

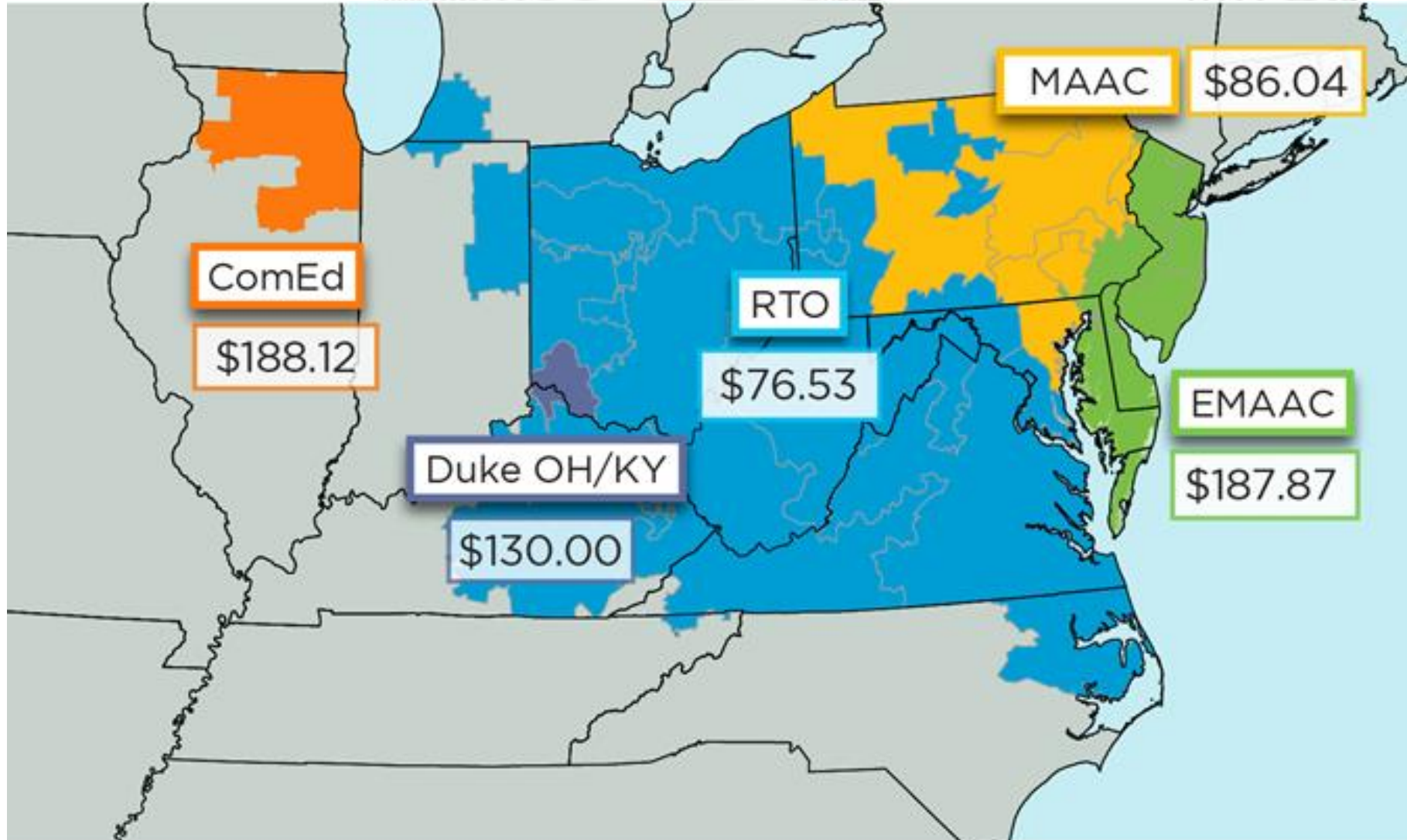


Intermittent Resource Participation in RPM for 2020/21 and beyond

March 5, 2018

- Effective with the 2020/2021 Delivery Year, PJM will only procure Capacity Performance Resources in each auction
- Capacity Performance Resources must be capable of sustained, predictable operation that allows resource to be available to provide energy and reserves during performance assessment hours throughout the Delivery Year
- Intermittent Resources, Capacity Storage Resources, Demand Resources and EE Resources are categorically exempt from the RPM CP must-offer requirement
 - Intermittent Resources are generation resources with output that can vary as a function of its energy source, such as wind, solar, landfill gas, run of river hydroelectric power and other renewable resources

- Participate as stand-alone resource at levels that recognize risk of non-performance based on expected output during Performance Assessment Hours
 - Not offering or offering at lower CP commitment quantity reduces risk of non-performance during PAHs and increases quantity eligible for Bonus Performance during PAHs (Bonus Performance MWs for actual energy delivered above committed quantity)
 - Lower capacity market revenues offset by additional revenues during PAHs
- Combine with other intermittent/storage/seasonal-limited DR/EE resources to form an Aggregate Resource representing the aggregated UCAP value of the individual resources
- Submit seasonal capacity sell offer into an auction and auction clearing algorithm clears seasonal sell offers to ensure equal quantities of opposite seasonal capacity are cleared



	Annual	Summer	Winter	Total
Generation	155,572.4 MW	6.2 MW	397.9 MW	155,976.5 MW
DR	7,531.5 MW	288.9 MW		7,820.4 MW
EE	1,607.4 MW	102.8 MW		1,710.2 MW
Total	164,711.3 MW	397.9 MW	397.9 MW	165,109.2 MW*

* Annual Commitments = 164,711.3 MW + 397.9 MW

Intermittent/Renewable Participation Cleared MW (UCAP)

	Annual	Summer	Winter	Total
Wind	504.3 MW	0	383.4 MW	887.7 MW
Solar	119.1 MW	6.2 MW	0	125.3 MW
Hydro	6,274.5 MW	0	14.5 MW	6,289 MW

- 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
- Seller may offer the Aggregate Resource as Capacity Performance at a UCAP value that is representative of a capacity performance product (not to exceed the sum of the CIR value/UCAP value of the individual resources that make up the aggregate)

- The committed quantity of an Aggregate Resource must be allocated on a monthly basis to the underlying capacity resources prior to the start of the Delivery Year and may be updated no later than the last day of each month for months remaining in the Delivery Year
 - The quantity allocated to an underlying resource is used to determine the Expected Performance of each underlying resource located in a PAH area
- Performance of an Aggregate Resource for a given PAH is based on the net of the performance of the individual underlying resource that were required to perform during the PAH (i.e. the resources located in the PAH area)
- Non-Performance Assessment Charges/Credits are assessed to the Aggregate Resource – not to the individual resources

- If individual resources are located in different modeled LDAs:
- For BRA modeling and compensation, the Aggregate Resource is placed in the smallest LDA common to each individual resource

Examples:

- Aggregate Resource modeled in EMAAC if one resource in PECO zone and second resource in PSEG Zonal LDA
- Aggregate Resource modeled in MAAC if one resource in EMAAC and second resource in SWMAAC
- Aggregate Resource modeled in rest of RTO if one resource in ComEd Zonal LDA and second resource in EMAAC
- The Aggregate Resource receives the RPM auction clearing price applicable to the modeled location

- The non-performance charge rate for an under-performing Aggregate Resource is based on the rate associated with the LDA in which the under-performing underlying resources are located weighted by the under-performance MW quantity of such resources
 - The stop-loss of the Aggregate Resource however is based on the non-performance charge rate associated with the LDA in which the Aggregate Resource was modeled in the RPM auction
- An Aggregate Resource commitment may be removed or reduced via replacement transaction based on the modeled LDA of the Aggregate Resource
 - the allocation of the Aggregate Resource commitment to the individual resources must be updated to reflect new total commitment level upon submittal of the replacement transaction

- Additional stand-alone participation mechanism for resources with seasonal capability
- Mechanism is available to the same resource types that are eligible to form an Aggregate Resource but that do not do so prior to a BRA:
 - Intermittent Resources, Capacity Storage Resources, Environmentally-Limited Resources, summer-only DR Resources and summer-only EE Resources
- Seasonal CP Resource sell offers consist of:
 - Summer-period sell offers which take on a commitment and performance obligation for months of June thru October and following May if cleared
 - Winter-period sell offer which takes on a commitment and performance obligation for months of November thru April if cleared

- Intermittent Resources, Capacity Storage Resources and Environmentally-Limited Resources may submit a sell offer for CP capacity (i.e. annual capability) and a separate sell offer for either summer-period capacity or winter-period capacity
 - Up to total sell offer quantity for each season of no greater than the lower of the resource's UCAP Value or the resource's "seasonal" CIR value
- Summer-only DR and summer-only EE may submit summer-period CP sell offer
- Cleared Seasonal CP Resource sell offers receive a daily auction credit for each day of the applicable commitment period based on cleared UCAP MW and the auction clearing price applicable to the resource
- non-performance charge rate based on the physical location of the resource that clears a Seasonal CP Resource sell offer

- Auction clearing algorithm will clear all annual CP sell offers, summer-period CP sell offers and winter-period CP sell offers simultaneously to minimize bid-based cost of satisfying the reliability requirements of the RTO and each modeled LDA subject to all applicable requirements and constraints, including:
 - LDA CETL values (same as today)
 - Total cleared summer-period sell offers must exactly equal total cleared winter-period sell offers across the entire RTO (new constraint to ensure that seasonal CP sell offers clear to form annual CP)
- Equal matching of cleared opposite-season sell offer quantities is not enforced at the LDA level; however, only equally matched quantities of opposite-season sell offers within an LDA are considered as satisfying the LDA's reliability requirement
 - Unmatched cleared quantities are effectively "moved" to the next level LDA until a match is found
 - Only the equally matched cleared quantity within each LDA may receive that LDA's price (within this group, those resources with the lowest sell offer price will receive the LDA price; and remaining cleared capacity is effectively moved to the next higher level constrained LDA for price determination purposes)
- If the clearing price applicable to a cleared seasonal CP sell offer is less than the sell offer price, the resource receives a make-whole payment equal to the difference

- Generation resource types that are eligible for aggregation may request winter CIRs
- Process to request, study and allocate winter CIRs is currently on a year-by-year basis
- Requested winter CIRs for the 2021/2022 delivery year have been evaluated and allocated and may be utilized in the upcoming 2021/2022 BRA

Appendix

- Aggregate Resource Request Process for “Commercial” Aggregation
- Example of cross-LDA Commercial Aggregate Resource including example PAH

See Manual 18 – Section 4.9 for Additional Information

- Market Seller that intends to create an Aggregate Resource must submit a written email request to rpm_hotline@pjm.com at least two weeks prior to the opening of the RPM.
- Requests must specify:
 - Capacity resources that are being combined to form the Aggregate Resource
 - Installed capacity owned on each generation resource
 - Nominated DR Value for each Demand Resource
 - Nominated EE Value for each EE Resource
 - Requested UCAP value for Aggregate Resource
- Requests should include explanation of how aggregation allows one or more of the resources that are being combined to realize a higher level of CP (in UCAP MWs) than the individual resources could provide themselves, supporting data for the CP level of the aggregate resource & initial MW allocation among component resources
- PJM will review requests and provide notification to Market Seller of the UCAP value approved for the Aggregate Resource.
- PJM will model the Aggregate Resource in the eRPM system for the relevant Delivery Year.
- Once Aggregate Resource is modeled, the Market Seller will not be able to offer into RPM Auction or transact bilaterally for the relevant Delivery Year those individual resources that make up the Aggregate Resource.

	Wind	Solar	Aggregate Resource
Nameplate Capacity	100 MW	100 MW	n/a
UCAP Value (CIR value)	13 MW	38 MW	51 MW
Zone	ComEd	JCPL	n/a
Modeled LDA	ComEd	EMAAC	Rest of RTO
Avg output: summer performance hours	13 MW	38 MW	51 MW
Avg output: winter performance hours	40 MW	2 MW	42 MW
Assumed CP Offer MW of Example (Avg output of most limited season)	13 MW	2 MW	42 MW

- Existing rules do not permit aggregation of above resources since located in different modeled LDAs
- Proposed changes would permit aggregation of above resources and would model the Aggregate Resource in the rest of RTO area for RPM auction clearing and pricing perspective
- Example** – Assume Aggregate Resource above offers and clears 42 MW in BRA

- Assume Aggregate Resource of prior slide offers and clears 42 MW and allocates the 42 MW commitment to the individual resources based on expected seasonal performances as:

		Commitment Allocation (UCAP MW)	
Resource	LDA	Summer Period	Winter Period
Solar	EMAAC	32	29
Wind	ComEd	10	13*
Aggregate	Rest of RTO	42	42

* Performance expectation assigned to underlying resource cannot exceed the CIR value of the resource

Example #1: RTO-Wide Emergency Action in summer period
Assume Balancing Ratio = 1.0

Resource	LDA	Output (MW)	Expected Performance (MW)*	Actual Performance (MW)	Performance (MW)
Solar	EMAAC	34	32	34	2
Wind	ComEd	5	10	5	-5
Aggregate	Rest of RTO				-3

- Aggregate Resource performance based on net performance of all underlying individual resources since all were located in PAH area
- Aggregate Resource assessed non-performance charge based on 3 MW under-performance at non-performance charge rate associated with ComEd LDA (100% weighting of the LDA associated with the non-performing underlying resource in this example)

*Expected Performance equals Balancing Ratio times Allocated Commitment MW applicable to the season (see prior slide)