand (PRD) is an annual capacity resource provided by a PRD Provider (CSP, EDC, or LSE) that represents customers that will reduce load based on price
 - Customer load must have a dynamic retail rate
 - PRD Provider must have the remote capability to decrease the load at each location to the required service level
 - Customer must reduce load to committed level within 15 minutes when a PJM Performance Assessment Interval has been declared and LMP at the applicable location has exceeded their price point

Peak Shaving Adjustment (PSA)

- Peak shaving programs receive no direct payment
- Value received as avoided capacity cost based on a shift in the Variable Resource Requirement (VRR) curve used in the Base Residual Auction (BRA) and Incremental Auctions (IA)
 - The Peak shaving program MW curtailment value submitted to PJM for a BRA cannot be later reduced in the IAs
- The zone receives the benefit of a lower load forecast
 - The EDC allocates the lower zonal forecast to all LSEs within its zone in accordance with its state-approved allocation methodology



Energy Market Obligations of Generation Capacity Resources

- Offers to sell into an energy auction have three basic pieces:
 - **Economic Minimum (ECOMIN)**—the least power the generator can provide while online.
 - **Economic Maximum (ECOMAX)**—the most power the generator can provide. This is the “offer quantity”.
 - The **offer price**—the price at which the generator is willing to sell electricity in the target interval. This can be higher prices for higher quantities (an “offer curve”).
- There are a variety of other **parameters** that indicate limited flexibility of units. Some (like ramp limits) can affect MW dispatch points, others (like minimum run time) affect the development of the on/off schedules called “unit commitment”.

What is the Energy Market Must Offer Obligation?

- Committed Generation Capacity Resources must offer their capability into the energy market. Tariff Attachment K Appendix Sec 1.10.1A(d):
“Market Sellers owning or controlling the output of a Generation Capacity Resource that was committed... and that has not been rendered unavailable by a Generator Planned Outage, a Generator Maintenance Outage, or a Generator Forced Outage **shall submit offers for the available capacity** of such Generation Capacity Resource, including any portion that is self-scheduled by the Generating Market Buyer.”
- After the Day Ahead market:
 - Committed Generation Capacity Resources that are not picked up in Day Ahead may be sold on a bilateral basis, self-scheduled, or offered for dispatch during the operating day (AttK Appendix Section 1.10.4(b)). Their schedules should remain available and the unit available for dispatch in real time unless it’s on an outage.
 - In real time, PJM may recall committed Generation Capacity Resources that are exporting to neighboring balancing authorities to instead serve PJM load (AttK Appendix Section 1.10.4(b) and 1.11.3(a)).

Attachment K Appendix Sec 1.10.1A(d):

“Such offers shall be based on the **ICAP equivalent of the Market Seller’s cleared UCAP capacity commitment...**”

Example:

- Unit A has an ICAP of 100 MW
 - Unit A’s UCAP is 90 MW
 - If Unit A is committed at its UCAP of 90 MW in the capacity market, it will be required to offer its ICAP of 100 MW in the energy market
-
- **ICAP:** Installed Capacity. Summer rated net capability, not to exceed Capacity Interconnection Rights.
 - **UCAP:** Unforced Capacity. $ICAP \cdot (1 - EFOR_d)$, where $EFOR_d$ is the forced outage rate.

Required Hourly MWh Offer Quantities for Intermittent Resources and Capacity Storage Resources

Attachment K Appendix Sec 1.10.1A(d):

“Such offers shall be based on the ICAP equivalent of the Market Seller’s cleared UCAP capacity commitment, provided, **however, where the underlying resource is a Capacity Storage Resource or an Intermittent Resource, the Market Seller shall satisfy the must offer requirement by either self-scheduling or offering the unit as a dispatchable resource, in accordance with the PJM Manuals, where the hourly day ahead self-scheduled values for such Capacity Storage Resources and Intermittent Resources may vary hour to hour from the capacity commitment.**”

- Such resources must offer all of their available committed capacity to PJM in the day ahead energy market.
- For wind and solar resources, this is their forecasted hourly output for the next day.
 - PJM develops a forecast for each wind and solar unit, and makes that forecast available to the provider in Markets Gateway for those units for use in day ahead offers.

- Offers designated “Maximum Emergency” are deployed during emergencies. This designation is narrowly limited (Attachment K Appendix Sec 1.10.1A(d)):

“Offers may only be designated as Maximum Emergency offers to the extent that the Generation Capacity Resource falls into at least one of the following categories:

- i) Environmental limits...
 - ii) Fuel limits...
 - iii) Temporary emergency conditions at the unit...
 - iv) Temporary megawatt additions. If a resource can provide additional megawatts on a temporary basis by oil topping, boiler over-pressure, or similar techniques, and such megawatts are not ordinarily otherwise available.”
- Scenarios that do not meet criteria for temporary MW additions:
 - Increased wear and tear or maintenance costs
 - Power augmentation such as duct firing, steam/water injection, evaporative cooling, inlet chilling, wet compression, or peak firing unless OEM specified limitations
 - Inability to provide temporary MWs on demand

- **Status quo:** All Generation Capacity Resources must offer the Synchronized Reserves they are physically capable of providing (Manual 11 Section 4.2.1).
- **Reserves filing** (currently pending): all Generation Capacity Resources must offer all the synchronized reserves, non-synchronized reserves, and secondary reserves (all both in Day-Ahead and Real-Time) they are physically capable of providing.
 - *Energy Storage Resources and hydro resources calculate their own quantities, otherwise the quantities are determined by PJM.*

- Generators use parameters like minimum run time, start-up time, etc. to indicate to PJM limitations on flexibility. These will be respected in on/off schedules (“unit commitment”).
- Generation Capacity Resources must submit different sets of certain parameters: one for use during normal conditions, and one for use during unusual conditions. The latter set, called “parameter-limited schedules”, are approved by PJM.
- Parameter Limited Schedules can apply when:
 - PJM declares a Maximum Generation Emergency.
 - PJM issues an alert or schedules in anticipation of a potential Maximum Generation Emergency, Hot Weather Alert, or Cold Weather Alert.
 - The owner fails the market power test (the “Three Pivotal Supplier” test) in the energy market.
- See Manual 11 Section 2.3.4.5 and Tariff Attachment K Appendix Section 6.6

Performance Obligations

- **CP Non-Performance Assessments**
 - Measures the performance of resources during certain emergency conditions that trigger **Performance Assessment Intervals (PAIs)**
 - Committed Capacity Resources that fail to perform during PAIs are subject to Non-Performance Charges, and resources (capacity of energy-only) that over-perform may be eligible for Bonus Performance Credits
- **Other Performance Assessments**
 - Resource Commitment Compliance: Determines if sufficient unforced capacity on resource during Delivery Year to meet its commitments
 - Generation Rating Test: Determines if generation resource demonstrated its ICAP commitment amount through summer and winter testing
 - DR Load Management Test Compliance: In the absence of a CP event, measures the reduction level of committed demand resources
 - EE Measurement and Verification (M&V) Audit: Confirms the nominated capacity value of an EE resource through a post-installation M&V audit

OATT, Attachment DD, Section 5.5A Capacity Resource Types

- “Capacity Performance Resources are Capacity Resources which, to the extent such resources cleared in a Reliability Pricing Model Auction or are otherwise committed as a Capacity Resource, are obligated to deliver energy during the relevant Delivery Year as scheduled and/or dispatched by the Office of Interconnection during the Performance Assessment Intervals.”
- “Capacity Performance Resources that fail to meet this obligation will be subject to a Non-Performance Charge, unless excused pursuant to Tariff, Attachment DD, section 10A(d)t.”

Performance windows for certain resource types:

- Summer-Period CP Resources: June – October and following May of Delivery Year
- Winter-Period CP Resources: November – April of Delivery Year
- Demand Resources: 10 AM – 10 PM (Jun – Oct. and following May); 6 AM – 9 PM (Nov. – Apr.)

Performance Assessment Intervals

- Performance Assessment Interval (PAI) shall mean each Real-time Settlement Interval for which an Emergency Action has been declared by PJM.
- Emergency Actions shall mean any emergency action for locational or system-wide capacity shortages that either utilizes pre-emergency mandatory load management reductions or other emergency capacity, or initiates a more severe action.
- Performance is assessed for each interval that PJM declares specific actions or warnings.
- Compare a resource's Expected Performance against Actual Performance for each Performance Assessment Interval.

Performance Assessment Interval (PAI) shall mean each Real-Time Settlement Interval for which an Emergency Action has been declared by PJM.

PAI Triggers:

Steps 1–10 in Sections 2 and 5 of Emergency Procedures Manual 13

- Pre-Emergency Load Management Reduction Action (30, 60 or 120 minutes)
- Emergency Load Management Reduction Action (30, 60 or 120 minutes)
- Primary Reserve Warning
- Maximum Generation Emergency Action
- Emergency Voluntary Energy-Only Demand Response Reduction Action
- Voltage Reduction Warning & Reduction of Critical
- Curtailment of Non-Essential Building Load
- Deploy All Resources Action
- Manual Load Dump Warning

■ Warnin
■ gs
 Actions

Section 5.7 of Emergency Procedures Manual 13

- Load Shed Directive

Hot Weather Alerts and Cold Weather Alerts **ARE NOT** triggers

- Performance assessment encompasses all resources (including energy-only) located in the area defined by the Emergency Action
 - When Emergency Procedures are called for the RTO or a given Zone, all resources in the defined region included in assessment
 - For sub-zonal events that are a result of a transmission-related emergency, the list of units assessed are based on ability to help the constraint
 - Performance of Demand Resources is only evaluated if dispatched for 30 minutes or more of the clock hour
 - External Generation Capacity Resources included in the assessment if such external resources would have helped resolve the declared Emergency Action

Resource Type

Expected Performance

Generation Capacity Resource	Committed UCAP * Balancing Ratio
Demand Resource	Committed ICAP <i>(adjusted to account for linked registrations that were not dispatched)</i>
Energy Efficiency Resource	Committed ICAP
Price Responsive Demand <i>(effective with 2022/2023 DY)</i>	Nominal PRD Value Committed <i>(adjusted to account for any PRD registrations in the Emergency Action Area that were not subject to compliance measurement)</i>
Qualifying Transmission Upgrade	Committed UCAP
Energy-Only Resources	0 MW
Energy Imports	0 MW

Expected Performance during a PAI is calculated based on resource type and CP commitments on the day of PAI.

Resource Type	Actual Performance
Generator/Storage	Metered Energy Output + Reserve/Regulation Assignment
Demand Response	Load Reduction + Reserve/Regulation Assignment
Energy Efficiency	PJM Approved Post Installation Load Reduction
Qualifying Transmission Upgrade (QTU)	Committed UCAP value if in service, otherwise 0 MW
Net Energy Imports	Net Energy Imports – Net Energy Exports – Energy from External Generation Capacity Resource. If negative, actual performance is 0 MW.
Price Responsive Demand (PRD) *	The sum of the actual load reduction for PRD registrations measured for compliance

* Effective in the 2022/2023 Delivery Year

Initial Performance Shortfall =

$$\begin{array}{ccc} \text{Expected} & - & \text{Actual} \\ \text{Performance} & & \text{Performance} \end{array}$$

- **Positive number** indicates potential under-performance (shortfall)
- **Negative number** indicates potential over-performance (Bonus Performance)

- Performance shortfalls are determined for each PAI separately
- A positive initial performance shortfall may be adjusted downward due to Excused MW:
 - Approved Generator Planned Outage or Generator Maintenance Outage
 - Not scheduled to operate or scheduled down (unless this was due to an operating parameter limitation or submission of a market-based offer higher than cost-based offer)
- Note: Performance of Demand Resources in the PAI is netted within a seller's portfolio to determine a net positive or negative shortfall MW for the seller

Committed resource with a positive Final Shortfall MW for PAI/PAI Area is subject to **Non-Performance Charge =**

**Final Shortfall
MW for PAI/PAI
Area**



**Non-Performance
Charge Rate
(\$/MW-interval)**

Non-Performance Charge Rate is based on yearly Net CONE (for CP commitments), a divisor (i.e., an assumed 30 Emergency Action hours per year), and the number of Real-Time Settlement Intervals in an hour.

CP Non-Performance Charge Rate (\$/MW-interval) =

$[(\text{LDA Net CONE } (\$/\text{MW-day in ICAP terms}) \text{ for which the resource resides} * \text{ Number of days in DY}) / 30] / \text{ Number of Real-Time Settlement Intervals in an hour.}$

If LDA Net CONE = \$300/MW-day,

the Non-Performance Charge Rate =

$[(\$300/\text{MW-day} * 365 \text{ days}) / 30] / 12 = \$304.17/\text{MW-interval}$

Modeled LDAs and respective Net CONE values are provided in DY BRA Planning Parameters posted on Capacity Market (RPM) web page.

- Stop-loss provisions limit the total Non-Performance Charge that can be assessed on each Capacity Resource.
- **The maximum yearly Non-Performance Charge =**
 $1.5 * \text{Applicable LDA Net CONE} * 365 \text{ days} * \text{max daily CP UCAP MW}$
 commitment from June of the Delivery Year through the end of the billing month for which the Non-Performance Charge was assessed.

Stop-loss for Seasonal Capacity Performance Resource considers the number of days in the applicable season .

- Revenue collected from payment of Non-Performance Charges is distributed to resources (of any type, even if they are not Capacity Resources) that perform above expectations during each PAI.
 - The credit is based on the ratio of its Bonus Performance quantity to the total Bonus Performance quantity (from all resources and PRD Providers for the same PAI).
 - The bonus performance credit rate on a per MW basis may fall below the penalty rate, particularly when there are a large number of Excused MW during a PAI

SME/Presenter:
Paul Scheidecker
Paul.Scheidecker@pjm.com
Andrew Levitt
Andrew.Levitt@pjm.com
Pat Bruno
Patrick.Bruno@pjm.com

RASTF Facilitation:
Dave Anders
David.Anders@pjm.com

**RASTF KWAs #4, #5, and #6
(Performance Obligations, Qualification
and Accreditation, and Energy Market
Obligations)**



Member Hotline
(610) 666 – 8980
(866) 400 – 8980
custsvc@pjm.com

**PROTECT THE
POWER GRID**
**THINK BEFORE
YOU CLICK!**



Be alert to
malicious
phishing emails.

Report suspicious email activity to PJM.
(610) 666-2244 / it_ops_ctr_shift@pjm.com

