

Hybrid Storage Model: Interconnection and Capacity

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Capacity Market Design

ICAPWG/MIWG

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WebEx

Agenda

- **Background**
- **Overview**
- **Interconnection Rules Proposal**
- **Capacity Rules Proposal**
- **Project Timeline**

Background

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%202013%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

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



Project Background

- **The Hybrid Storage Model 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**

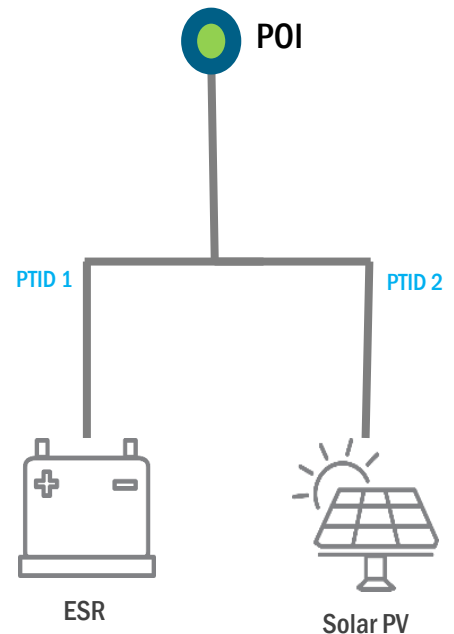
Overview

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.

Co-located Storage Resource (CSR)

- The NYISO is targeting to propose market rules for this participation option in 2020
- Each resource component (unit) within a CSR will have a distinct PTID, offer, and award
- Units will participate under their respective participation models based on resource type, with modifications to UCAP calculations that will be discussed in subsequent slides
 - These changes account for any undersized injection capability that is shared between the units



Interconnection Rules Proposal

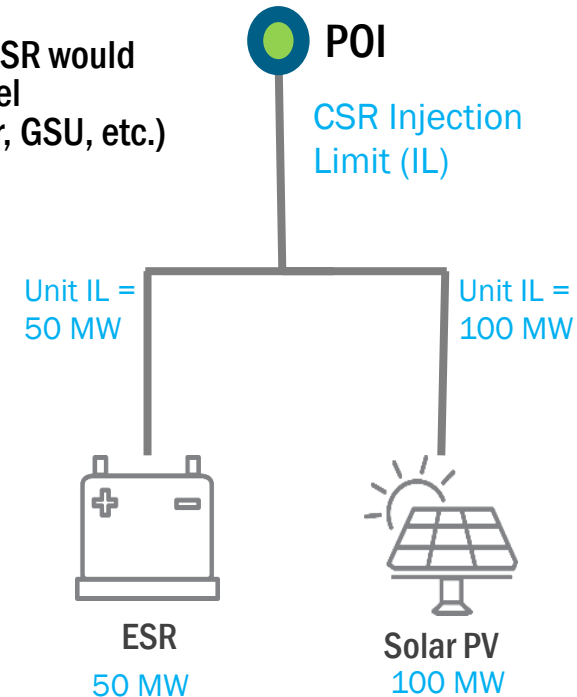
Interconnection Rules for CSRs

- **For facilities proposing to interconnect as a CSR, all units within the CSR may be included in a single Interconnection Request (IR)**
 - The NYISO is working on transition rules to enable projects that currently have separate positions in the Interconnection Queue to combine and proceed under a single Interconnection Request as a CSR
- **Each CSR will be studied in the interconnection process as a single facility with separate ERIIS and CRIS values for each unit**
 - The CSR will indicate to the NYISO how much ERIIS and CRIS it is requesting for each unit within the CSR
 - Requested CRIS may not exceed ERIIS
 - ERIIS and CRIS values may not exceed the injection capability of each unit
 - The sum of CRIS among all units may not exceed the CSR injection limit
 - While the sum of ERIIS among all units may exceed the CSR injection limit, energy injection at the POI may not exceed the CSR injection limit, as described in the examples on subsequent slides
 - The CSR shall register each unit consistent with the allocation of ERIIS and CRIS values awarded during the interconnection study process
- **As currently permitted for facilities proceeding through the NYISO interconnection process, units within the CSR may request ERIIS below the nameplate for the unit in order to avoid upgrading injection capability, provided proper control technologies are in place, per the Tariff**
- **All units within the CSR will have a single Interconnection Agreement (IA)**

Interconnection Examples

- The scenarios below illustrate the amount of ERES and CRIS that units within a CSR would be eligible to receive based on whether injection capability is limited by unit-level equipment (such as PV inverter) and/or facility-level equipment (shared inverter, GSU, etc.)
 - In the examples on this slide, unit-level injection capability is sized to unit nameplate

	Example 1: CSR IL=150 MW	Example 2 : CSR IL=100 MW	Example 3 : CSR IL = 70 MW
Eligible ERES (MW)	PV <= 100 ESR <= 50	PV <= 100 ESR <= 50	PV <= 100* ESR <= 50
Eligible CRIS (MW)	PV + ESR <=150 PV <= 100 ESR <= 50	PV + ESR <=100 PV <= 100 ESR <= 50	PV + ESR <=70 PV <= 70 ESR <= 50

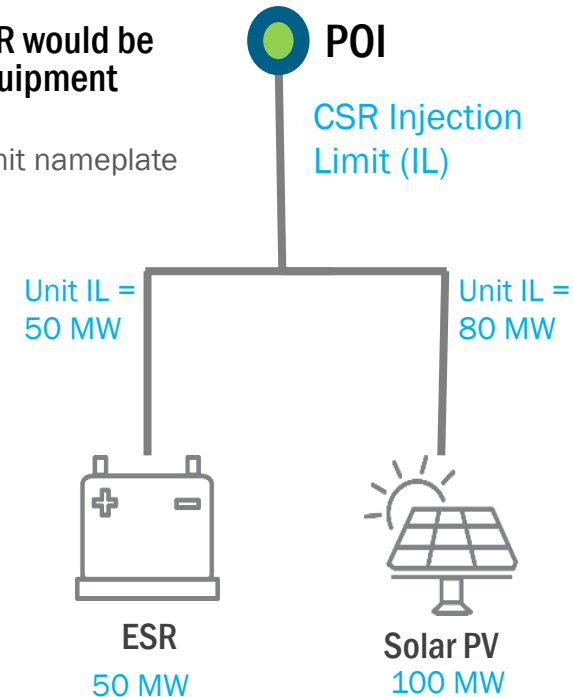


*ERIS may only exceed the IL in the case where both CSR units are in the same Interconnection Request

Interconnection Examples

- The scenarios below illustrate the amount of ERIS and CRIS that units within a CSR would be eligible to receive based on whether injection capability is limited by unit-level equipment (such as PV inverter) and/or facility-level equipment (shared inverter, GSU, etc.)
 - In the examples on this slide, PV injection capability is undersized compared to unit nameplate

	Example 1: CSR IL=130MW	Example 2 : CSR IL=80 MW	Example 3 : CSR IL = 70 MW
Eligible ERIS (MW)	PV <= 80 ESR <= 50	PV <= 80 ESR <= 50	PV <= 80* ESR <= 50
Eligible CRIS (MW)	PV + ESR <= 130 PV <= 80 ESR <= 50	PV + ESR <= 80 PV <= 80 ESR <= 50	PV + ESR <= 70 PV <= 70 ESR <= 50



* ERIS may only exceed the IL in the case where both CSR units are in the same Interconnection Request

Capacity Rules Proposal

ICAP Mitigation Measures

- **The NYISO is still evaluating ICAP Mitigation Measures for CSRs**
 - If necessary, the NYISO will return to a future ICAPWG to discuss ICAP Mitigation Measures for CSRs

DMNC Test for CSR

- **Each unit within the CSR will have its own DMNC value**
 - Existing DMNC rules for each resource type will be applicable to units within a CSR
 - ESR units must perform DMNC tests during the Peak Load Window if they have an Energy Duration Limitation (EDL) or provide operating data
 - DMNC is nameplate for Intermittent Power Resources

CSR ICAP and UCAP Calculations

- **ICAP and UCAP calculation methods for each unit within a CSR will be similar to existing methods based on resource type, with small adjustments to account for the shared Point of Interconnection (POI)**
 - A POI itself can have a derate (e.g., if the inverter is limited) that does not require the ESR unit to reduce its UOL to match the POI injection capability. Therefore, the NYISO proposes to calculate CSR ESR UCAP using the existing method for calculating UDR
 - While the existing ESR UCAP calculation only measures availability of the ESR itself, the proposed CSR ESR UCAP calculation will multiply the POI availability by the ESR availability
 - Intermittent UCAP will also be limited by the POI injection capability, by taking the minimum of POI injection capability and intermittent output when calculating the Production Factor for CSR intermittent units
 - Additional detail on these calculations is on subsequent slides
- 1. It is to be noted that the DAF is 100% for non-duration limited resources
- 2. Intermittent Power Resources have a DAF of 100% as they are not eligible to be a Duration Limited Resources

CSR ICAP and UCAP Calculations

■ CSR ESR

- $ICAP = \min(CRIS, DMNC)$
- $Adjusted\ ICAP = ICAP * Duration\ Adjustment\ Factor\ (DAF)^1$
- $UCAP = Adjusted\ ICAP * (1 - Derating\ Factor)$
 - $Derating\ Factor = 1 - Availability\ Factor\ (AF)$
 - $CSR\ ESR\ Availability\ Factor = ESR\ Unit\ Availability\ Factor * CSR\ Injection\ Limit\ Availability\ Factor$

■ CSR Intermittent

- $ICAP = \min(CRIS, DMNC)$
- $Adjusted\ ICAP = ICAP * DAF^2$
- $UCAP = Adjusted\ ICAP * Production\ Factor\ (PF)$
 - $CSR\ Intermittent\ Production\ Factor = average(\min(CSR\ Intermittent\ Output, CSR\ Injection\ Limit) / CSR\ Injection\ Limit)$ across performance measurement window

■ Numerical examples of these calculations are on subsequent slides

*Blue font designates additional calculation components for CSR units. Existing resource type calculations are in gray.

1. It is to be noted that the DAF is 100% for non-duration limited resources
2. Intermittent Power Resources have a DAF of 100% as they are not eligible to elect an Energy Duration Limitation

CSR Intermittent ICAP and UCAP Example

- Assumptions: Nameplate = 100 MW, CRIS = 30 MW, DMNC = 100, Max Facility Injection Limit = 80MW, DAF = 1

Hour	CSR Intermittent Output (MW) (A)	CSR Injection Limit (MW) (B)
1	90	80
2	70	40
3	60	80
4	50	80

- ICAP = $\min(\text{CRIS}, \text{DMNC}) = 30 \text{ MW}$
- Adjusted ICAP = $\text{ICAP} * \text{DAF} = 30 \text{ MW} * 1 = 30 \text{ MW}$
- UCAP = $\text{Adjusted ICAP} * \text{Production Factor}$
 $= 30 \text{ MW} * (\text{sum}(\min(\text{A}, \text{B})) / (80 * 4 \text{ hours}))$
 $= 30 \text{ MW} * ((80 + 40 + 60 + 50) / 320 \text{ MWh})$
 $= 22 \text{ MW}$

CSR ESR ICAP and UCAP Example

- Assumptions: Nameplate = 50 MW, CRIS = 50 MW, DMNC = CRIS, Max Facility Injection Limit = 80MW, DAF = 1

Hour	CSR ESR UOL (MW)* (A)	CSR Injection Limit (MW) (B)
1	50	80
2	50	40
3	30	80
4	50	80

- ICAP = min (CRIS,DMNC) = 50 MW
- Adjusted ICAP = ICAP * Duration Adjustment Factor (DAF) = 50 MW * 1 = 50 MW
- UCAP = Adjusted ICAP * Availability Factor
 - = 50 MW * CSR ESR Availability Factor * CSR Injection Limit Availability Factor
 - = 50 MW * (Sum(A)/(50 MW*4 hours)) * (Sum(B)/(80 MW* 4 hours))
 - = 50 MW * 0.9 * 0.875
 - = 39 MW

*Note that other elements are included in the existing availability calculation for ESRs, all of which will be applicable for ESRs within CSRs. UOL is used as a proxy for ESR availability for the purposes of this simplified example.

CSR Bid/Schedule/Notify (B/S/N) Obligations

- **Each unit within a CSR will be subject to B/S/N obligations consistent with existing rules based on resource type**
 - An ESR within a CSR that has an Energy Duration Limitation (EDL) must Bid/Schedule/Notify in the Day-Ahead Market (DAM) for injection of the ICAP Equivalent of UCAP sold (ICE), for the consecutive number of hours that correspond to its duration requirement, and during the Peak Load Window (PLW)
 - An ESR within a CSR that has an EDL must also bid the full withdrawal range, i.e. max(negative Installed Capacity Equivalent, Lower Operating Limit), for all hours outside of the Peak Load Window
 - If the ESR does not have an EDL, it must B/S/N ICE injection into the DAM for all hours, consistent with traditional generator requirements
 - Intermittent units within a CSR will not be required to B/S/N in the DAM

Project Timeline

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

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



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

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 storage 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 market design in 2020. The NYISO also proposed to pursue the Aggregated HSR option for Market Design Concept Proposal in 2021.

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	

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 inability to pursue 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