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Independent System Operator

Hybrid Storage: Energy Market Participation rules for Co-located Storage Resources

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Energy Market Design

ICAPWG/MIWG

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WebEx

Agenda

- Project Background
- Continued discussions on NYISO proposal for participation options
- Definitions
- Energy Market participation rules for Co-located Storage Resources
  - Metering and Settlement rules will be discussed at a later ICAPWG/MIWG
- Next Steps and Timeline

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Previous Presentations

Date	Working Group	Discussion Points and Links to Materials
01-13-20	ICAPWG/MIWG	Hybrid Storage Model Project Kick-Off https://www.nyiso.com/documents/20142/10252714/Hybrid%20Storage%20Model_MIWG_Jan%2013%202019.pdf/caf29abe-a431-a2d1-358d-43326153824a
04-14-20	ICAPWG/MIWG	Hybrid Storage Model – Initial Market Design Concept Overview https://www.nyiso.com/documents/20142/11904936/Hybrid%20Storage%20Model%20MIWG%2004142020%20Final.pdf/08841944-5251-4497-c52b-105151f150ad
05-11-20	ICAPWG/MIWG	Hybrid Storage Interconnection Proposal https://www.nyiso.com/documents/20142/12465245/Hybrid%20Storage%20Interconnection_0511%20MIWG_ICAPWG_FINAL.pdf/0740db02-ac07-e7f4-42b4-0b17da0e82eb
06-30-20	ICAPWG/MIWG	Hybrid Storage: Proposal for participation options https://www.nyiso.com/documents/20142/13434223/Hybrid%20Storage%206.30.2020%20ICAPWG_MIWG%20draft%20v5_final.pdf/176a272a-cc21-08ef-749a-c4a157fe2bc3

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Project Background

A Grid in Transition – The Plan

- **Carbon Pricing**
- **Comprehensive Mitigation Review**
- **DER Participation Model**
- **Energy Storage Participation Model**
- **Hybrid Storage Model**

Aligning Competitive Markets and New York State Clean Energy Objectives

- **Enhancing Energy & Shortage Pricing**
  - Ancillary Services Shortage Pricing
  - Constraint Specific Transmission Shortage Pricing
  - Enhanced Fast Start Pricing
- **Review Energy & Ancillary Services Product Design**
  - More Granular Operating Reserves
  - Reserve Enhancements for Constrained Areas
  - Reserves for Resource Flexibility

Valuing Resource & Grid Flexibility

- **Enhancements to Resource Adequacy Models**
- **Revise Resource Capacity Ratings to Reflect Reliability Contribution**
  - Expanding Capacity Eligibility
  - Tailored Availability Metric
- **Capacity Demand Curve Adjustments**

Improving Capacity Market Valuation

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Project Background

- This project seeks to explore market participation option(s) for co-located front-of-the-meter generators and energy storage resources (i.e. Hybrid Storage Resources)
  - Incentives along with improvements in flexibility and availability are motivating developers to couple generation resources with storage resources
- The NYISO identified three participation models at the June 30, 2020 MIWG/ICAPWG:
  - Option 1 – Co-Located Storage Resources
  - Option 2 – Aggregated Hybrid Storage Resources
  - Option 3 – Forecasted Hybrid Storage Resources
- Modifications to existing market rules will be developed to accommodate Co-Located Storage Resources by the end of 2020

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Continued discussion on proposal for Participation Options

Issues with an Intermittent Hybrid Model

- **Stakeholders had requested NYISO to consider an Intermittent like model for Hybrid storage projects comprising of an Intermittent resource coupled with a storage resource.**
  - Accommodating hybrid resources within the NYISO's participation model for intermittent resources and allowing them the same settlement structure could lead to potential issues as described in this and subsequent slides
- **The NYISO's participation model for intermittent resources is designed to accommodate the weather-dependent nature of these resources' fuel.**
  - The NYISO strives towards an accurate forecast of intermittent output, but imperfections remain, as with any weather forecast, which can cause operational challenges
    - For example, undergeneration/overgeneration can lead to reserve shortages, transmission constraints, non-optimal use of other resources, etc.
  - Because forecasting only serves to predict intermittent output, supply uncertainty is increased by the addition of storage to intermittent facilities without the ability to schedule those assets
- **Since the storage component of a co-located facility is dispatchable, it is important to the NYISO that this capability be available for commitment**
  - The ability to schedule dispatchable resources is critical to maintaining system reliability and market efficiency, as described in the examples on the following slides

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Issues with an Intermittent Hybrid Model: Example 1

- **Suppose a penetration of intermittent hybrid facilities at 1000MW, consisting of 800MW of wind and 200MW of storage**
  - HB 10:00 – NYISO intermittent forecast predicts 600MW of wind output in hour 10
  - HB 10:15 – Gas Plant trips resulting in a loss of 150 MW, leading to sharp LBMP spike
  - HB 10:16 – The market software attempts to make up for the lost energy by converting reserves to energy
  - HB 10:20 – In order to capture this high LBMP, all 200MW of storage decides to inject at the hybrid POIs, which NYISO market software did not anticipate
    - This additional injection could cause reliability issues such as overloads on the transmission system
  - HB 10:25 – Total injection at hybrid facilities is now 800MW instead of the anticipated 600MW. The market software would have committed 150 MW to make up for the gas plant trip. This results into a surplus 200 MW which would cause LBMPs to drop and the market software would now have to resolve this surplus. Such scenarios could result into a greater price volatility in the market
    - Regulation would need to be used to make up for this additional overgeneration between RTD runs to avoid impacts to NERC BAAL and CPS standards compliance. This additional volatility would require additional regulation procurement.

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Issues with an Intermittent Hybrid Model: Example 2

- **Penetration of hybrid facilities at 1000MW, consisting of 800MW of wind and 200MW of storage**
  - HB 10:00 – NYISO intermittent forecast predicts 600MW of wind output in hour 10
  - HB 10:15 – Sharp LBMP drop driven by a large influx of imports or loss of load
  - HB 10:16 – The market software attempts to tackle over generation through regulation down and/or redispatch of resources
  - HB 10:20 – In order to take advantage of the low LBMP, all 200MW of unscheduled storage decides to withdraw at the hybrid POIs, which NYISO market software did not anticipate
  - HB 10:25 – Wind output is 600MW as forecasted, but total injection at hybrid facilities is now 400MW instead of the anticipated 600MW (due to the 200MW storage withdrawal). The market software would now have to resolve the 200MW deficit. This could result into a greater price volatility in the market
    - This example has similar reliability concerns as the previous example
- **While the NYISO currently manages the possibility of sudden fluctuations in intermittent output, the additional uncertainty from unscheduled storage injection leads to unnecessary incremental operational challenges, which could be avoided by retaining the dispatchability of the storage units**
  - Excluding the dispatchable component of a hybrid resource from the requirements that apply to all other dispatchable resources and permitting them to freely chase price would be expected to increase volatility, which is the opposite of what NYISO will need when it relies upon more intermittent renewable resources to provide Energy to New York
  - It also removes the storage units from being able to provide reserve and regulation services in the markets

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Forecasted HSR Option

- **As presented at the 6/30/20 MIWG, the NYISO developed this option in order to address some of the challenges described on prior slides**
  - This HSR would have a single PTID, bid, schedule, and settlement
  - Schedules would be derived from the NYISO's forecast for the intermittent component of the HSR
  - The HSR would be expected to follow NYISO dispatch signal at all times or be subject to over/under generation charges
- **This option would fulfill the objective of utilizing storage to reduce variability in intermittent output, which would provide value for grid reliability as well as reducing consumer costs**
  - Enhancing the predictability of intermittent output would reduce out-of-market actions, reserve shortages, and other reliability measures that increase costs for consumers
- **If there is stakeholder interest, a future phase of the project could explore the possibility to develop additional detail on this option**

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Making Co-located option technology neutral

- **Co-located option requires the implementation of a new constraint in the market software**
  - Making it technology neutral will require confirming the feasibility of scheduling constraint for different generator types coupled with energy storage, and identify the associated implications. The effort could delay the deployment timeline for the project
- **For the 2020 efforts , the NYISO plans on developing market rules to accommodate intermittent renewables plus storage only**
  - A future phase of the project could explore the possibility to make the co-located option technology neutral

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Definitions

Definitions

- **Hybrid Storage Resource (HSR):** A combination of generation and energy storage units co-located behind a single Point of Interconnection, that participates in the wholesale market as a single resource with a single PTID. Resources co-located with load shall not qualify as a HSR.
- **Co-located Storage Resource (CSR):** A combination of a single intermittent renewable generation unit and a single energy storage unit co-located behind a single Point of Interconnection, that participates in the wholesale market as distinct resources. Resources co-located with load shall not qualify as a CSR.
- **Other definitions:**
  - **CSR Injection limit (CSR IL):** It is the maximum output of the Co-located Storage Resource at the AC point of interconnection
  - **Units:** Resources within the HSR and CSR are referred as units. Each unit shall only consist of resources that have common operating characteristics and use a common fuel type
  - **Unit Injection Limit (Unit IL) :** It is the maximum AC output available from the unit. Registered UOL for each unit should be equal to or less than its individual injection limit
  - **CSR Scheduling constraint:** It is the software constraint to determine Energy, Operating Reserve, and Regulation Service schedules for different units in a CSR. The sum of Energy, Operating Reserves and Regulation Service schedules for all units shall be less than or equal to the CSR Injection Limit

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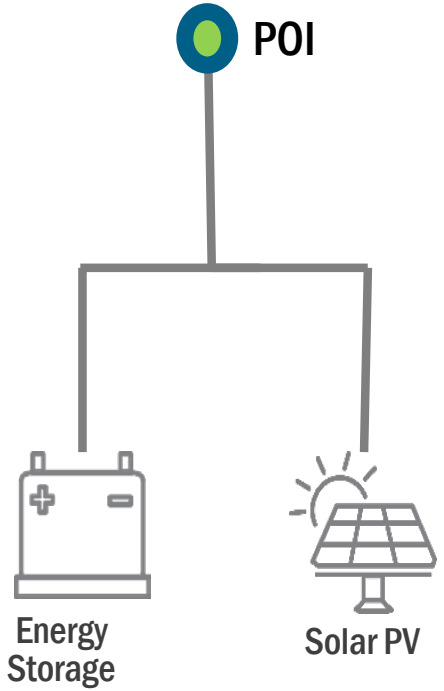
Energy Market Participation rules

Co-located Storage Resource (CSR): Design Overview

- Each unit within a CSR will have a distinct PTID/bid/schedule/settlement
- Units will participate under their own participation model. In the illustrative example shown here, Solar PV will participate as an Intermittent Power resource(IPR) and Energy Storage will participate under Energy Storage Resource (ESR) model
  - Only ESR unit would be eligible to provide ancillary services
- The NYISO plans to utilize a CSR scheduling constraint to determine feasible energy and reserve schedule for units within the CSR
- All units within a CSR will be settled at the LBMP at POI



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Resource Registration

Registration rules for CSR

- **The entity(s) operating the CSR, will be responsible to register all parameters pertaining to CSR and its units.**
- **CSR Registration Parameters:**
  - Following new registration parameters are proposed to be added for CSR:
    - CSR Injection Limit (MW)
    - CSR Generation Capability (MW)
    - CSR Storage Capability (MW)
    - No. and type of units
- **Registration rules and parameter requirements for each unit within the CSR depends upon the participation model used by them**
  - The NYISO is not proposing any new registration parameters for units within the CSR at this time

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Energy Market Bidding

Energy Market Bidding for CSRs

- Market Participant(s) operating the CSR will submit separate bids for each unit participating in the NYISO wholesale market
- Bidding rules and parameter requirements depends upon the participation model used by the units within the CSR
  - For the ESR unit, bidding rules and parameter requirements under ESR model will be applicable
  - For IPR unit, bidding rules and parameter requirement for specific IPR resource will be applicable
- CSR Injection limit shall not be a biddable parameter
- All desired charging/injecting operations for ESR may be reflected through the bids

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Energy Market Bidding for CSRs

- **Similar to other generators, CSR will be able to bid in both Day Ahead and Real Time markets.**
- **Minimum offer size for Energy and Ancillary Services:**
  - 1 MW for generation units;
  - 100 kW for ESR unit
- **The Bidding process will be same as currently applicable to different resource types**
  - In Real time, bids are locked 75 minutes prior to the operating hour.

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Operating and Energy Level modes for CSRs

- Unit operation modes available to each resource type within CSRs are consistent with existing rules

	Unit type	Unit Operation mode	Energy Level mode
Co-located Storage Resource	IPR	Wind: ISO-Committed Flexible; Solar: Self-Committed Fixed[1]	NA
	ESR	ISO-Committed Flexible/Fixed[2]; Self-Committed Flexible/Fixed	Self-managed/ISO – managed

1. Unit operation mode for Solar will change once Solar on Dispatch is implemented
2. ISO committed Fixed is allowed only if qualified by the NYISO (taken from ESR rules)

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Energy Market Scheduling

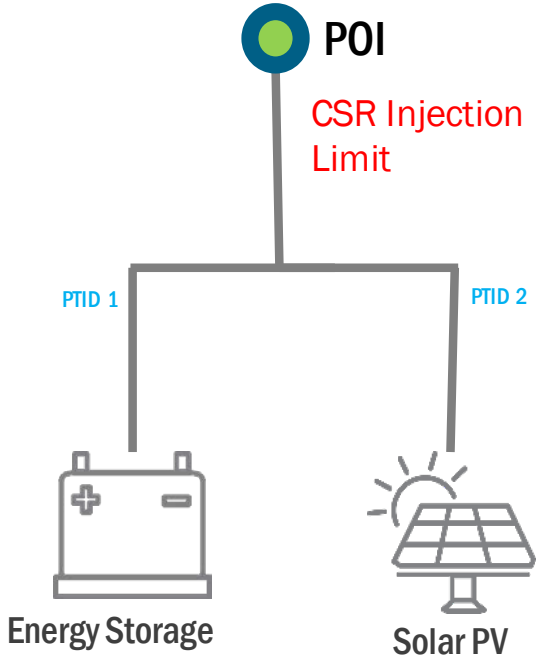
Energy Market Scheduling for CSR

- **Basepoints will be sent to individual units**
- **NYISO will determine energy and reserve schedule for units within the CSR**
  - The NYISO is evaluating the feasibility of imposing an CSR scheduling constraint to determine energy and ancillary services schedules for different units within the CSR

Assuming n components within the HSR

$$\sum_{comp=1}^{n} \left(Energy_{comp} + Reserves^{*}_{comp} + Regulation^{*}_{comp}\right) \leq CSR\ Injection\ Limit$$

  - Other scheduling constraints applicable to each generation unit shall continue to apply
  - The NYISO is evaluating if headroom on the POI will need to be reserved to allow for variation in the IPR and still maintaining the ability to deliver reserves and regulation



*Please note that IPRs are not eligible to provide reserves and regulation

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Energy Market Scheduling for CSR

- Confirming the feasibility of implementing the CSR scheduling constraint, and identifying the associated implications is in progress
- CSR Injection Limit could constrain economic output from one or more units associated with the CSR, similar to other constraints currently modeled (e.g. UOL_N, ramp limit)

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Energy Market Mitigation

Energy Market Mitigation for CSR

- **The NYISO has not identified the need for any additional energy market mitigation rules specifically for CSRs at this time**
  - Units within the CSRs shall be subjected to the existing mitigation rules

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Next Steps and Timeline

Next Steps

- **NYISO will pursue Co-located Storage Resource option (Option 1) for Market Design Complete in 2020**
  - Bring more details on the CSR participation rules to future stakeholder discussions.
- **NYISO will pursue Aggregated HSR option (Option 2) for Market Design Concept Proposal in 2021**

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Timeline for Co-located Storage Resource option

Milestone	Target
Market Design Concept Proposal	Q3 2020
Present Consumer Impact Analysis	Q3 2020
MDC presentation and BIC vote	Q3/Q4 2020
MC vote	Q4 2020
FERC filing	2021

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Questions?

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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Appendix

Stakeholder Feedback Summary

- **Below is a summary of stakeholder questions from previous working groups and NYISO's response to them. Some of these have been addressed in earlier and today's presentation (as marked) and others will be addressed at a future working group**
  - Request for additional information about NPCC reserve requirements
    - Please refer to ICAPWG/MIWG presentation on "Uses of Reserves and Impacts to ESR" dt. April 27, 2020 for a detailed discussion on NPCC reserve requirements.
  - Request for clarification on "front-of-the-meter" definition
  - Request for exploration of possible thermal + storage model
    - Addressed in 06.30.2020 and 07.22.2020 presentation
  - Request for examples with numbers to understand how many MW can participate under each market (Energy, Reg, Reserves, Capacity) under each proposed option
  - Request for clarification on which option(s) the NYISO will pursue
    - Addressed in 06.30.2020 ICAPWG/MIWG presentation

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Stakeholder Feedback Summary

- Request for examples on CRIS and ERIS allocation
  - Addressed in 07.22.2020 ICAPWG/MIWG presentation
- Request for examples on UCAP calculations
  - Addressed in 07.22.2020 ICAPWG/MIWG presentation
- Request for a detailed timeline of the proposed options
- Concerns on the sufficiency of Co-located HSR Option (Option 1) to meet the business needs for hybrid storage projects.
  - Based on the feedback received from developers, as well as evaluation of other options, the NYISO has determined that Option 1 with scheduling constraint could satisfy majority of the hybrid use cases as well as be made available on a shorter time frame. Therefore, NYISO has proposed to pursue this option for MDC in 2020. The NYISO also proposed to pursue the Aggregated HSR option for Market Design Concept Proposal in 2021.

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Stakeholder Feedback Summary

- Request to make hybrid participation options technology agnostic
- Request to provide data on hybrid projects in the queue
  - The determination of possible co-located storage projects from the interconnection queue is based on the similarity among projects with respect to their location, POI, project name and developer.

	ESR (MW)	Solar (MW)	Wind (MW)	Zone
Solar + ESR	100	200		C
Solar + ESR	4	20		E
Solar + ESR	83	177		C
Wind + ESR	5		100.8	E
Total	192	397	100.8	

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Stakeholder Feedback Summary

- Request to develop IPR like model for Hybrid Storage resources comprising of Intermittent resources with a small energy storage.
  - Reasons for our concerns with an IPR like model for HSRs is explained in detail in 07.22.2020 ICAPWG/MIWG presentation
- Concerns expressed that Aggregated HSR option (Option 2) may not be suitable for Hybrid Storage resources comprising of Intermittent resources with a small energy storage
  - A new option - Forecasted HSR, targeted towards such use cases, was introduced in 06.30.2020 ICAPWG/MIWG presentation

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