New York ISO
Independent System Operator

Hybrid Storage Model – Energy and Capacity Market Design Proposal

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New Resource Integration

MIWG/ICAPWG

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Agenda

- Registration Proposal
- Metering and Telemetry Proposal
- Ancillary Services Participation Proposal
- Energy Market Bidding Proposal
- Energy Market Scheduling Proposal
- Capacity Market Design Proposal

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Background

Project Background

- This project (HSR) is distinct from the CSR, DER and ESR Integration initiatives, but it will build on work completed as part of those initiatives. This project is a continuation of the 2020-2021 Hybrid Storage model effort and will develop market rules that allow at least one ESR and other Generator(s) to be co-located behind the same point of injection and share a PTID.

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Hybrid Storage Resource Definition

- HSRs are comprised of at least one Energy Storage Resource and at least one additional Generator that: (a) are both located behind a single Point of Injection; (b) participate in the Energy and Ancillary Services Markets as one Generator sharing a single PTID; and (c) have a POI limit greater than 20MW.
- Hybrid Storage Resources are dispatch–only units
- Hybrid Storage Resources cannot be co-located with Load
  - Only Station Service load is permitted

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HSR Resource Registration Proposal

HSR Registration Rules

- **The entity operating the HSR will be responsible for registering all parameters pertaining to HSR**
- **HSR Registration Parameters**
  - The following new registration parameters will be considered for HSR:
    - Maximum Reserve MW Capability
      - See slide 15 for more details
    - Number and type of units within HSR and information about their capabilities and characteristics

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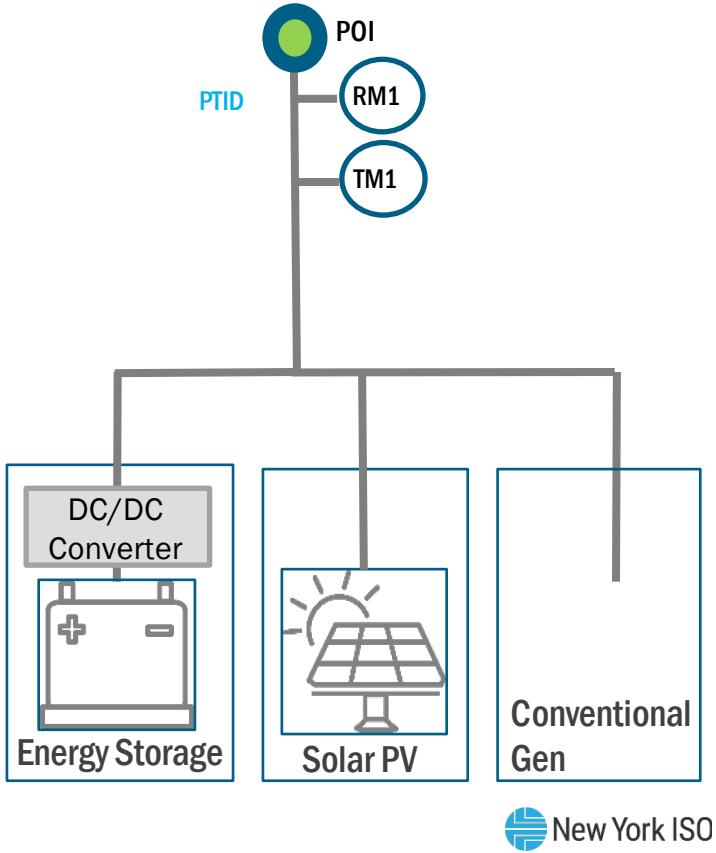
HSR Metering and Telemetry Proposal

HSR Metering and Telemetry Proposal

Meter Designation	Meter Requirements	Data flows
RM1	Revenue grade; dual – channel meter; reported by a Meter Authority	Hourly data
TM1	SCADA data	6 second output telemetry from HSR



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HSR Metering and Telemetry Proposal

- **HSR will be required to have a dual channel Revenue Grade Meter (RGM) [AC] at the Point of Injection (POI)**
  - Meter must be capable of separately recording Energy injections and Energy withdrawals
  - RGM data at the POI will be used for settlement purposes
- **HSR shall provide 6-second telemetry at the POI**
  - Telemetry data must reflect the total Energy injections and Energy withdrawals of the HSR
  - 6-second total HSR telemetered data will be used for real-time operations
- **HSR component – level performance data may be required for audit/verification purposes**
  - Details regarding HSR component – level performance data are being discussed internally

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HSR Ancillary Services Proposal

HSR Service Eligibility Rules: Reserves and Regulation

- **Some ancillary service product eligibilities for HSRs will be evaluated on the individual component level:**
  - **Example: GT + ESR**
    - This HSR may provide 10-minute spinning reserves and regulation based on the ESR's capabilities only;

    OR
    - This HSR may elect to provide non–spinning reserves based on the combined capabilities of the GT and the ESR
  - **Example: Intermittent + ESR**
    - This HSR may provide 10-minute spinning reserves and regulation service based on the ESR's capabilities only
    - IPR components of an HSR cannot contribute towards the HSR's reserve/regulation qualifications; Today, IPRs are unable to qualify to provide reserves in the NYISO markets
- **Reserve configurations and accompanying information must be declared during HSR Registration**

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HSR Service Eligibility Rules: Reserves and Regulation Example 1

- Example: 40 MW GT + 40 MW/40 MWh ESR
  - This HSR may elect to provide up to 40 MW of 10-minute spinning reserves and regulation

    OR
  - This HSR may elect to provide up to 80 MW of non–spinning reserves based on the combined capabilities of the GT and the ESR

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HSR Service Eligibility Rules: Reserves and Regulation Example 2

- Example: 40 MW IPR + 40 MW/40 MWh ESR
  - This HSR may provide up to 40 MW of 10-minute spinning reserves and regulation service

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Updating Reserve Capabilities

- **In addition to providing ongoing updated HSR Operating Limits, HSRs qualified for and offering Reserves will be required to provide updated Reserve "limits"/capabilities to the NYISO closer to RT**
  - The Reserves capability provided to the NYISO must represent what the HSR is capable of providing for 1 hour*
- **This is to account for scenarios when the IPR output decreases and the HSR uses energy from the ESR components providing Reserves to continue providing Energy as scheduled**
  - If the HSR Operator does not update their Reserve Capabilities with the NYISO, the NYISO could be subject to a violation of the NPCC requirements due to unintentionally being short of Reserves

*NPCC Directory 5 Requirement R6. A Balancing Authority's **synchronized reserve, ten-minute reserve, and thirty-minute reserve,** if activated, shall be sustainable for at least one hour from the time of activation.

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Updating Reserve Capabilities: Timing

- **Updated Limits/Capabilities would need to be submitted to the NYISO in near – Real – Time**
  - NYISO is working internally to define a window of time after the real-time market has closed within which an HSR operator will be expected to submit these updates
- **NYISO is working internally to identify and address possible mitigation issues relating to near - RT limit/capability updates**

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HSR Service Eligibilities : Voltage Support Service

- **Voltage Support Service (VSS)**
  - Subject to the existing supplier qualification criteria, the HSR may be eligible to provide VSS
  - HSRs must test according to "normal operating conditions" of their Resource
    - Multiple HSR components may be required to test together, if they will normally be operated in tandem
  - The total compensable MVARs of the HSR shall be the lesser of:
    - The combined HSR component VSS test results or
    - The Injection limit at the POI
  - Metering/telemetry to measure the MVAR flows at the units and POI will be required for an HSR to provide VSS
  - Testing requirements and performance measurement details for HSR will be incorporated into the Ancillary Services Manual, as necessary

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Ancillary Services for HSRs

- **After the fact, telemetry will be used to verify the Reserves "limits"/capabilities provided to the NYISO were feasible and would not have put the NYISO into a situation where it would have been short of Reserves**
  - This verification will check to ensure the limits provided reflect what the HSR was capable of providing for 1 hour
  - Additional telemetry/metering in excess of current HSR Telemetry and Metering requirements are being evaluated internally
- **When the NYISO goes short of reserves for more than 10 minutes, per NPCC Directory 5 requirements, it is required to procure additional reserves and may be subject to a financial penalty**

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HSR Energy Market Bidding Proposal

Energy Market Bidding for HSR

- HSRs will be able to bid in both Day Ahead and Real Time markets
- HSRs may offer via the following bid modes:
  - Self-Committed Fixed
  - Self-Committed Flex
  - ISO-Committed Flex
- HSRs will self-manage their storage levels; there will be no SOC management by the NYISO
- HSRs must be able to offer at least 1 MW to bid for Energy and Ancillary Services
- HSRs may submit bids in increments of 100 kW
- HSR operators will submit a single bid for the entire HSR
  - LOL and UOL measures must be included as part of an HSR's bid and updated as necessary based on changing HSR capabilities and conditions (e.g., wind production decreases sooner than anticipated)
  - Reserve MW measures must be included as part of an HSR's bid and updated as necessary based on changing HSR capabilities and conditions (e.g., wind production decreases sooner than anticipated)
- Bidding rules and parameters will otherwise be similar to those used by ESRs

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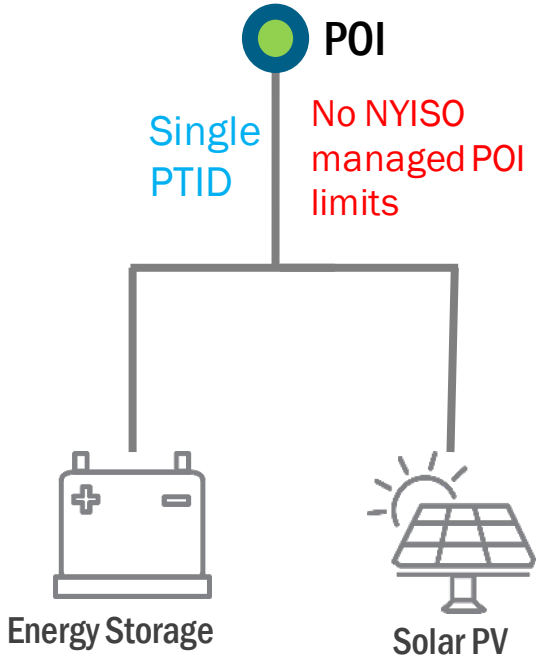
HSR Energy Market Scheduling Proposal

Energy Market Scheduling for HSR

- **A single Basepoint/Schedule will be sent to the HSR**
  - Injections and withdrawals will not be scheduled independently
- **NYISO will determine energy, reserves and regulation schedule for the HSR**
  - The NYISO will use HSR telemetry, real-time operating limits and ramp rate to determine feasible energy and ancillary services schedules
  - LOL, UOL, and Reserve MW must be provided on bids and must be updated as necessary based on changing HSR capabilities and conditions (e.g., wind production decreases sooner than anticipated)



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

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HSR Energy Market Settlements Proposal

HSR Energy Market Settlements

- Settlement will occur at the HSR level
  - Individual HSR components will not be settled separately
- HSRs will be treated as withdrawal – eligible generators for Energy Settlements
  - Can be settled for both withdrawals and injections
- HSRs are dispatch–only
- HSRs will be required to follow basepoints in Real-Time
- HSRs will be exempt from IPR settlement rules/exceptions
  - HSRs will not be required to pay IPR forecasting fees to the NYISO
- The NYISO operators will be able to issue an Out-of-Merit (OOM) to change the HSR Operating Limits in Real-Time for ISO/TO reliability

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HSR Energy Market Settlements cont.

- HSRs will be subject to persistent Undergeneration and Overwithdrawal charges
  - The tolerance for persistent Overwithdrawal and Undergeneration will be the same as tolerances for other Generators
  - See MST Section 15.3A
- HSRs will be expected to follow NYISO's dispatch instructions
  - Underwithdrawal and Overgeneration rules will apply to HSRs
  - The tolerance for Underwithdrawal and Overgeneration will be the same as tolerances as for other generators (+/-3% of LOL/UOL below/above RTD basepoint)

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HSR Energy Market Settlements

- The following Settlement topics will be addressed as a future ICAPWG/MIWG:
  - RT/DA BPCG eligibilities
  - DAMAP eligiblities
  - Applicability of TSC/NTAC charges to HSR withdrawals

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HSR Interconnection Rules

CRIS and Interconnection Rules for HSRs

- **For any Resource proposing to interconnect as a multi-unit facility behind the same Point of Injection, all units within the multi-unit facility may be included in a single Interconnection Request (IR)**
- **Each HSR may be studied in the interconnection process as a single facility evaluated at a single HSR ERIS and CRIS value with the ERIS and CRIS allocated to each unit (such that each unit will have its own ERIS and CRIS value)**
- **Maximum Permissible Requested ERIS and CRIS**
  - ERIS and CRIS values may not exceed the injection capability of each unit
  - ERIS for the Intermittent Power Resource cannot exceed the HSR Injection Capability plus the full withdrawal capability of the Energy Storage Resource
  - The sum of CRIS among all units may not exceed the injection limit for the total facility
  - While the sum of ERIS among all units may exceed the HSR injection limit, energy injection at the POI may not exceed the HSR injection limit
  - Units within the HSR may request ERIS below the nameplate for the unit in order to avoid upgrading injection capability, provided proper control technologies are in place

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HSR Capacity Market Participation Proposal

Capacity Market Participation Proposal

- **NYISO proposes to require HSRs to use largely the same Capacity Market Participation rules as the CSR program**
  - The proposed Capacity participation model simplifies Resource participation, as an MP operating a HSR will be able to convert the unit to a CSR without learning a new set of Capacity rules
    - The proposed rules will also make it easier for Resources participating as CSRs to become HSRs
  - Applying very similar rules to CSRs and HSRs will give the NYISO the insights needed to appropriately model HSRs in long term planning studies

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DMNC Test for HSR

- **Each component of an HSR will have its own DMNC value and will use existing DMNC rules applicable to each component's individual resource type**
  - If any individual component of an HSR has an Energy Duration Limitation, all components of the HSR must perform coincident DMNC tests during the Peak Load Window (PLW) or provide operating data
  - DMNC is nameplate for Intermittent Power Resources

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HSR ICAP and UCAP Calculations

- **HSR components that have dedicated inverters will use existing ICAP and UCAP calculation methods based on resource type**
- **HSRs with components that share a single inverter can experience a combined derate across components. The ICAP and UCAP calculation methods for each component behind a shared inverter will be similar to existing methods based on resource type, with small adjustments to account for the shared inverter derate**
  - HSRs operating in this way must provide shared derate information to the NYISO
  - A shared derate may not reduce the UOL of every HSR component
    - The proposed HSR component UCAP calculation will multiply the shared inverter availability by the availability or performance of each HSR component
- **Intermittent UCAP will be limited by the POI injection capability**
  - This will be done by taking the minimum of the shared inverter injection capability and intermittent output when calculating the Production Factor for HSR intermittent units
  - Additional detail on these calculations is on subsequent slides

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CSR/HSR ICAP and UCAP Calculations

- **HSR ESR Component**
  - ICAP = min(CRIS, DMNC)
  - Adjusted ICAP = ICAP * Duration Adjustment Factor (DAF)[1]
  - UCAP = Adjusted ICAP * (1 – Derating Factor)
    - Derating Factor = 1 – Availability Factor (AF)
      - HSR ESR Availability Factor = ESR Unit Availability Factor * HSR shared limit*
- **HSR Intermittent Component**
  - ICAP = min(CRIS, DMNC)
  - Adjusted ICAP = ICAP * DAF [2]
  - UCAP = Adjusted ICAP * Production Factor (PF)
    - CSR Intermittent Production Factor = average(min(CSR Intermittent Output, HSR shared limit*)/min(Unit Nameplate, HSR shared limit*) across performance measurement window
- **HSR Conventional Generator Component**
  - ICAP = min(CRIS, DMNC)
  - Adjusted ICAP = ICAP * DAF^1
  - UCAP = Adjusted ICAP * (1 - EFORd)
- **Numerical examples of these calculations are on the next slide**

#Blue font designates additional calculation components for HSR units

*When there is a shared inverter across multiple HSR gens

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

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HSR ICAP and UCAP Example 1

Assumptions: Max Facility Injection Limit = 80MW with a shared limit

HSR Component	Nameplate (MW)	CRIS (MW)	DMNC	DAF
IPR	100	30	100	1
ESR	50	50	50	1

Hour	HSR Intermittent Output (MW) (A)	HSR ESR UOL (MW)* (B)	HSR shared limit (MW) (C)
1	90	50	80
2	70	50	40
3	90	30	60
4	50	50	80

HSR Intermittent Calculations

ICAP = min (CRIS,DMNC) = 30 MW

Adjusted ICAP = ICAP * DAF = 30 MW * 1 = 30 MW

UCAP = Adjusted ICAP * Production Factor

= 30 MW * (sum(min(A,C))/(min(100, 80)*4 hours))

= 30 MW * ((80+40+60+50)/320 MWh)

= 22 MW

HSR ESR Calculations

ICAP = min (CRIS,DMNC) = 50 MW

Adjusted ICAP = ICAP * DAF = 50 MW * 1 = 50 MW

UCAP = Adjusted ICAP * Availability Factor (AF)

= 50 MW * HSR ESR AF * HSR shared limit AF

= 50 MW * (Sum(B)/(50 MW*4 hours)) * (Sum(C)/(80 MW* 4 hours))

= 50 MW * 0.9 * 0.8125

= 36.6 MW

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

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HSR ICAP and UCAP Example 2

Assumptions: Max Facility Injection Limit = 80MW with individual limits

HSR Component	Nameplate (MW)	CRIS (MW)	DMNC	DAF
IPR	100	30	100	1
ESR	50	50	50	1

Hour	HSR Intermittent Output (MW) (A)	HSR ESR UOL (MW)* (B)
1	80	50
2	70	50
3	60	30
4	50	50

HSR Intermittent Calculations

ICAP = min (CRIS,DMNC) = 30 MW

Adjusted ICAP = ICAP * DAF = 30 MW * 1 = 30 MW

UCAP = Adjusted ICAP * Production Factor

= 30 MW * (sum(A)/(min(100, 80)*4 hours))

= 30 MW * ((80+70+60+50)/320 MWh)

= 24.4 MW

HSR ESR Calculations

ICAP = min (CRIS,DMNC) = 50 MW

Adjusted ICAP = ICAP * DAF = 50 MW * 1 = 50 MW

UCAP = Adjusted ICAP * Availability Factor (AF)

= 50 MW * HSR ESR AF

= 50 MW * (Sum(B)/(50 MW*4 hours))

= 50 MW * 0.9

= 45 MW

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

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HSR ICAP and UCAP Example 3

Assumptions: Max Facility Injection Limit = 80MW with a shared limit

HSR Component	Nameplate (MW)	CRIS (MW)	DMNC	DAF
Wind	50	20	50	1
Solar	30	10	30	1
ESR	50	50	50	1

Hour	HSR Wind Output (MW) (A)	HSR Solar Output (MW) (B)	HSR ESR UOL (MW)* (C)	HSR Limit (MW) (D)
1	50	30	50	80
2	30	30	50	40
3	50	20	30	60
4	10	10	50	80

HSR Wind Calculations

ICAP = min (CRIS,DMNC) = 20 MW

Adjusted ICAP = ICAP * DAF = 20 MW * 1 = 20 MW

UCAP = Adjusted ICAP * Production Factor

= 20 MW * (sum(min(A,D))/(min(50, 80)*4 hours))

= 20 MW * ((50+30+50+10)/200 MWh)

= 14 MW

HSR Solar Calculations

ICAP = min (CRIS,DMNC) = 10 MW

Adjusted ICAP = ICAP * DAF = 10 MW * 1 = 10 MW

UCAP = Adjusted ICAP * Production Factor

= 10 MW * (sum(min(B,D))/(min(30, 80)*4 hours))

= 10 MW * ((30+30+20+10)/120 MWh)

= 10 MW

HSR ESR Calculations

ICAP = min (CRIS,DMNC) = 50 MW

Adjusted ICAP = ICAP * DAF = 50 MW * 1 = 50 MW

UCAP = Adjusted ICAP * Availability Factor (AF)

= 50 MW * HSR ESR AF * HSR Injection Limit AF

= 50 MW * (Sum(C)/(50 MW*4 hours)) * (Sum(D)/(80 MW* 4 hours))

= 50 MW * 0.9 * 0.8125

= 36.6 MW

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

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HSR ICAP and UCAP Example 4

Assumptions: Max Facility Injection Limit = 100MW with individual limits

HSR Component	Nameplate (MW)	CRIS (MW)	DMNC	DAF
Gas Turbine	100	100	100	1
ESR	50	50	50	1

Hour	HSR GT UOL (MW) (A)	HSR ESR UOL (MW)* (B)
1	100	50
2	95	50
3	90	30
4	100	50

HSR GT Calculations

ICAP = min (CRIS,DMNC) = 100 MW

Adjusted ICAP = ICAP * DAF = 100 MW * 1 = 100 MW

UCAP = Adjusted ICAP * (1 – EFORd)

= 100 MW * (1 - HSR GT EFORd)

= 100 MW * (1 - 0.07)

= 93 MW

HSR ESR Calculations

ICAP = min (CRIS,DMNC) = 50 MW

Adjusted ICAP = ICAP * DAF = 50 MW * 1 = 50 MW

UCAP = Adjusted ICAP * Availability Factor (AF)

= 50 MW * HSR ESR AF

= 50 MW * (Sum(B)/(50 MW*4 hours))

= 50 MW * 0.9

= 36.6 MW

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

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

- **The HSR will be subject to the combined B/S/N obligations of its underlying components that sell UCAP, consistent with the existing rules based on resource type**
  - An ESR within an HSR 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 HSR 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 HSR will not be required to B/S/N in the DAM

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Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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Questions?