DER Energy Market Design

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Agenda

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- **Transmission Nodes**
  - NYISO's Approach to Transmission Nodes
- **Aggregations**
  - NYISO's Approach to Aggregations
  - Participation Models for DER
  - Rules for All Aggregations
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  - Dispatchable DER Registration, Aggregator & Aggregations
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- **Telemetry & Baselining**
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  - Aggregation Telemetry
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- **Settlements & Revenue Metering**
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  - Aggregation Energy Withdrawal Treatment
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  - NYISO's Application of FERC Order No. 745
  - BPCG & DAMAP
  - Additional Energy Market Concepts
  - DER/Facility Meter Configurations
  - Aggregation Measurement & Verification
- **Other**
  - Mitigation
  - Dual Participation
  - Appendix A: Settlements Example
  - Appendix B: Transmission Nodes
  - Appendix C: Participation Graphic
  - Appendix D: Registration and Bidding Parameters for DER Facilities and Aggregations

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Background

Date	Working Group	Discussion points and links to materials
03-06-18	Market Issues Working Group (MIWG)	DER Market Design: Aggregations
04-26-18	Market Issues Working Group (MIWG)	DER Market Design: Measurement & Configuration
06-01-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
06-19-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
07-26-18	Market Issues Working Group (MIWG)	DER Market Design Updates: Energy Market Bid to Bill Examples
10-09-18	Market Issues Working Group (MIWG)	DER Market Design Update: Wholesale Obligations for Dual Participation
10-10-18	Market Issues Working Group (MIWG)	DER Market Design Update
11-05-18	Market Issues Working Group (MIWG)	DER Market Design Updates

Overview & Purpose

Purpose of the DER Roadmap Effort

- Develop and enhance participation opportunities for DER in the NYISO-administered wholesale markets by creating:
  - A Dispatchable DER Participation Model; and
  - Dispatchable Homogenous Aggregations of DER
- Create a model that supports the **NYISO Market Design Vision** - ***Attract and retain*** the most efficient resources ***to meet NY's reliability needs.***

Purpose of this Presentation

- Review previous topics discussed with stakeholders to enable and enhance the participation of DER in the NYISO Wholesale Energy & Ancillary Services Market **only;** and will be effectuated as rules in the NYISO Tariffs
- This presentation does not cover the following topics which will be discussed in future presentations:
  - Interconnections/ERIS/CRIS
  - Capacity

DER Definition for the Market Design

- DER: A Generator, Energy Storage Resource, Intermittent Power Resource, Energy Limited Resource, or Capacity Limited Resource participating in an Aggregation whose maximum physical injection is 20 MW or less and Demand Side Resources (including facilities that can reduce Load and inject Energy) that respond to the ISO's instructions.
- Dispatchable DER are a subset of DER that are capable of responding in real-time to NYISO dispatch instructions.

Transmission Nodes

NYISO's Approach to Transmission Nodes

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Transmission Node Background

- Transmission Nodes reflect the collection of electrically similar facilities to which individual DER may aggregate as an Aggregation with a single PTID
- The DER Roadmap outlined the need to:
  - Consider all Transmission Nodes that allow the NYISO to best represent DERs impact on the transmission system
  - Deliver more granular pricing data to incent efficient locational investment

NYISO Transmission Node Approach

- The NYISO considers individual DER to be small resources, often times distributed across multiple sites, often times connected to the Distribution system
- These individual DER would not normally have the ability to participate in NYISO Markets, when only taking into account their individual operating characteristics

Transmission Node Overview

- The ISO shall establish the set of Transmission Nodes in the New York control Area
  - All Transmission Nodes will be identified in ISO Procedures
- Aggregators will work with Transmission Owners to determine which ISO identified Transmission Node, each individual DER/Facility electrically maps to
  - Only DER/Facilities which map to the same Transmission Node may be aggregated together
- Aggregators may enroll one or more Aggregations at a Transmission Node

*See slides Appendix B for additional information

DER Aggregations

NYISO's Approach to DER Aggregations

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DER Aggregation Approach

- **Aggregations were chosen as the preferred participation method for DER in NYISO markets**
  - Similar to the methodology for the development of Transmission Nodes, the concept of an Aggregation allows for the participation of smaller distributed resources to act in concert to meet minimum eligibility requirements

DER Aggregation Approach, con't

- Aggregations grouped at a Transmission node allow NYISO to effectuate dispatch in a manner that both sends correct price signals and effectively relieve transmission constraints on the system
  - This transmission node level granularity, instead of Load Zone level, will more effectively relieve transmission constraints thereby resulting in lower overall total production cost

Participation Models for DER

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DER Market Participation

- **The DER participation model will only be available to Aggregations**
  - An Aggregation consists of two or more individual resources, except that Demand Side Resources and individual facilities that can reduce load and inject energy (i.e., transition from being Load to Supply without an infeasible operating range), will be permitted to individually use the DER participation model as a single-resource Aggregation
- **Individual facilities in an Aggregation will participate under the market rules for either:**
  - A DER Aggregation (when there are multiple Resource types in the Aggregation), or
  - The specific Resource type (when there is a single Resource type in the Aggregation)

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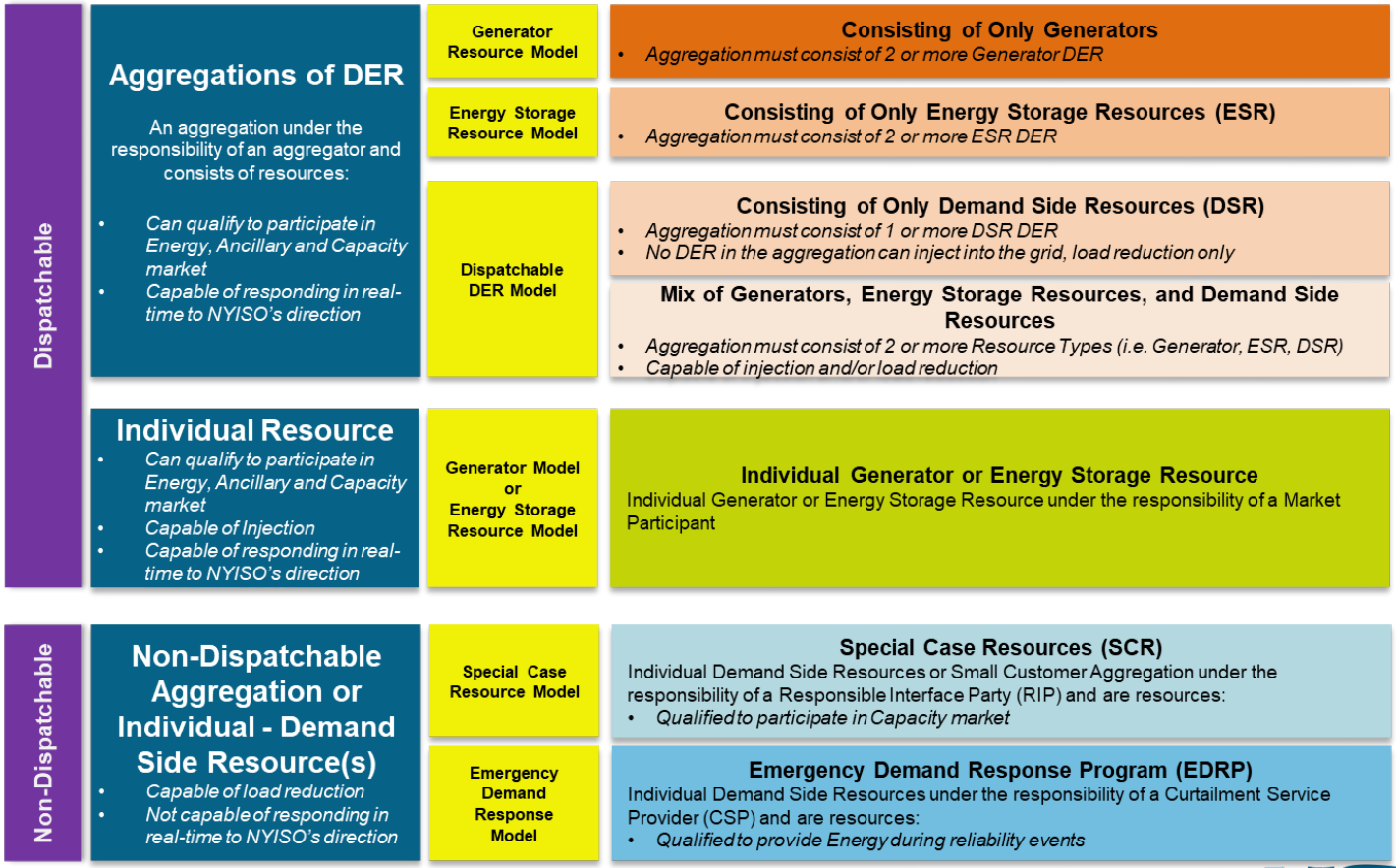
Participation Models Available to DER



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Rules for All Aggregations

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Basics for all Types of Aggregations

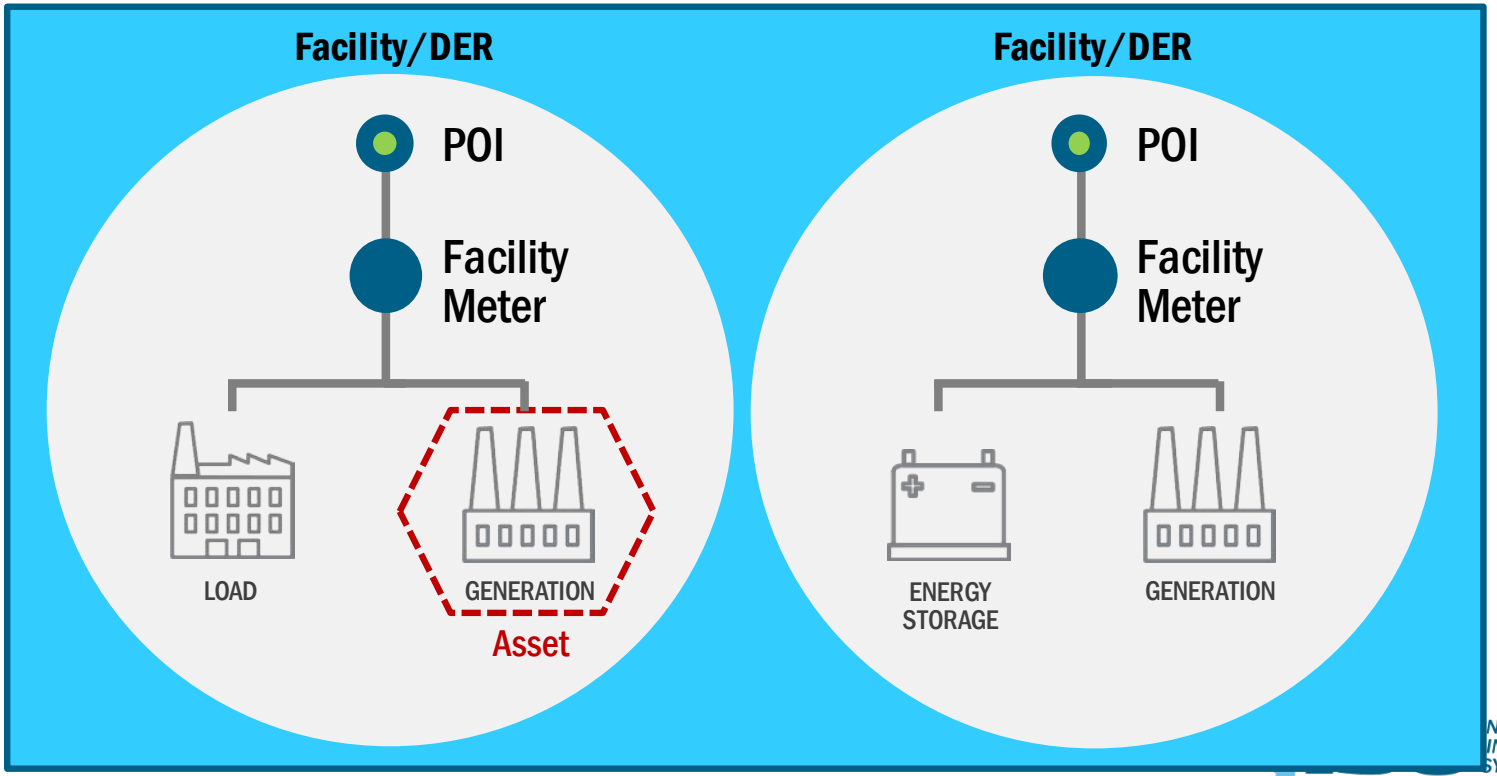
- Resources will be permitted to aggregate to meet minimum requirements and performance obligations for eligible participation models (see slide 30 for more details)
- The Aggregator will be the NYISO Market Participant
- The Aggregation will be a group of one or more resources participating in the NYISO Market, represented by a PTID
  - Bids will represent the offer of the Aggregation
  - Performance will be measured in aggregate
  - Financial settlements will be in aggregate
    - NYISO intends to separately process the injection, withdrawal and load reduction data to ensure accurate settlements

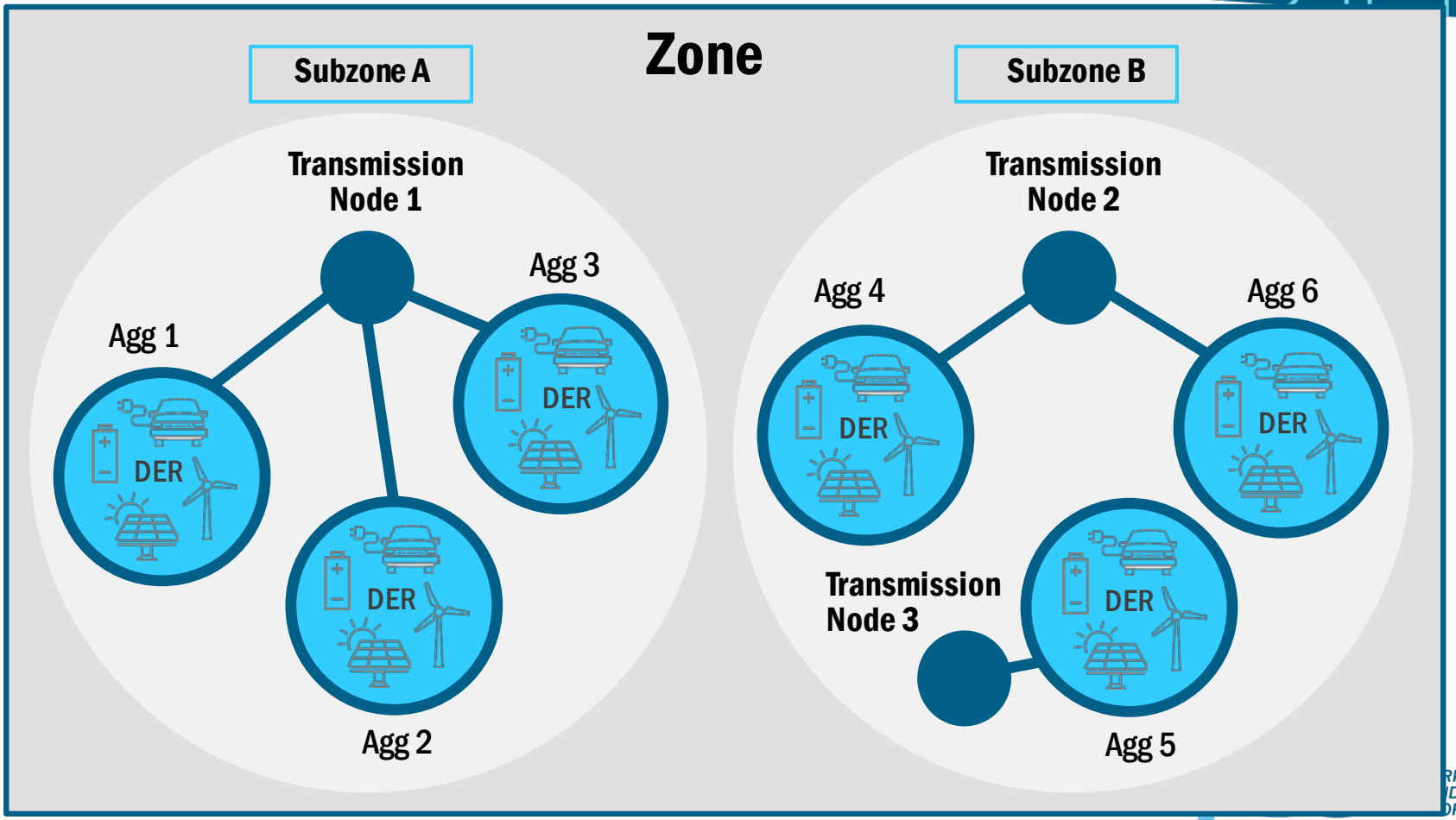
Terminology

- Point of Interconnection (POI) – Where the individual asset or facility/DER electrically interconnects to the distribution or transmission system
- Transmission Node – The virtual point at which the entire Aggregation will be modeled on the transmission system
  - Aggregation performance will be measured at the Transmission Node
  - The Transmission Node will be the "Transmission Bus" at which LBMP will be calculated
- Resource Type –includes Demand Side Resources, Energy Storage and Generation
- Dispatchable – a resource that is able to respond to real-time (i.e., at least 5-minute) dispatch signals

Terminology Overview

Aggregation





Locational Requirements for all Aggregations

- **All resources within a Aggregation will be required to be electrically behind the same NYISO modeled Transmission Node**
  - The NYISO is working with utilities to identify the set of Transmission Nodes which will accurately reflect intra-zonal congestion
  - The NYISO will work with utilities to verify the resources modeled at the proper Transmission Nodes
  - See Appendix for additional details on the Transmission Nodes

What Resources can Aggregate

- **The proposed rules are technology neutral, and will permit most resource types to aggregate**
  - The NYISO's proposal will prohibit Generators with PURPA contracts, Limited Control Run of River Resources, Behind-the-Meter Net Generation Resources, Municipally-owned Generation, System Resources, and Control Area System Resources from participating in an Aggregation
    - These participation models recognize certain resource-specific attributes, hence NYISO is proposing to not allow aggregations for these participation models.
- **Aggregation participation will be open to individual facilities/DER with:**
  - 20 MW or less injection capability
    - Individual facilities may have a nameplate capability greater than 20 MW if sufficient controls exist to limit the physical injections to 20 MW or less
  - Any amount of Load reduction
    - There is no maximum limit on Load reductions by Demand Side Resources
- **The proposal does not include a maximum number of individual facilities in an Aggregation or a maximum MW limit**

Aggregation - Resource Type Modeling/Rules

- Aggregations of a single resource type (other than dispatchable Demand Side Resources) must contain two or more resources that participate under the same rule set that each resource would have otherwise participated under, if the resources had participated in the NYISO markets individually
- Aggregations will be modeled as an individual unit for the purpose of identifying the rule set applicable to the Aggregation
  - Mixed resource type Aggregations will follow the DER participation model, not the various participation models of the individual units
  - Examples:
    - A homogenous Aggregation of Intermittent solar will adhere to solar specific reporting requirements and pay forecasting subscription fees
    - An Aggregation containing an ESR, solar, and Load Reduction Resources will follow the DER participation model

Single Resource Type Aggregations

- **An Aggregation will only be considered a "Single Resource Type" Aggregation when:**
  - Each individual resource in the Aggregation is eligible (except for the minimum size requirement) to participate in the participation model (e.g., as an Energy Limited Resource), and
  - Each individual resource in the Aggregation has the same operating characteristics (e.g., continuous ESRs)
- **All Resources within an Aggregation will be bid as a single unit**
  - Example: an ESR Aggregation will be Bid in as either a single ISO-Managed or Self-Managed (Bids will not be submitted for individual ESR)

Aggregations, Participation Options

Resource Type	As Aggregations of:	As an Individual Energy Storage Resource	As an Individual Energy Limited Resource	As an Individual Gen	As an Individual Intermittent Power Resource
DSR	DER, SCR, EDRP	No	No	No	No
ESR	ESR	Yes	Yes	Yes	No
Wind	IPR (wind only)	No	No	No	Yes
Solar	IPR (solar only)	No	No	No	Yes
GTs	Gen (GTs only)	No	Yes	Yes	No
Other Gens	Gen	No	Yes	Yes	No
Mixed	DER	No	No	No	No

Note: All resources must individual qualify to be eligible to aggregate as an Aggregation of LESR, CLR, ELR
Note: Generators with PURPA contracts, Limited Control Run of River Resources, Behind-the-Meter Net Generation Resources, Municipally-owned Generation, System Resources, and Control Area System Resources are not eligible to aggregate as an Aggregation

Aggregation Services

- **Aggregations may qualify to provide Energy, Capacity and Ancillary Services**
  - Eligibility to provide services in the NYISO-administered markets will be dependent upon the operating and other characteristics of the Aggregation
    - For example, ESR Aggregations will be eligible to provide Spinning Reserve, 10-Minute Non-Synchronized Reserve, and 30-Minute Reserve whereas
    - A DER Aggregation with an ESR and a Generator will not be eligible to provide 10-Minute Spin
  - Minimum offer requirements for ESR and all Aggregations will be at 100 kW

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Aggregation & Ancillary Services

- **Aggregations will be eligible to supply the Ancillary Service Products for which all DER within the Aggregation are eligible to supply**
  - Example 1: An Aggregation would be eligible to supply Regulation only if all DER in the Aggregation are eligible to supply Regulation
  - Example 2: If one resource in the Aggregation is only eligible to supply 30 Minute Non-Synchronous Reserves, the entire Aggregation is only eligible to supply 30 Minute Non-Synchronous Reserves

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Aggregation & Ancillary Services, con't

- Aggregations will be dispatch only and the NYISO will only have the real-time visibility of the operating state of the entire Aggregation as a whole
  - NYISO will not have real-time visibility to the operating status of individual DER
- Compliance with Northeast Power Coordinating Council standard requires that synchronous reserves can only be awarded to resources that are synchronized to the electric grid[1]
- Aggregations containing generator-based DER will only be eligible to provide Non-Synchronous Operating Reserves because the NYISO will not know real-time visibility of the grid synchronization operating state of the individual generator-based DER within the Aggregation

[1]NPCC Glossary of Terms: https://www.npcc.org/Standards/Directories/Glossary%2020171103.pdf

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Aggregation & Ancillary Services, con't

- Similar to today's Ancillary Service requirements, resources must have the capability to meet the minimum bidding obligation of the product they wish to offer
- Aggregation minimum offer size is 100kW
  - Regulation Services is a bi-directional product
  - This would in turn, require these Aggregations to have a UOL of at least 200 kW to participate in Regulation Service
  - Amount of Regulation Service offered must equal 100kW at a minimum which requires a UOL higher than 100kW in this situation

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Aggregation Dispatch

- Non-dispatchable Demand Side Resources [DSR](*i.e.,* those resources that are not capable of responding to real-time dispatch signals from the NYISO) may continue to participate in the EDRP or SCR Program
- All other DER must be dispatchable and will be dispatch-only (similar to ESR and BTM:NG Resource participation models)

Aggregation Dispatch, con't

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- **Aggregations will not receive unit commitment from the NYISO and will instead be considered as only a dispatch resource, when participating in the wholesale market**
  - Aggregation will not have any commitment parameters such as start up cost considered in the market evaluation
  - Dispatchable DER will likely be serving a primary function other than providing Energy and Ancillary Services to the NYISO-administered wholesale markets, and therefore will already be "committed" when used to serve that primary function. It follows, then, that those resources will not require a day-ahead or real-time commitment by the NYISO.
  - In addition, unit commitment requires knowing the off/on status of the resource. Given that a Aggregation is an Aggregation of DER, it is not possible to determine Aggregation's on/off status

Registration

NYISO's Approach to DER Registration

DER Registration

- Participants in any of the DER Aggregation participation options will have registration requirements similarly to the registration requirements of NYISO's reliability programs
- Participants will be required to register:
  - Themselves as Market Participants
  - Each of their individual resources (DER)
  - The ability of the aggregation to participate in the registered NYISO programs

Dispatchable DER Registration, Aggregator & Aggregations

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Aggregator Registration

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- **Aggregators will be required to**
  - Register as a Market Participant
  - Post cost requirement
    - Aggregators will be required to follow all existing market Collateral requirements for their Aggregations
      - Based on market products qualified and enrolled in

DER/Aggregation Registration

- **Aggregator will be required to register individual DER's parameters/unique operating characteristics, which will be a hybrid of existing Generator, ESR and Demand Response Parameters**
  - Matrix of required information for cumulative Aggregation values will be dependent on the characteristics of each individual DER, see appendix D for a list of parameters
- **An aggregator may register any number of Aggregations at a transmission node**
  - Transmission nodes will be unique to a single TO's subzone
  - A subzone may have multiple transmission nodes

Bidding & Dispatch

NYISO's Approach to DER Bidding

DER Bidding, Approach

- All DER Aggregations, regardless of resource mix, will be bid into the market place and settled as a single entity
- The distinction for the settlements process, as it will pertain to Revenue Metering and Telemetry, will be that the NYISO has to account for the following aspects of each DER Aggregation when evaluating performance:
  - Energy Injection from Generation units
  - Load Reduction provided as Supply from Demand Side Resources
    - To account for FERC Order No. 745
  - Energy Withdrawal from Eligible Generators

Bidding

Participation Timeline

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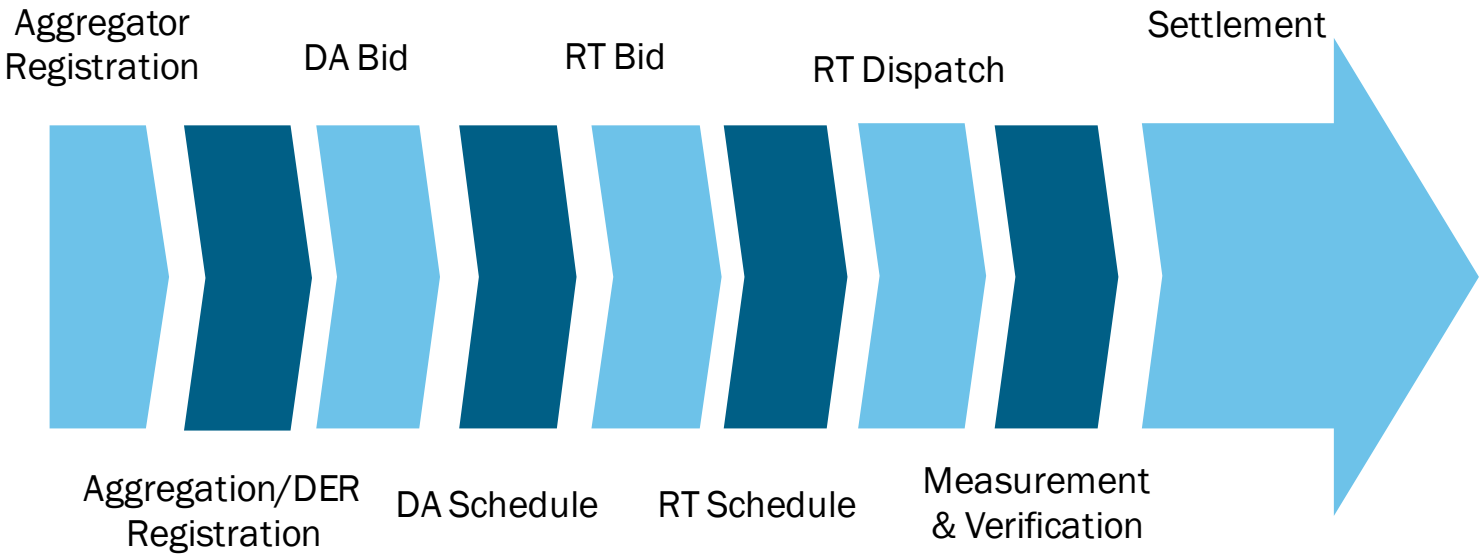

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Overview Example on Following Slides

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- The following slides are a time-step sequence of actions taken by the Aggregator/Aggregation and the NYISO for the implementation of the Energy markets
- Each slide will denote which entity the action is attributable to

Overview Example on Following Slides, con't

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- There is one example on the following slides:
  - An Aggregation of mixed asset types
    - Current methodology works regardless of Heterogeneous or Homogeneous nature of the Aggregation
- For the purposes of this example, the Aggregation will bid into the Day-Ahead Energy market

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Bidding Overview

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- **The NYISO will post the calculated NBT value prior to the beginning of the month**
  - Current filing states as of the 15th of the prior month
    - Ex: April 15th for May
- **Aggregator would then:**
  - Bid the Aggregation in at 100kW increments, at a minimum, in the Day Ahead market
  - Aggregator will bid in values appropriate for each Aggregation's physical characteristics (Injection/Withdrawal/Load Reduction) and economic characteristics
    - No NBT limitations would be placed on bids

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Day-Ahead Market

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- **For the Day-Ahead Market, the aggregator will:**
  - Enter bids appropriate for the Aggregation
- **The NYISO will evaluate these bids and if accepted, provide the aggregator with a Day-Ahead schedule**
  - Schedule does not infer commitment, Aggregations are not eligible for commitment

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In Day Actions

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- **As part of the NYISO two part settlement system a NYISO initiated balancing transaction will have the Aggregation balance its Day-Ahead position with Real-Time performance**
  - This is represented as occurring during Real-Time but the process is handled during settlements

Real Time Dispatch

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- **NYISO would then dispatch the economic Aggregations**
- **Aggregator would then:**
  - Respond to dispatch with a 6 sec telemetry signal, representing aggregate response of all resources within an Aggregation
  - Provide additional 6 second telemetry signals for sub components
    - "Generation" telemetry signal will consist of the Injection and Negative Generation of all Injection-type and ESRs within the Aggregation, regardless of utilization
    - "Load Reduction" telemetry signal will consist of the supply provided by all Load Reduction assets, regardless of utilization
      - Max(Baseline – Metered Value, 0)

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Example of Aggregate Response Signal

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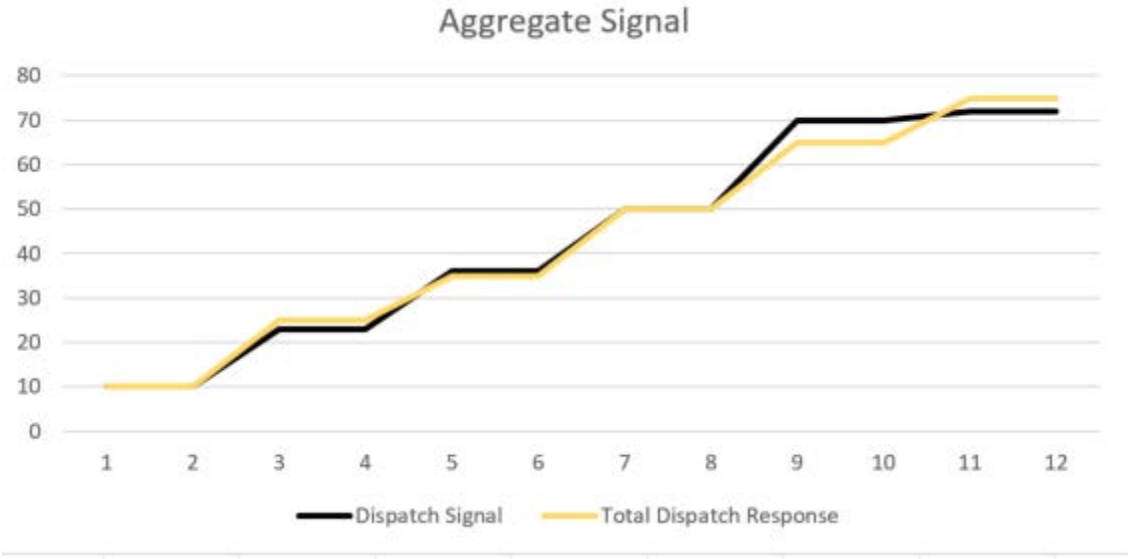

- This example contains the NYISO dispatch signal and the aggregate response signal

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Aggregate Response Signal with Individual Components

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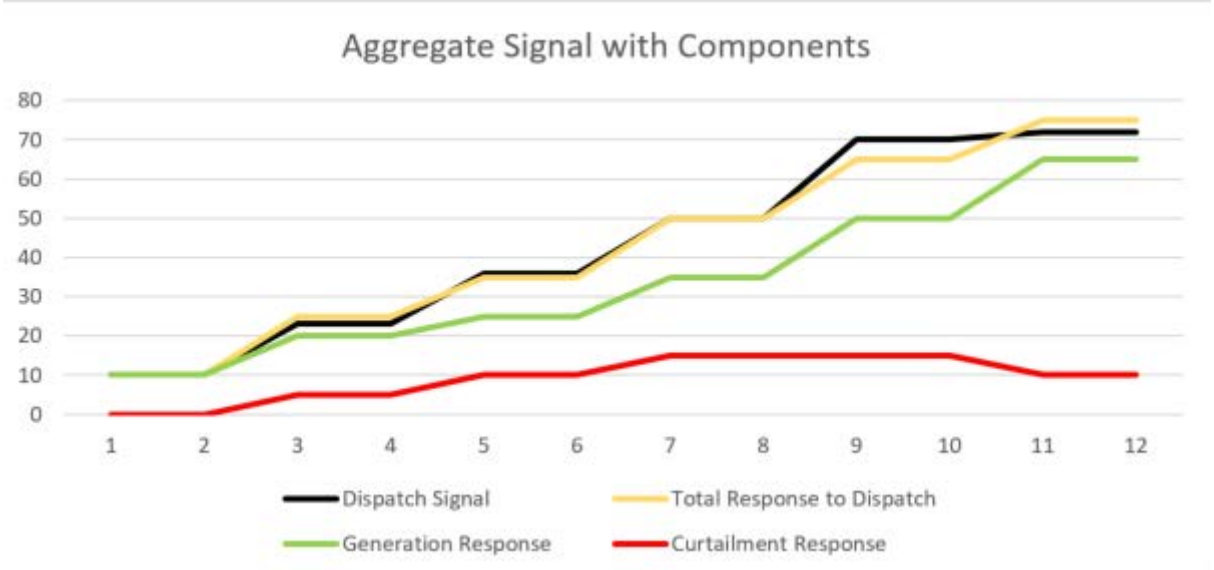

- This example contains the NYISO dispatch signal, the aggregate response signal and the sub-component signals for settlements

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Scheduling & Pricing Overview

NYISO's Approach to Scheduling & Pricing

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Scheduling & Pricing, Approach

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- DER Aggregations will be scheduled consistent with their bids and capabilities, consistent with the treatment of other units participating in NYISO markets
- DER Aggregations will be eligible to set prices for the programs/participation models in which they are Scheduled & Dispatched

Telemetry & Baselining

NYISO's Approach to DER Telemetry

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Aggregation Telemetry, Approach

- DER Aggregations will have the ability to participate in NYISO markets as a single entity, similar to large scale units which participate in the markets today
- In order to maintain reliability and effectuate economic dispatch, it is crucial that the NYISO is able to do so in a manner that is in line with that of other units participating in the same products

Meter Services Entities

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Meter Services Entities

- The NYISO is working on a set of rules that will establish the qualification requirements and operating protocols for third party Meter Services Entities
  - Aggregators may use authorized Meter Services Entities to provide metering and telemetry services for wholesale market participation
- Meter Services Entities are intended to remove barriers and increase DER participation by offering Aggregators the option to procure metering services competitively
  - *Meter Service Entity Design Updates, ICAP Working Group, November 30th, 2018*
  - *https://www.nyiso.com/documents/20142/3759319/DER%20Market%20Design%20-%20Meter%20Service%20Entity%20Design%20Updates.pdf/4ee326f7-5dfb-fecb-ae09-f17008dd3233*

Aggregation Telemetry

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Real-Time Telemetry for Power System Operations: Communication Options

12/19 MIWG

- **Existing rules require Generators to send data through the appropriate TO to the NYISO**
  - DSASP Resources have the option of direct communication with the NYISO as the primary communication path
- **There will be two options for DER communication of telemetry data:**
  - Existing communication path through the TO to the NYISO; and
  - Simultaneously to the NYISO and TO
- **For both options, the utility must receive the same telemetered values as the NYISO for the purposes of maintaining Interim Control Operations**
  - Interim Control Operations are activated under emergency conditions when NYISO is not able to function and the Transmission Owners take over the system operation to maintain grid reliability. See section 8 of the Emergency Operations Manual for additional details

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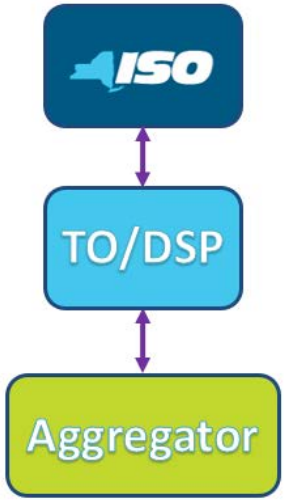
Options for Real-time Telemetry Data Communication Paths

Option 1 – Aggregator communicates only with DSP and DSP provides data to/from NYISO

Option 2 – Aggregator communicates with both DSP and NYISO in parallel

12/19 MIWG



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Real-Time Telemetry & Settlement Data

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- **Similar to Generators participating in the NYISO markets today, the Aggregation will be required to send all telemetry signals for 24 hours of the day, 7 days a week if it is participating in the wholesale markets**
  - This will be required regardless of dispatch schedule, for the independent signals for:
    - Aggregation aggregate signal
    - Aggregation aggregate Injection or Negative Generation (when an Aggregation eligible to withdraw Energy is dispatched to withdraw)
    - Aggregation aggregate Load Reduction
- **The aggregator will need to measure the injection and the load reduction of all DER within the Aggregation, during dispatch**
  - This will be done regardless of utilization of assets for meeting dispatch
  - This applies to both real-time telemetry and settlement data submission

Real-Time Telemetry & Settlement Data, con't

6/19
MIWG

- The aggregator will substitute values of zero for the load-reduction response of all load reduction DER during intervals of non-dispatch by the NYISO
- The aggregator will send any non-zero injection response of all injecting DER during intervals of non-dispatch by the NYISO
  - This will ensure that the sub-zonal load calculations are accurate

Revenue Data

- **Similar to Generators participating in the NYISO markets today, the Aggregation will be required to send all revenue grade meter files by noon* the next day following dispatch**
  - This will be required regardless of dispatch schedule, for the independent categories for:
    - Aggregation aggregate signal comprised of:
      - Aggregation aggregate Injection
      - Aggregation aggregate Load Reduction

*DER resources will be required to comply with all existing meter data management schedules and standards for generators and tie lines for submissions, revisions, and challenges. See section 3 of the Accounting and Billing Manual for details.

Reporting & Retention

- **Requirements:**
  - All data used in and for telemetry is subject to the same data retention requirements as traditionally metered resources *i.e.*, 6 years
  - NYISO reserves the right to audit telemetry infrastructure and data to ensure compliance with NYISO requirements

Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate

10/10
MIWG

One of NYISO's is responsibilities is maintaining the reliability of the New York Bulk Power System and timely information on market resource performance supports this mission. 6-second telemetry of resources participating in NYISO's market is crucial to effectively maintain the reliability of the grid.

- Real-time telemetry updated every 6 seconds provides essential two-way communication of operational data between market resources and NYISO
- NYISO relies on real-time telemetry for situational awareness necessary to balance supply and demand within the New York Control Area (NYCA), and to identify and respond to normal and abnormal conditions

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Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate, cont'd

10/10 MIWG

- **NYISO currently requires 6-second scan rate for real-time telemetry for all market resources participating in NYISO's Energy and Ancillary Services Market † for the following reasons:**
  - Situational Awareness
    - 6-second telemetry is needed for NYISO to maintain situational awareness of the NYCA power system, especially during times of significant or unexpected grid events or changes
    - System operators must have an accurate understanding of the power system conditions at all times in order to make quick decisions and direct resources as needed to maintain reliability
  - Automatic Generation Control
    - 6-second telemetry is necessary for NYISO's Automatic Generation Control process to control market resources in order to maintain NYCA generation and load balance
    - NYISO's Automatic Generation Control process operates every 6 seconds and provides all market resources basepoints of their required operating level

(Continued on next slide)

†DADRP Resources are not required to have telemetry

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Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate, cont'd

10/10 MIWG

- NYISO currently requires 6-second scan rate for real-time telemetry for all market resources participating in NYISO's Energy and Ancillary Services Market † for the following reasons (Continued from previous slide):
  - Reliability Compliance
    - 6-second telemetry is needed to meet mandatory bulk power system transmission operating reliability criteria, including criteria unique to New York State
    - New York State Reliability Council's D.1 reliability requirement‡ requires bulk transmission facility overloads above Short Term Emergency (STE) rating be relieved within 5 minutes
    - To meet the New York State Reliability Council's requirement, NYISO requires 6-second telemetry of market resources to develop and quickly communicate the required schedules to the market resources
  - Emergency Response
    - Even though NYISO's Security Constrained Economic Dispatch (SCED) nominally operates on a five-minute period, NYISO will use SCED at any time to immediately respond to unexpected system events
    - NYISO requires 6-second telemetry from market resources to develop and quickly communicate the required schedules to the market resources and confirm that they are responding as required
    - NYISO will dispatch any available market resources, including energy-only resources, to respond to reliability events and resolve them timely

†DADRP Resources are not required to have telemetry

‡NYSRC Reliability Rules & Compliance Manual: http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RRC%20Manual%20V41.pdf

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Real-Time Telemetry Requirements for Power System Operations: Scan Rate (Cont'd)

10/10 MIWG

- **NYISO will require 6-second scan rate for real-time telemetry for Aggregations**
  - DER Aggregations will have similar impacts on real-time grid operations as that of other market resources
    - Demand Side Resources participating as dispatchable DER will be seen as supply that is equivalent to traditional generation in the real-time grid operations and therefore requires the same treatment and visibility as generation resources
  - A critical aspect of DER integration is the ability to instruct all market resources, including Aggregations, to address reliability events such as providing relief on a overloaded transmission facility
  - NYISO will rely on Aggregations, like all dispatchable market resources, to satisfy the reliability requirements of the New York State Reliability Council
  - Aggregations will provide services comparable to generation resources for the purposes of real-time grid operations

6-Second Scan Rate Real-Time Telemetry Costs

10/10 MIWG

- **NYISO's evaluation has indicated that multiple cost effective technologies exist for providing 6-second scan rate for real-time telemetry and is not a barrier to entry**
  - NYISO's 6-second telemetry accuracy requirement of ±5% range is less stringent than the ±0.2% range for the settlement data → cost effective approaches could be used for telemetry
  - NYISO gives the flexibility to the aggregator (i.e., DER aggregator) to use cost effective technologies to acquire and transmit telemetry data between DER and aggregator
  - There is no significant cost difference between 6-second scan rate versus 1-minute scan rate for telemetry
  - NYISO's evaluation indicates that the 6-second telemetry between DER and aggregator for a 0.250 MW DER could be met with a cost $1 per MWh/month
    - Based on one time metering device and installation cost of $600 + optional secure gateway device and installation cost of $1000; existing broadband internet connection and router; one time costs levelized over 5 years = $26.70/month; monthly maintenance cost for the metering device and secure gateway of $20.00/month ➔ Total monthly costs = $46.70/month; Based on 6 hour/day energy output ➔ $1.00 per MWh/month cost
- **Small DER in an Aggregation can utilize alternate telemetry approach to minimize the cost of providing 6-second scan rate for the real-time telemetry**

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Alternate Telemetry Approach

This alternate telemetry methodology could be utilized by small DER participating in an Aggregation

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Alternative Telemetry Approach

10/10
MIWG

- NYISO proposes to allow small DER participating in an Aggregation to provide real-time operational data for telemetry at a 6-second scan rate through an alternative method to directly metered methods *i.e.,* Traditional
- Alternative telemetry is the manner of deriving the status and output of a resource without a traditional meter on a six second basis.
- Alternative telemetry concepts the NYISO is aware of:
  - Representative devices of the responding resources i.e. thermostat
  - Use of status changes, communicated by exception, that indicate when the resource is output limited, de-rated to a specific range, or operating under a specific operating parameter
- DER employing an alternative methodology for telemetry will be required to meet the same operational requirements as directly metered telemetry methods
  - NYISO's existing telemetry requirements for all Generators (including Intermittent Power Resources, Energy Limited Resources, DSASP Resources) participating in NYISO's Energy Markets include:
    - 6-second (or faster) scan rate
    - Not to exceed 10-sec one-way latency (from the resource to NYISO or from NYISO to the resource)
    - Not to exceed 20-sec round-trip latency (from NYISO to resource and back to NYISO)
    - Not to exceed ±5% full-scale error

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Alternative Telemetry Eligibility

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- This option for alternative telemetry will be limited to DER with a load reduction/max injection below 100 kW
  - DER below 100 kW cannot individually participate in NYISO wholesale markets and, because of their capability, their operating information must be aggregated by an aggregator
  - The NYISO is attempting to lower barriers to market entry for resources small enough where traditional telemetry solutions may not be cost-effective
- Alternative telemetry methodologies must employ the status or measurement of a physical device
  - ex. Thermostat
- Alternative telemetry solutions must incorporate traditionally metered telemetry with a periodicity of 5 minutes or faster
- The use of alternative telemetry methodologies must be communicated to and approved by the NYISO before use by a DER
- Aggregation's electing to use alternative telemetry would be ineligible to offer Regulation Service

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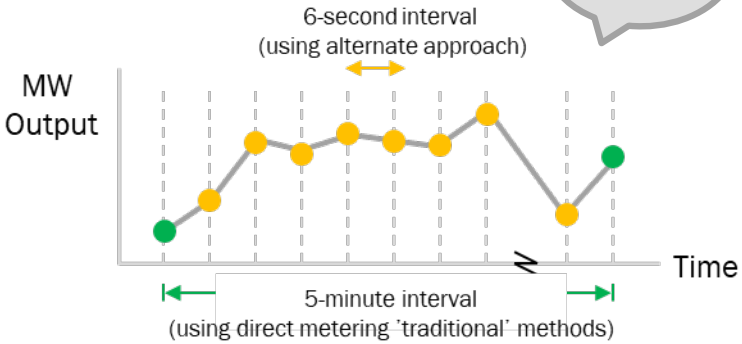
Alternative Telemetry Requirements Recap

10/10 MIWG



- **Operational Requirements:**
  - For each DER within an Aggregation, the Aggregation is expected to have MW output data for that DER on a 6-second basis to generate its aggregate MW output values for telemetry to the NYISO
  - Resource 6-second MW output values comprise:
    - Measurements through direct metering ('traditional') methods (e.g., CT/PT) from the resource with periodicity of 5 minutes or faster, and
    - Calculated values through an alternate approach to augment direct metered values as needed to produce operational data on a 6-second basis
- **Reporting Requirements:**
  - All data used to develop alternative telemetry is subject to the same data retention requirements as traditionally metered resources *i.e.,* 6 years
  - NYISO reserves the right to audit and disapprove alternative telemetry schemes if found noncompliant with NYISO's telemetry requirements

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Determination of Real-Time Response of an Aggregation

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Aggregation Performance

6/19
MIWG

- An Aggregation's performance will be measured by the Aggregator, across all DER in the Aggregation
- Aggregation allows for balancing by the Aggregator of individual DER performance within the Aggregation
  - Over performing DER can balance the under performing DER within the Aggregation
  - Specific examples can be found in the "Energy Balancing" section

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Real-Time Response of an Aggregation

- **The aggregator is required to provide within its aggregated telemetry signal the MW portion that (1) represents the Aggregation's Load Reduction response and (2) represents the Aggregation's Injection response**
  - The Aggregation's Load Reduction response is the sum of Load Reduction MW from each resource within the Aggregation
  - The Aggregation's Injection response is the sum of Injection MW from each resource within the Aggregation, inclusive of any withdrawals by Withdrawal-Eligible Generators
- **The Aggregation Load Reduction response will be the sum of the resource-level response of Load Reduction resources**
  - Response for each Load Reduction resource will be determined by the aggregator using energy baseline methodologies prescribed by the NYISO

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Real-Time Response of an Aggregation, con't

- The Aggregator is responsible for aligning the time intervals of Injection and Load Reduction response for each DER within the Aggregation for the purposes of real-time telemetry to the NYISO
- Regardless of if the Aggregation has been dispatched by the NYISO, the Aggregator is to include the DER's calculated/actual response into the Aggregation's signal, regardless of whether the Aggregator has dispatched the individual resource
  - The aggregator must provide the response of the Aggregation in its entirety when it is dispatched by the NYISO
  - The aggregator must provide the response of the Injection type DER in the Aggregation, in its entirety, even when the Aggregation is *not* being dispatched by the NYISO
  - If the Aggregation has not been dispatched by the NYISO, the aggregator is to indicate a zero MW response of the Load Reduction aspect of the Aggregation
- Additionally, the Aggregator will be required to provide the Aggregation's total ESR withdrawal as a separate response file
- If the telemetry between the aggregator and DER has been lost, the Aggregator must consider that DER as unavailable, and if necessary, report a de-rate if the Aggregation cannot meet its schedule without that DER

Energy Baselines and Real-Time Response for Load Reduction in an Aggregation

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Use of Baselines for Load Reduction within an Aggregation

4/26 MIWG

- As a reminder, the DER market design intends to allow an Aggregation to provide offers for energy, operating reserves, regulation service or combination of such if capable and qualified to do so
- As a result a Load Reduction resource within an Aggregation may be contributing to an aggregated dispatch instruction of the Aggregation for energy, reserves and/or regulation service
  - Calculation methodologies for a Load Reduction resource need to account for the ability to provide (1) energy and reserves, and (2) regulation

Proposed Energy Baseline Methodology for Load Reduction within an Aggregation

4/26 MIWG

- To minimize the data exchange between the NYISO and the aggregator, the energy baseline will be calculated by the aggregator to support real-time operation and settlement purposes, and will not be reported to the NYISO in real-time
  - The energy baseline of each resource will be used by the aggregator to determine the energy response by each resource providing Load Reduction within a Aggregation
  - Only the Load Reduction response of the Aggregation as a whole is communicated to the NYISO in real-time via telemetry
- The NYISO intends to include the calculation methodology to determine the energy baselines to be used by the aggregator in its Tariffs, similar to EDRP, DADRP and SCR
- The aggregator will be required to retain these calculation results and make them available to NYISO upon request

Proposed Energy Baseline Methodology for Load Reduction within an Aggregation, cont'd

4/26 MIWG

- The NYISO is proposing that the aggregator use an adjusted 5-minute ECBL for calculating the Load Reduction of a resource when the Aggregation is providing energy
- This proposal is akin to the DADRP ECBL methodology with a few key differences:
  - Calculation of the baseline will be at a 5-minute time granularity instead of hourly
    - Hourly ECBL was intended for DADRP, which is an hourly granular market (i.e., day-ahead)
    - Dispatchable DER are intended to be dispatched in real-time for energy and ancillary services, making a 5-minute granular baseline more applicable when capturing load variability and resource capability

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Proposed Energy Baseline Methodology for Load Reduction within an Aggregation, cont'd

4/26 MIWG

- **Other key differences to the DADRP methodology include:**
  - The 5-minute ECBL will have an in-day adjustment applied on the resource's unadjusted 5-minute ECBL during the entire dispatch period of the Aggregation based on the resource's load during the three 5-minute intervals, starting 60 minutes prior to operating hour and ending 45 minutes prior to operating hour of the Aggregation
    - To better determine the real-time capability of a resource, NYISO is proposing a baseline adjustment to be calculated during the Operating Day for the purposes of real-time telemetry
    - The in-day adjustment will be capped at ±20%
    - DNV GL has concluded with similar finding that real-time adjustments perform better when the look-back window proximity is closer and its duration is shorter compared to the dispatch time, and when the adjustment is calculated throughout the Operating Day[1]
  - The in-day adjustment is to be recalculated when there is sufficient post dispatch load data available that is not affected by a wholesale market instruction to reduce load

[1] ISO New England, Inc., Oct. 31, 2014 Filing, Docket No. ER15-257-000, Testimony of Henry Yoshimura at 49

Example Unadjusted 5-minute ECBL Calculation

4/26 MIWG

- Calculation of Unadjusted 5-minute ECBL for 11:05 interval on March 2, 2018 (weekday)

Day	Load at 11:05 interval
March 1	1.1 MW
February 28	1.0 MW
February 27	1.0 MW
February 26	3.1 MW
February 23 **Dispatch Day**	2.8 MW + 0.5 MW (add-back) = 3.3 MW
February 22	2.4 MW
February 21	2.5 MW
February 20	1.2 MW
February 19 **Dispatch Day**	1.3 MW + 0.5 MW (add-back) = 1.8 MW
February 16	1.2 MW

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Example Unadjusted 5-minute ECBL Calculation

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- **Calculation of Unadjusted 5-minute ECBL for 11:05 on March 2, 2018 (weekday)**
  - Sorted highest to lowest
  - Unadjusted 5-minute ECBL = average of 5th and 6th values from descending list
  - Unadjusted 5-minute ECBL @ 11:05 March 2, 2018 = average (1.8, 1.2) = **1.5 MW**

Day	Load at 11:05 interval
February 23 **Dispatch Day**	2.8 MW + 0.5 MW (add-back) = 3.3 MW
February 26	3.1 MW
February 21	2.5 MW
February 22	2.4 MW
February 19 **Dispatch Day**	1.3 MW + 0.5 MW (add-back) = 1.8 MW
February 20	1.2 MW
February 16	1.2 MW
March 1	1.1 MW
February 28	1.0 MW
February 27	1.0 MW

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Example Timeline when Applying the In-Day Adjustment

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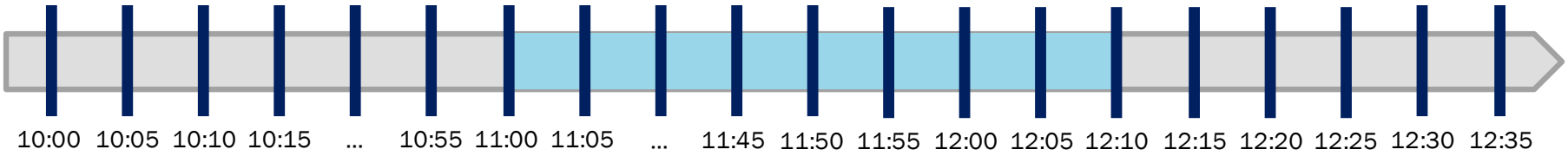
$Adj_{10:00,10:05,10:10}$ = (Average of Actual Metered Load Data) – (Average of Unadjusted 5-minute ECBL) for 5-min time intervals: 10:00, 10:05, 10:10

Start of Aggregation Dispatch

End of Aggregation Dispatch



Adjusted 5-minute $ECBL_{11:00}$ = Unadjusted 5-minute $ECBL_{11:00}$ + $Adj_{10:00,10:05,10:10}$

Adjusted 5-minute $ECBL_{11:05}$ = Unadjusted 5-minute $ECBL_{11:05}$ + $Adj_{10:00,10:05,10:10}$

and so on during dispatch period …

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Review of NYISO Ancillary Service Baseline for DSASP

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- Today the real-time response of a Demand Side Ancillary Service Program (DSASP) resource is calculated by taking its baseload prior to a dispatch event minus its actual metered load
- DSASP resources can provide 10-minute or 30-minute operating reserves and regulation service
- The baseload value is carried throughout the entire duration of the dispatch
- NYISO proposes to use the same methodology from DSASP to determine the response of a Load Reduction resource contributing to a regulation dispatch of an Aggregation
  - The methodology used in DSASP adequately captures the response information needed by the NYISO for a resource providing regulation movement

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Response Calculation Methodology of Curtailment Resources within a Aggregation

4/26 MIWG

- **The NYISO proposes to use the aforementioned baselines to prescribe how an aggregator is to calculate the Load Reduction response of a resource such that it can be incorporated into the Aggregation's total Load Reduction response:**
  - When an Aggregation is dispatched for energy and reserves, the aggregator is to calculate any Load Reduction response by taking the difference (MW) of (1) its Adjusted 5-minute ECBL and (2) its current 6-second resource load,
  - When an Aggregation is dispatched for regulation, the aggregator is to calculate any Load Reduction response by taking the difference (MW) of (1) its baseload prior to start of dispatch for regulation service and (2) its current 6-second resource load, akin to the methodology used for existing DSASP resources
    - If the Aggregation was dispatched for energy only prior to being dispatched for regulation, the aggregator is to use a Load Reduction resource's 6-second resource load during the time interval prior to dispatch plus its calculated response for the same time interval to calculate its "baseload prior to start of dispatch for ancillary regulation"

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Response Calculation Methodology of Load Reduction Resources within an Aggregation – Energy Only Example

4/26 MIWG

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	N	N	N
Agg Scheduled for Regulation	N	N	N	N	N	N
Resource Load	1.00	1.05	1.05	1.60	1.70	1.75
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Load Reduction Response	0.70	**0.65**	0.65	0	0	0

Load Reduction Response at 10:59:48

= Unadjusted 5-minute ECBL @ 10:59:48 + In-Day Adjustment @ 10:59:48 – Resource Load @ 10:59:48

= 2.00 MW + (-0.30 MW) – 1.05 MW

= 0.65 MW

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Response Calculation Methodology of Load Reduction Resources within an Aggregation – Regulation Only Example

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	N	N	N	N	N	N
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.75	1.85	1.70	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Load Reduction Response	0	0	0	**0.10**	0	-0.15

Load Reduction Response at 11:00:00

= Baseload Prior to Regulation Dispatch – Resource Load @ 11:00:00

= (Resource Load @ 10:59:54 + Load Reduction Response @ 10:59:54) - Resource Load @ 11:00:00

= (1.70 MW + 0 MW) – 1.60 MW

= 0.10 MW

Response Calculation Methodology of Load Reduction Resources within an Aggregation – Energy and Regulation Example

4/26 MIWG

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	Y	Y	Y
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.00	1.05	1.05	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Load Reduction Response	0.70	**0.65**	0.65	0.10	0	-0.15

Load Reduction Response at 10:59:48

= Unadjusted 5-minute ECBL @ 10:59:48 + In-Day Adjustment @ 10:59:48 – Resource Load @ 10:59:48

= 2.00 MW + (-0.30 MW) – 1.05 MW

= 0.65 MW

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Response Calculation Methodology of Load Reduction Resources within an Aggregation – Energy and Regulation Example, cont'd

4/26 MIWG

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	Y	Y	Y
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.00	1.05	1.05	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Load Reduction Response	0.70	0.65	0.65	**0.10**	0	-0.15

Load Reduction Response at 11:00:00

= Baseload Prior to Regulation Dispatch – Resource Load @ 11:00:00

= (Resource Load @ 10:59:54 + Load Reduction Response @ 10:59:54) - Resource Load @ 11:00:00

= (1.05 MW + 0.65 MW) – 1.60 MW

= 0.10 MW

Settlements & Revenue Metering

NYISO's Approach to Settlements

Settlements Approach

- The distinction for settlements, as it will pertain to Revenue Metering and Telemetry, will be that the NYISO has to account for the following aspects of each DER Aggregation when evaluating performance:
  - Energy Injection from Generation units
  - Load Reduction provided as Supply from Demand Side Resources
    - To account for FERC Order No. 745
  - Energy Withdrawal from Eligible Generators
- This will be implemented by separating the Telemetry signals and the Revenue Meter files into distinct data sets for Settlements processing

Aggregation Energy Withdrawal Treatment

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Energy Withdrawals by Aggregations

- **An Aggregation may conceivably have a negative operating range if there are any ESR contained in the Aggregation**
  - Example: Aggregation contains 3 – 1MW small generators and 1 – ESR with a -2MW to +2MW range
    - Aggregation operating range would be -2 to +5

Aggregation Bids to Withdraw Energy

10/9 MIWG

- **An aggregator's ability to bid to withdraw Energy for an Aggregation will be determined when an individual ESR enters or leaves the Aggregation**
- **If the Aggregation does not contain individual ESR, it will not have the ability to bid to withdraw Energy**
  - This will be a limitation set with each new DER enrolled within an Aggregation
  - Required for the reason that all Aggregations will have access to a sub-component of ESR bid parameters

Energy Balancing

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Energy Balancing with Generation

10/9
MIWG

- **Aggregators will be allowed to balance individual DER response within the Aggregation to achieve Aggregation dispatch**
- **Example:**
  - Aggregation contains one 5 MW ESR and one 4 MW generator
  - Aggregation bids in and is scheduled to charge 1 MW
  - The ESR charges at 5 MW while running its generator at 4 MW
    - Aggregation response = -5 MW of ESR + 4 MW of injection = - 1 MW
    - The Aggregation would be invoiced for 1 MW of Energy withdrawals from the wholesale market

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Energy Balancing with Load Reduction

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- **Load Reduction DER within an Aggregation may provide balancing within the Aggregation if the Real-time LBMP is greater than the Net Benefits Test (NBT) threshold price**
  - Aggregation contains one 5 MW ESR and 4 MW of load reduction
  - Aggregation bids to charge 1 MW at $25
  - NBT is $22; LBMP is $29
  - Aggregation is scheduled to charge 1 MW
  - The ESR charges at 5 MW while the Aggregation is providing 4 MW of load reduction
  - Aggregation response = -5MW of ESR + 4 MW of load reduction = -1 MW
  - Aggregation is invoiced for 1 MW at LBMP

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Energy Balancing with Load Reduction, con't

- **If the NBT threshold price is less than the Real-time LBMP, Load Reduction DER within a Aggregation will not be permitted to provide balancing within the Aggregation**
- **Example:**
  - Aggregation contains one 5 MW ESR and 4 MW of load reduction
  - Aggregation bids to charge 1 MW at $25
  - NBT is $35; LBMP is $29
  - Aggregation is scheduled to charge 1 MW
  - The ESR charges at 5 MW while the Aggregation is providing 4 MW of load reduction
  - Aggregation response = -5MW of ESR + 4 MW of load reduction = -1 MW
  - Load Reduction component of Aggregation response is not credited to the Aggregation because Real-time LBMP was below the NBT threshold price; Aggregation is invoiced for all 5 MW of Energy withdrawals
- **Aggregation may also be penalized for failing to follow dispatch instructions (i.e., over-withdrawal charges)**

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Application of FERC Order No. 745 Net Benefits Test

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Time of Application

7/26 MIWG

- **The NYISO will apply its NBT as an after-the-fact evaluation**
  - NYISO will continue to calculate a monthly NBT value applicable to Curtailment resources participating in the DER participation model
  - NYISO will perform an evaluation of an Aggregation's bids and telemetry data during the settlements process
  - Application of the NBT during the settlements process instead of as an Offer Floor will allow aggregators to bid in Demand Side Resource in the energy markets at any dollar value
    - If the clearing price for energy is greater than the monthly NBT value, Curtailment resources would be eligible for payment
    - If the clearing price for energy is less than the monthly NBT value, Curtailment resources would not be paid (notwithstanding its contribution to the Aggregation's response to the dispatch signal)
      - Curtailment resource performance will be included in the evaluation of whether an Aggregation meets its basepoint signal, regardless of whether those resources are eligible for payment.

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Application/Overview of Order 745

7/26
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- DER will be required to buy out of their Day-Ahead positions when their Real-Time schedule and performance differs from Day-Ahead subject to the Net Benefits Threshold
- NYISO Day-Ahead transactions
  - Do not guarantee dispatch in Real Time
    - Real-Time dispatch is re-evaluated with the incorporation of Real-Time bids
    - Aggregations are dispatch only and will not be considered for startup in NYISO's Security Constrained Unit Commitment (SCUC) evaluation and will not receive commitment

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Application/Overview of Order 745, con't

7/26 MIWG

- **For these reasons, the NYISO will conduct the after-the-fact Net Benefits Test evaluation for Real-Time load reduction MW only**
  - For the purposes of balancing obligation determination, Real-Time load reduction MW would only be considered if the Real-Time LBMP is greater than or equal to the Net Benefits Test threshold
  - This presentation, in the section labeled "Bidding and Settlements", describes this calculation in three steps:
    - A buy-out of the Day-Ahead scheduled MW at Real-Time LBMP
    - Payments to the Real-Time Injection MW at Real-Time LBMP
    - Payments to the Real-time Load Reduction Response MW at Real-Time LBMP with consideration for the Net Benefits Test threshold

Application/Overview of Order 745, con't

7/26
MIWG

- **The NYISO is not proposing a change to the application of the Cost-Allocation Methodology**
  - Order No. 745 cost-allocation methodology will be applied for Aggregation's load reduction response
- **DADRP currently disallows Aggregations across multiple LSEs**
  - The NYISO has determined that this requirement is not necessary for the implementation of DER

BPCG & DAMAP Eligibility

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DER & Commitment

- Aggregations are dispatch only resources and will not receive commitment
- BPCG is a cost guarantee primarily for resources which are committed in either the Day-Ahead or Real-Time Markets
  - More on following slides

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DER BPCG Eligibility

- **Aggregations will be eligible for BPCG, including:**
  - Recovery of as-bid costs over the applicable time period (Day-Ahead or real-time) being SRE'd or dispatched OOM for reliability
- **BPCG eligibility for Load Reduction DER is contingent on the supply provided by the resource being economic, where the LBMPs are equal to or higher than the NBT value**

DER DAMAP Eligibility

- **DAMAP protects Day-Ahead Margins that are lost as a result of Real-Time dispatch instructions provided by the NYISO**
  - Protecting Generators' Day-Ahead Margins incentivizes them to respond to NYISO instructions in RT
  - Generators that offer as ISO-Committed Flexible or Self-Committed Flexible for the same hours in the DAM and RTM are eligible for DAMAP (among certain other categories of Suppliers)
  - DAMAP is generally reduced or eliminated when Generators decrease their availability in RT

DAMAP Eligibility, DER Aggregations

- **All Aggregations are dispatch only resources**
  - Aggregations will not receive a commitment
- **DER Aggregations will not have a "Day-Ahead Margin" to protect**
  - DER and ESR Aggregations will have intertemporal energy constraints that limit their injecting/withdrawing capabilities For these reasons, the NYISO's DAMAP eligibility for DER Aggregations will follow the same recommendation as that for ESRs[1]
  - Eligible only when committed OOM for reliability reasons

1. ESR Market Design Updates (MIWG, September 21st, 2018)

DAMAP & BPCG Eligibility, Other Aggregations

- All other Aggregations may qualify for the DAMAP & BPCG rule set for that governing participation model
  - Example: An Aggregation consisting of only generators may qualify for BPCG & DAMAP as would a single generator

Additional Energy Market Concepts

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Additional Energy Market Concepts

- **At this time the NYISO does not believe the calculations on the following slides need to be modified and will be implemented based on the type of supply provided by an Aggregation**
  - Calculation used will be determined based on supply provided by presence of either a Withdrawal-Eligible Generator or Load Reduction
  - Over-withdrawal/Undergen penalties will be applied per the NYISO Order 841 filing on December 3rd, 2018, when an Aggregation contains a Withdrawal-Eligible Generator
  - Supply provided by Load Reduction when the LBMP is below the NBT Offer Floor
    - Not eligible for Energy payment

Calculations

- Reserve Settlements
- Regulation Settlements
- Undergen Penalty Calculations
  - Calculation used determined on presence of a Withdrawal-Eligible Generator
- Overwithdrawal Penalty
  - Calculation used determined on presence of a Withdrawal-Eligible Generator
- Regulation Penalty

DER/Facility Meter Configurations

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Metering Configurations

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- The following examples will build up from the individual DER/Facility level to the Aggregation as a whole

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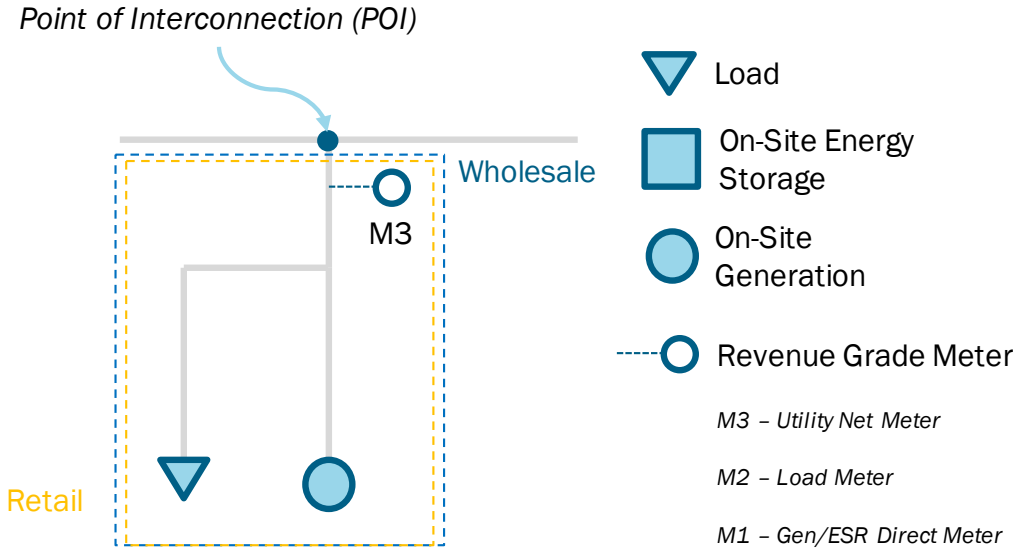
1 - Net-Metered, no ESR

- A net-metered facility/DER without ESR may participate as an injection, load reduction or both type resource



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2A – Facility/DER with no injection, ESR does not inject

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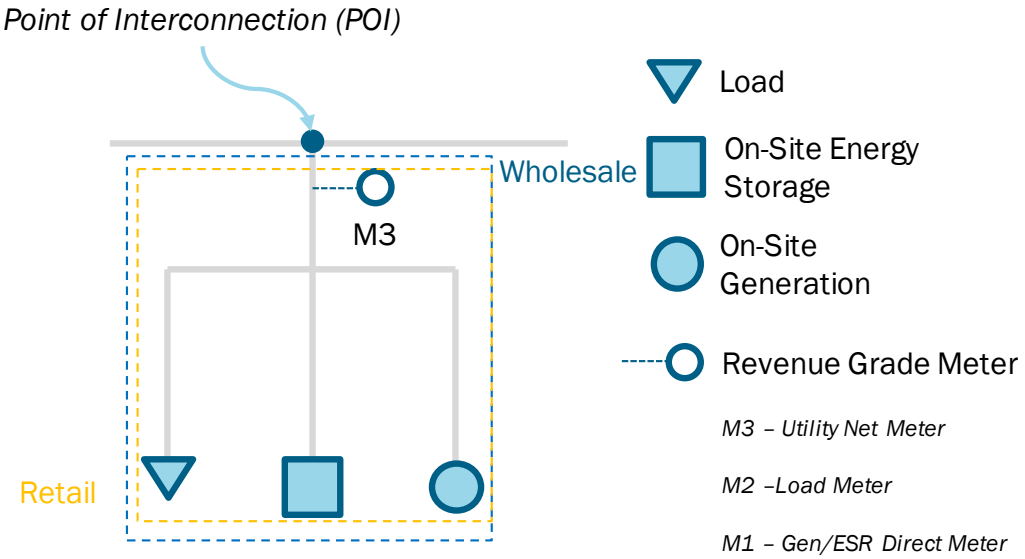
- If facility/DER has an ESR asset which does not inject into the grid, it will be considered a load-reduction asset and be net-metered



2B – Injecting Facility/DER , with Load and Wholesale ESR

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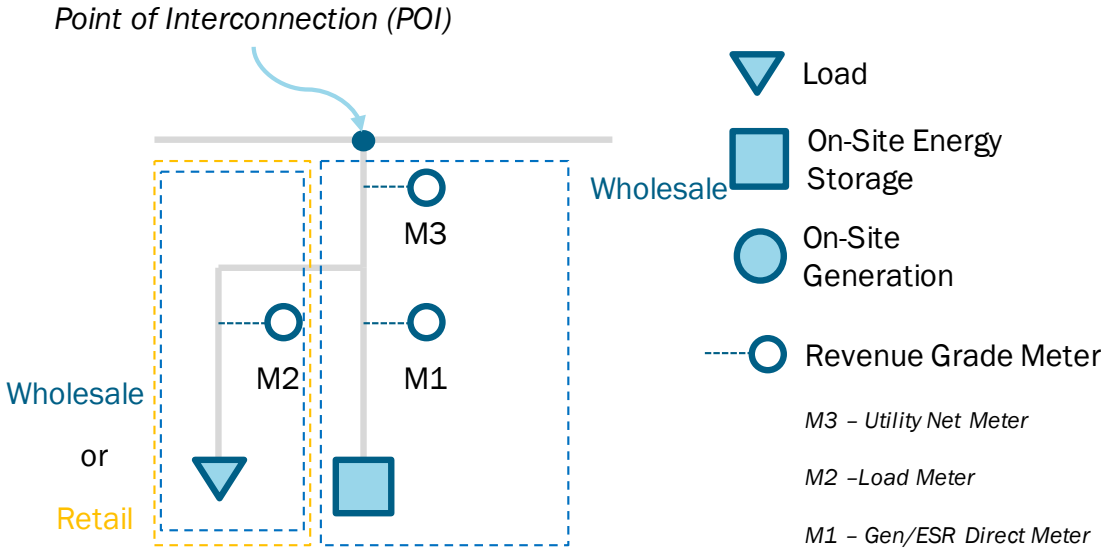
- A facility/DER with ESR will require both the ESR and the load to be metered separately
- The Load and ESR could participate as separate DER within the Aggregation
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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3 – Multiple generating assets with ESR

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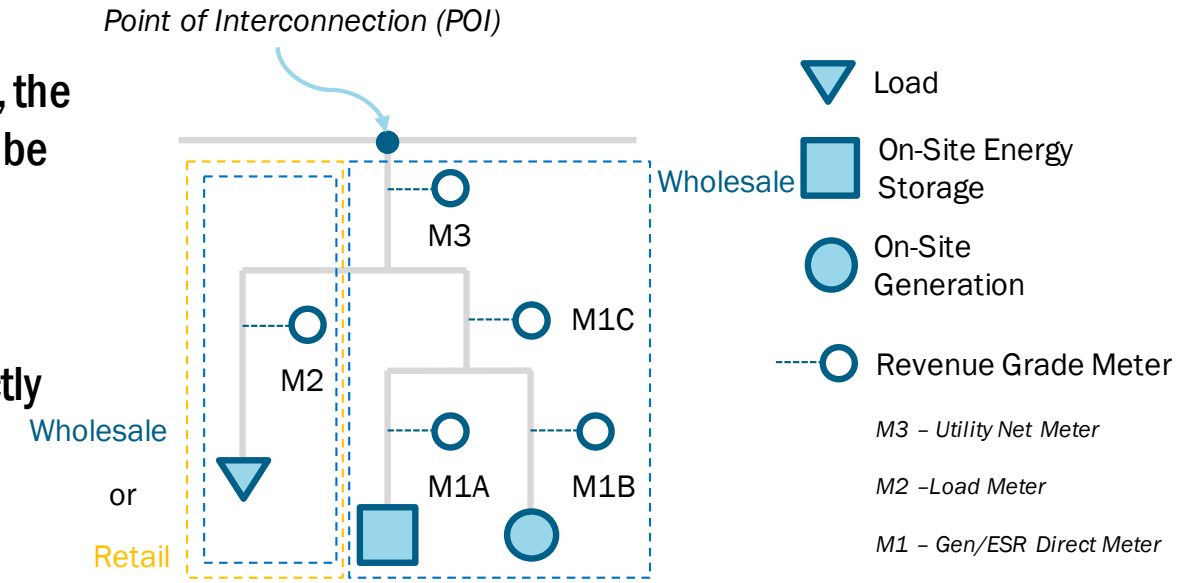
- If facility/DER has an ESR asset in addition to other generating assets, the ESR & other generating assets may be "group" or separately metered
  - M1C, or;
  - Both M1A & M1B
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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Metering Configurations Overview

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- Only facilities/DER with wholesale ESR assets which are looking to inject, are required to utilize separate metering configurations
- If assets are separately metered with approved metering devices at the same location, they will be regarded as separate and distinct Facilities/DER
  - Regardless of physical location

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Aggregation Measurement & Verification

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DER Response

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- **DER within an Aggregation can provide injection response and load reduction response in the same 5-minute LBMP interval**
  - Load with on-site generation may perform both Load reduction (either through curtailing the Load or shifting the Load to on-site generation) and injection into the grid at the same interval

DER Response, con't

6/19 MIWG

- **Telemetry and revenue/settlement data submittals for an Aggregation shall be provided by the aggregator, using the following calculation:**
  - For net-injection component of individual DER response:
    - Injection Response = max(0, Net Meter Value) (1)
  - For net-load reduction component of individual DER response:
    - Load Reduction Response = max(0, Baseline + min(0, Net Meter Value)) (2)
  - Total Response= (1) + (2)
    - Coincident injection and reduction response for the same resource shall be measured separately, telemetered separately and submitted in the separate and applicable meter files for settlements
- **Sign convention used for DER response calculation:**
  - 'Baseline' is always non-negative
  - 'Net Meter Value' is negative when DER is net-withdrawing from the grid, and positive when DER is net-injecting into the grid as measured at the net facility meter

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Injection and Load Reduction-No Dispatch

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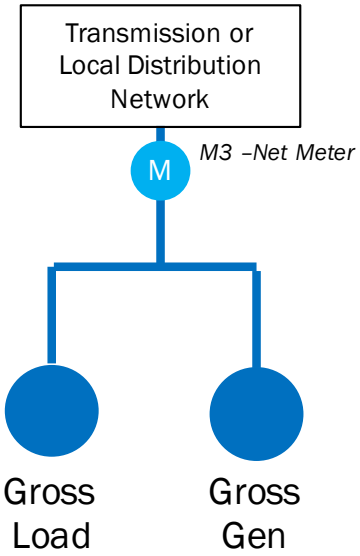
- **DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation**
- **At the start of that 5-minute interval:**
  - The Aggregation is not dispatched by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 0 MW
- **Injection component:**
  - At the point of interconnection (i.e. M3) there is 2 MW of Load
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, -2)
  - Injection Response = 0, Therefore the Injection response of the DER is 0 MW
- **Load Reduction component:**
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads -2 MW
  - Load Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Load Reduction Response = max(0, 2 + min(0,-2))
  - Load Reduction Response = 0, Therefore, Load Reduction response of the DER is 0 MW



Total Response=
Injection + Load Reduction
Total Response = 0 MW

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Injection & Load Reduction Response-Only Load Reduction

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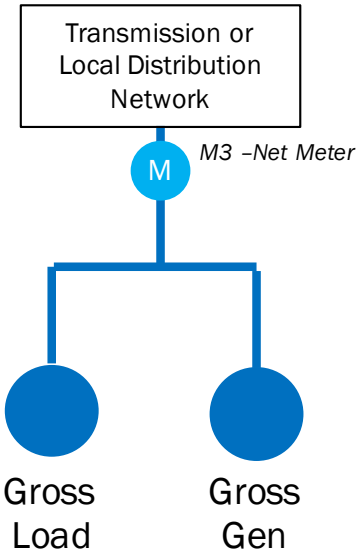
- **DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation**
- **At the start of that 5-minute interval:**
  - The Aggregation is dispatched for 2 MW by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 2 MW
- **Injection component:**
  - At the point of interconnection (i.e. M3) there is 0 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 0)
  - Injection Response = 0, Therefore the Injection response of the DER is 0 MW
- **Load Reduction component:**
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 0 MW
  - Load Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Load Reduction Response = max(0, 2 + min(0,0))
  - Load Reduction Response = 2, Therefore, Load Reduction response of the DER is 2 MW



Total Response=
Injection + Load Reduction
Total Response = 2 MW

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Injection and Load Reduction Response-Injection and Load Reduction – Example 1

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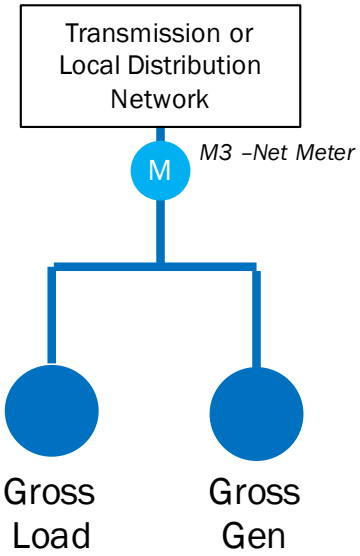
- DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation
- At the start of that 5-minute interval:
  - The Aggregation is dispatched for 4 MW by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 4 MW
- Injection component:
  - At the point of interconnection (i.e. M3) there is 2 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 2)
  - Injection Response = 2, Therefore the Injection response of the DER is 2 MW
- Load Reduction component:
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 2 MW, a net injection
  - Load Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Load Reduction Response = max(0, 2 + min(0,2))
  - Load Reduction Response = 2, Therefore, Load Reduction response of the DER is 2 MW



Total Response=
Injection + Load Reduction
Total Response = 4 MW

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Injection and Load Reduction Response-Injection and Load Reduction – Example 2

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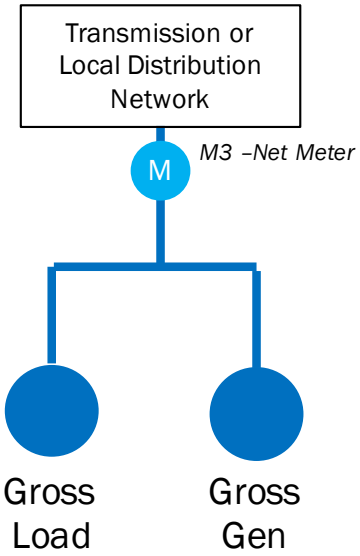
- DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation
- At the start of that 5-minute interval:
  - The Aggregation is dispatched for 4 MW by the NYISO
  - The facility baseline load is 2 MW
  - The facility load curtails 2 MW, the generator outputs 2 MW
- Injection component:
  - At the point of interconnection (i.e. M3) there is 2 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 2)
  - Injection Response = 2, Therefore the Injection response of the DER is 2 MW
- Load Reduction component:
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 2 MW, a net injection
  - Load Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Load Reduction Response = max(0, 2 + min(0,2))
  - Load Reduction Response = 2, Therefore, Load Reduction response of the DER is 2 MW



Total Response=
Injection + Load Reduction
Total Response = 4 MW

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Other

Mitigation

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DER Mitigation – Energy

- **The NYISO has not identified the need for any additional market mitigation measures specifically for the DER participation model at this time**
  - Individual DER, aggregators and Market Participant portfolios containing DER will be subject to existing mitigation measures

Dual Participation

10/9
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Dual Participation

- **The NYISO is working to allow resources that provide services to another entity (*e.g.,* the utility or a host facility) to also provide Wholesale Market services**
  - The NYISO believes that providing resources with the flexibility to meet wholesale and distribution system needs will deliver the maximum benefit to New York electricity customers
  - Resources participating in the wholesale markets will continue to be obligated to follow all applicable NYISO market rules and utilize good utility practices

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Expectations

- **Resources intending to meet additional obligations outside of the NYISO Markets, while also participating in the NYISO Markets and meeting obligations to the NYISO market will be required to:**
  - Appropriately offer into the wholesale markets and follow any schedules or obligations from the NYISO; and
  - Comply with all NYISO market rules for the services offered
    - Non-compliance may result in financial penalties

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Next Steps

- Review Energy Market Tariff
- Review Topics not Discussed Today
  - Interconnections/ERIS/CRIS
  - Capacity
  - Dual Participation

Feedback?

- Email additional feedback to: DER_Feedback@nyiso.com

Don’t forget the underscore

Appendix A: Settlements Example

Energy Settlement Calculations

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- To facilitate this implementation, new settlement calculations will be developed for Aggregations, which bid in the Day-Ahead market
- The following slides cover these Energy settlement calculations

Day Ahead

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- **Day-Ahead Market (DAM) Energy Settlement is the Day Ahead Schedule * the Day Ahead LBMP**
  - *DAM Energy Settlement = DAM Schedule * DAM LBMP*

Proposed Calculation, Real Time

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- **Next step, the Aggregation is bought out of its Day Ahead schedule and compensated for eligible Real Time performance**

  - RT Energy Settlement = (-DAM Energy Schedule * RT LBMP)

  *+ ((Min (Injection Response, RT Energy Schedule)) * RT LBMP)*

  *+ (If(NBT<RT LBMP, Min(Load Reduction Response, RT Energy Schedule – Injection Response) * (RT LBMP), 0))*

  - Breakdown on following slides

Proposed Calculation, con't

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- **RT Settlement, Step 1**
  - Buy out of the Day Ahead Energy Schedule
    - (-DAM Energy Schedule * RT LBMP)
- **RT Settlement, Step 2**
  - Compensate Aggregation for the max of the amount of Injection or the RT Energy schedule
    - + ((Min (Injection Response, RT Energy Schedule)) * RT LBMP)
- **RT Settlement, Step 3**
  - If the NBT is passed, compensate the Load Reduction portion of the Aggregation for the remaining performance, otherwise, pay zero for Load Reduction response
    - + (If(NBT<RT LBMP, Min(Load Reduction Response, RT Energy Schedule – Injection Response) * (RT LBMP), 0))

Proposed Calculation, exceptions

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- Implementation of calculation will additionally accommodate:
  - Charging/Negative Generation from ESRs
  - Allowance for Compensable Over Generation
    - 3%
- Regardless of these accommodations, the principles of the calculation remain the same
- Numerical examples follow this slide

Numerical Example

- **For the Numerical Example, assume the following;**
  - Aggregation comprises of both injection and curtailment
  - Order No. 745 NBT Offer Floor is not applied at time bid is accepted
  - The aggregator can bid all technologies, including DR, at any price
  - DR within the Aggregation could be dispatched below it's applicable NBT threshold value (calculated monthly)
  - If final Real Time clearing price is below the existing NBT Offer Floor $ value, the result would be:
    - Entire Aggregation is dispatched, but;
    - DR portion is not paid

Numerical Example 1 – Day Ahead

- **For this example;**
  - Aggregation bids in entire Aggregation at $40
  - Monthly NBT threshold value is $35 (no evaluation in Day Ahead)
  - Day Ahead clearing price for each hour is $45
  - Real Time dispatch and performance is 1:1 with Day Ahead offer and schedule

Numerical Example 1 – Real Time

Time Interval	Dispatch Signal	Generation Response	Curtailment Response	Total Response to Dispatch	MWs Compensated
Hour 1	10	10	0	10	10
Hour 2	15	10	5	15	15
Hour 3	35	20	15	35	35

- For this example;
  - Economics;
    - Aggregation bids in entire Aggregation at $40
    - Monthly NBT threshold value is $35
    - Real Time clearing price for each hour is $50
    - The NBT is lower than the offer price & clearing price
  - The Aggregation responded perfectly to dispatch
- Generation would get paid per current settlement rules for each of the three hours
- Order No. 745 cost allocation would be applied to the curtailment response for Hours 2 & 3

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Numerical Example 1 – Settlements

- **During Settlements the following would occur for Hour 1:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 10 MWs
    - RT Dispatch: 10 MWs
    - RT MW Injection Response: 10 MWs
    - RT MW Load Reduction Response: 0 MWs
    - RT Price: $50
    - NBT: $35
  - DAM Calculation For Hour 1:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - RT Calculation For Hour 1:
    - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT<LBMP, Min(Load Reduction Response, RT Schedule – Injection Response) * (RT LBMP), 0)

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Numerical Example 1 – Settlements, con't

- **During Settlements the following would occur for Hour 1:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 10 MWs
    - RT Dispatch: 10 MWs
    - RT MW Injection Response: 10 MWs
    - RT MW Load Reduction Response: 0 MWs
    - RT Price: $50
    - NBT: $35
  - DAM Calculation For Hour 1:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - DAM Calculation For Hour 1:
    - DAM Settlement = (10 MWs* $45) = $450
  - RT Calculation For Hour 1:
    - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT<LBMP, Min(Load Reduction Response, RT Schedule – Injection Response) * (RT LBMP), 0)
  - RT Calculation For Hour 1:
    - RT Settlement = (-10 MWs * $50) + ((Min (10 MWs, 10MWs)) * $50) + (If($35 < $50, Min(0 MWs, 10MWs – 10 MWs) * ($50), 0)

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Numerical Example 1 – Settlements, con't

- DAM Calculation For Hour 1:
  - DAM Settlement = (10 MWs* $45) = $450
- RT Calculation For Hour 1:
  - RT Settlement = (-10 MWs * $50) + ((Min (10 MWs, 10MWs)) * $50) + (If($35 < $50, Min(0 MWs, 10MWs – 10 MWs) * ($50), 0)
- RT Calculation For Hour 1:
  - RT Settlement = (-$500) + ($500) + (0) = $0

Numerical Example 1 – Settlements, con't

- **During Settlements the following would occur for Hour 2:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 15 MWs
    - RT Dispatch: 15 MWs
    - RT MW Injection Response: 10 MWs
    - RT MW Load Reduction Response: 5 MWs
    - RT Price: $50
    - NBT: $35
  - DAM Calculation For Hour 2:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - DAM Calculation For Hour 2:
    - DAM Settlement = (15 MWs* $45) = $675
  - RT Calculation For Hour 2:
    - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT<LBMP, Min(Load Reduction Response, RT Schedule – Injection Response) * (RT LBMP), 0)
  - RT Calculation For Hour 2:
    - RT Settlement = (-15 MWs * $50) + ((Min (10 MWs, 15MWs)) * $50) + (If($35 < $50, Min(5 MWs, 15MWs – 10 MWs) * ($50), 0)

Numerical Example 1 – Settlements, con't

- DAM Calculation For Hour 2:
  - DAM Settlement = (15 MWs* $45) = $675
- RT Calculation For Hour 2:
  - RT Settlement = (-15 MWs * $50) + ((Min (10 MWs, 15MWs)) * $50) + (If($35 < $50, Min(5 MWs, 15MWs – 10 MWs) * ($50), 0)
- RT Calculation For Hour 2:
  - RT Settlement = (-$750) + ($500) + ($250) = $0

Numerical Example 2 – Day Ahead

- **For this example:**
  - Aggregation bids in entire Aggregation at $40
  - Monthly NBT threshold value is $35 (no evaluation in Day Ahead)
  - Day Ahead clearing price for each hour is $45
  - ***In Real-time, Aggregation is dispatched for MWs above its Day Ahead schedule in Hour 1***

Numerical Example 2 – Settlements, con't

- **During Settlements the following would occur for Hour 1:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 10 MWs
    - RT Dispatch: 11 MWs
    - RT MW Injection Response: 11 MWs
    - RT MW Load Reduction Response: 0 MWs
    - RT Price: $50
    - NBT: $35
  - DAM Calculation For Hour 1:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - DAM Calculation For Hour 1:
    - DAM Settlement = (10 MWs* $45) = $450
  - RT Calculation For Hour 1:
    - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT<LBMP, Min(Load Reduction Response, RT Schedule – Injection Response) * (RT LBMP), 0)
  - RT Calculation For Hour 1:
    - RT Settlement = (-10 MWs * $50) + ((Min (11 MWs, 11MWs)) * $50) + (If($35 < $50, Min(0 MWs, 11MWs – 11 MWs) * ($50), 0)

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Numerical Example 2 – Settlements, con't

- DAM Calculation For Hour 1:
  - DAM Settlement = (10 MWs* $45) = $450
- RT Calculation For Hour 1:
  - RT Settlement = (-10 MWs * $50) + ((Min (11 MWs, 11MWs)) * $50) + (If($35 < $50, Min(0 MWs, 11MWs – 11 MWs) * ($50), 0)
- RT Calculation For Hour 1:
  - RT Settlement = (-$500) + (***$550***) + (0) = ***$50***

Numerical Example 3 – Day Ahead

- **For this example;**
  - Aggregation bids in entire Aggregation at $40
  - Monthly NBT threshold value is $35 (no evaluation in Day Ahead)
  - Day Ahead clearing price for each hour is $45
  - ***Real Time prices are lower than Day Ahead prices***

Numerical Example 3 – Settlements, con't

- **During Settlements the following would occur for Hour 1:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 10 MWs
    - RT Dispatch: 10 MWs
    - RT MW Injection Response: 10 MWs
    - RT MW Load Reduction Response: 0 MWs
    - RT Price: $40
    - NBT: $35
  - DAM Calculation For Hour 1:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - DAM Calculation For Hour 1:
    - DAM Settlement = (10 MWs* $45) = $450
  - RT Calculation For Hour 1:
    - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT<LBMP, Min(Load Reduction Response, RT Schedule – Injection Response) * (RT LBMP), 0)
  - RT Calculation For Hour 1:
    - RT Settlement = (-10 MWs * $40) + ((Min (10 MWs, 10MWs)) * $40) + (If($35 < $40, Min(0 MWs, 10MWs – 10 MWs) * ($40), 0)

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Numerical Example 3 – Settlements, con't

- DAM Calculation For Hour 1:
  - DAM Settlement = (10 MWs* $45) = $450
- RT Calculation For Hour 1:
  - RT Settlement = (-10 MWs * $40) + ((Min (10 MWs, 10MWs)) * $40) + (If($35 < $50, Min(0 MWs, 10MWs – 10 MWs) * ($40), 0)
- RT Calculation For Hour 1:
  - RT Settlement = (-$400) + ($400) + (0) = $0

Appendix B: Transmission Nodes

Transmission Nodes - Identification

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Transmission Node Background

- Transmission Nodes reflect the collection of electrically similar facilities to which individual DER may aggregate as an Aggregation with a single PTID
- The DER Roadmap outlined the need to:
  - Consider all Transmission Nodes that allow the NYISO to best represent DERs impact on the transmission system
  - Deliver more granular pricing data to incent efficient locational investment

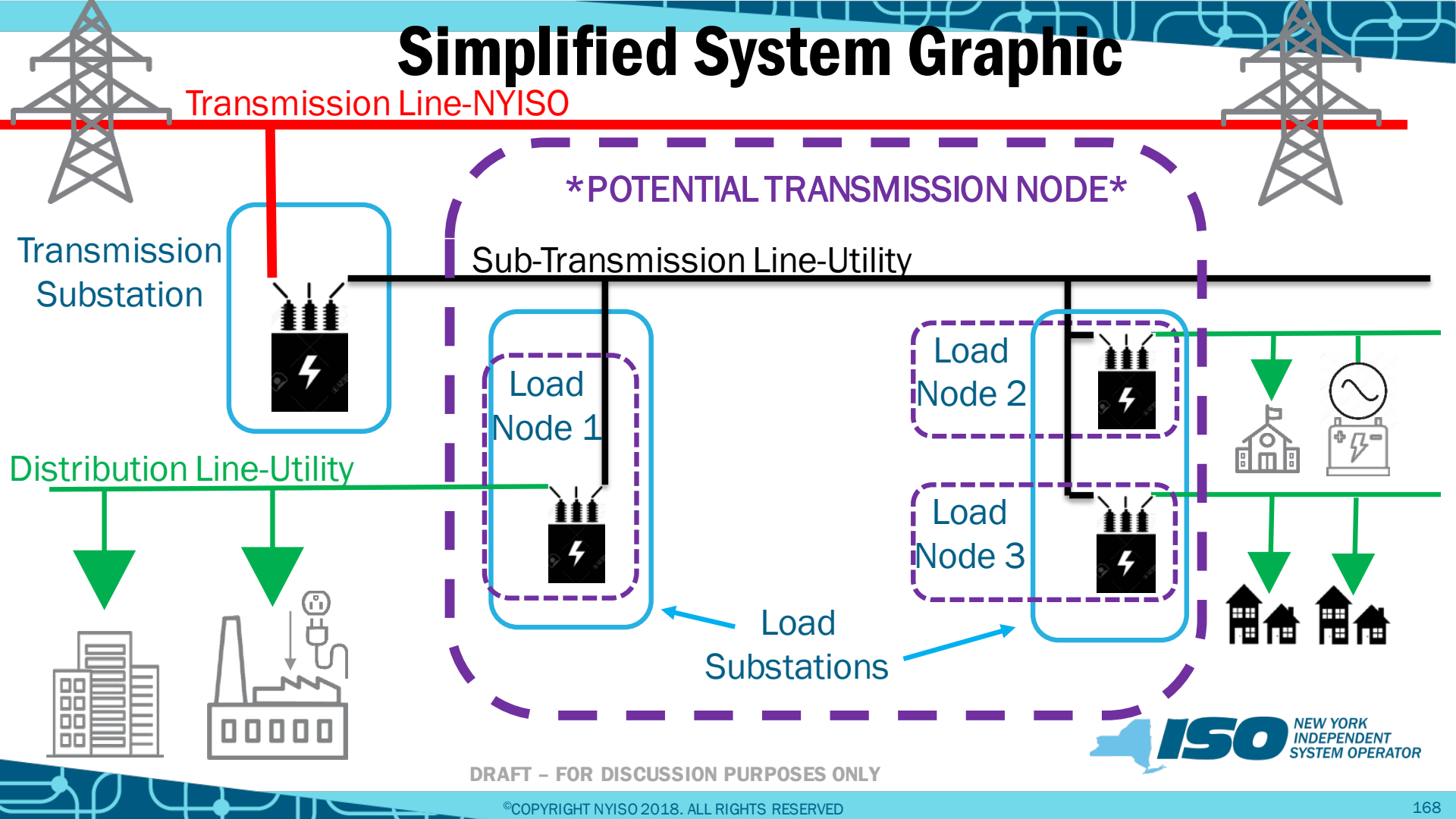
Transmission Node Pricing and DER Mapping

- Transmission Nodes will be priced individually, similar to generator nodes
- Transmission Node pricing will be calculated using the same LBMP calculation today:
  - LBMP=Marginal Energy + Transmission Congestion – Losses
- Transmission Nodes are for the purpose of wholesale market participation
  - The NYISO proposes to coordinate with the local distribution utility to manage any distribution level constraints in the process of identifying the electrical bounds of each Transmission Node

Load Nodes

- Load Nodes provide the most detail to the NYISO model
  - Load nodes are associated with distribution stepdown transformers at facilities below the transmission level NYISO currently secures
- While below a kV level that NYISO currently secures, DER interconnected at Load Nodes will face congestion and loss characteristics reflective of the transmission facilities that feed the load
- Load Nodes can be “mapped” up to the transmission system, but vary in paths based on the particular distribution owner service territory

Simplified System Graphic



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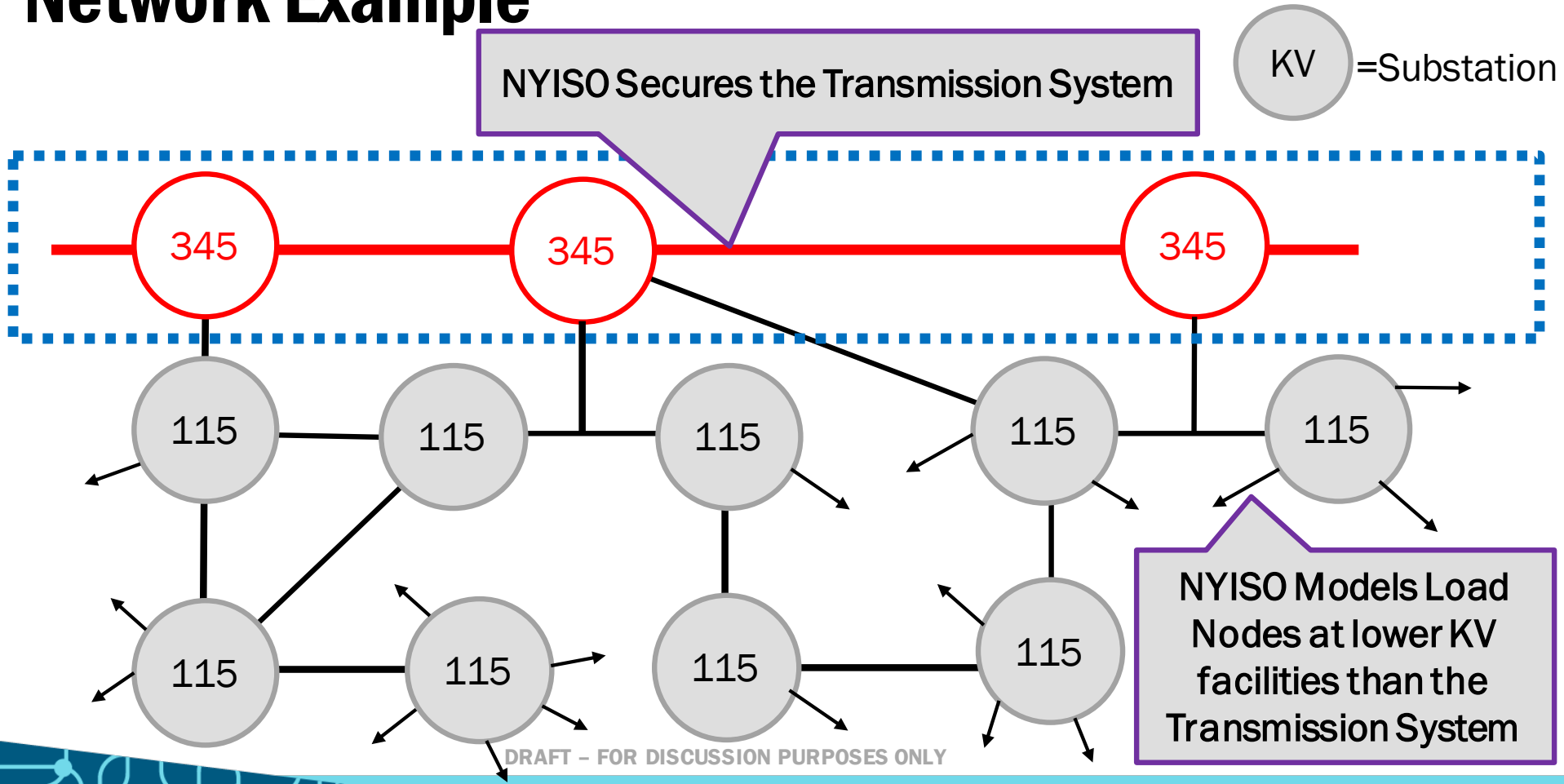
Network Example



NYISO Process

- **The NYISO will utilize a tiered evaluation of Load Nodes used by the NYISO and the Utilities to define each Transmission Node**
- **The NYISO will identify all substations with an associated Load Node and to which the NYISO has visibility shall be evaluated to be a potential Transmission Node**
  - The NYISO will identify radially bused substations as instances where substations may be grouped as a single Transmission Node
- **NYISO will additionally identify the step-down interfaces from the bulk electric system**
  - These interfaces will indicate the minimum Transmission Nodes needed to represent bulk transmission conditions within each zone

NYISO Process, cont'd

- **In the final step, the NYISO and the Utilities will identify distribution facilities on the distribution system that may be may be negatively impacted if DER aggregations are dispatched as a single PTID across such facilities**
  - These constraining distribution facilities might be:
    - Normally open circuits
    - Line overload potentials
    - Franchise demarcations
  - Once identified, distribution constraints will delineate the electrical bounds of either an expanded or constricted Transmission Node
- **No interfaces identified in the 100+ kV project may be grouped with other Load substations in a Transmission Node**
- **Transmission Nodes will be Utility and Sub-Zone specific**

Transmission Nodes - NYISO Review of Load Nodes

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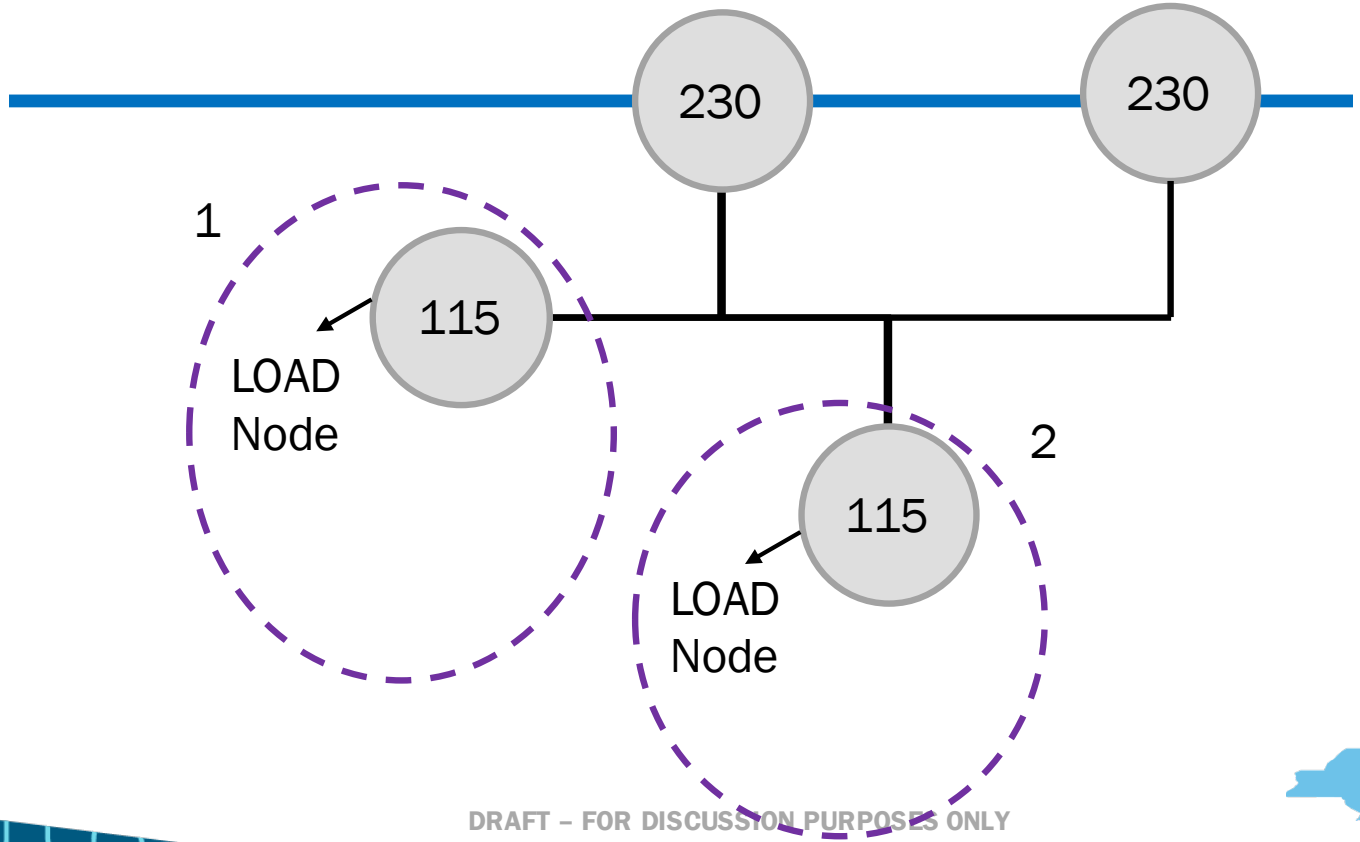
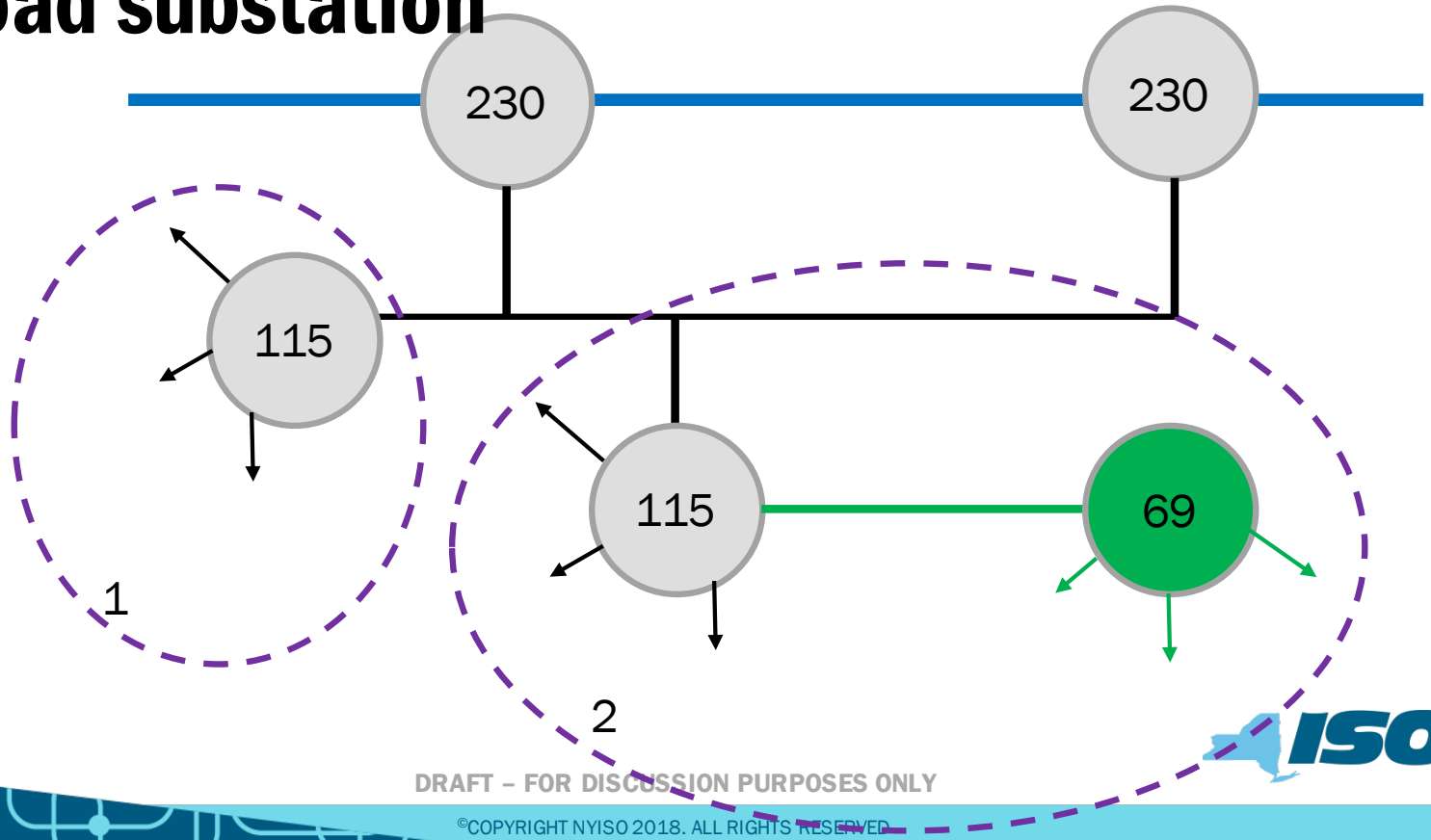
Default Case: 2 Transmission Nodes



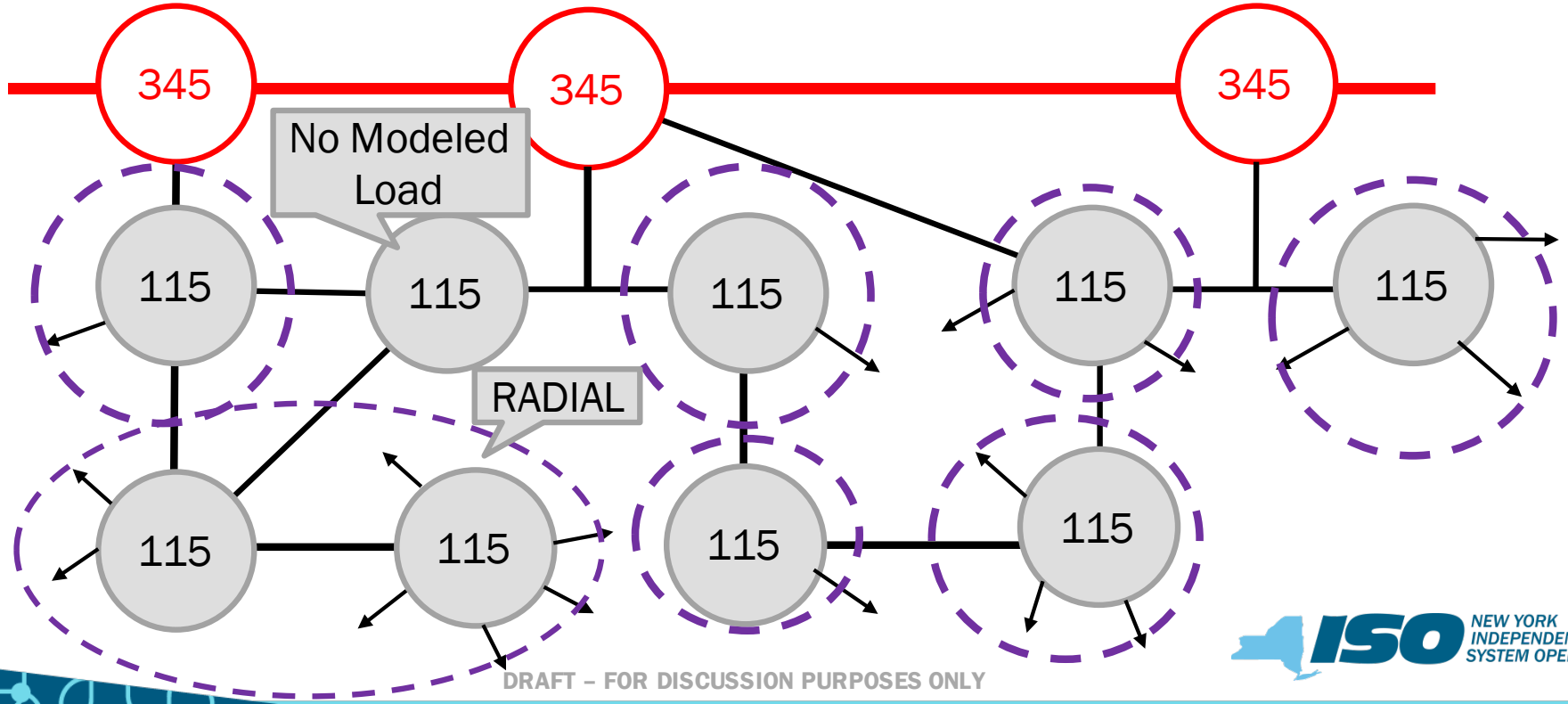
Transmission Node serving more than one Load substation

- Transmission Nodes may serve multiple Load substations when one Load substation is fed radially by another
  - When two Load substations radially connect to the same transmission substation there is no difference in transmission congestion between the 2 Load substations
    - Therefore, the NYISO will initially propose a Transmission Node that comprises both Load substations together

Transmission Node Including more than one Load substation



NYISO Initial Review



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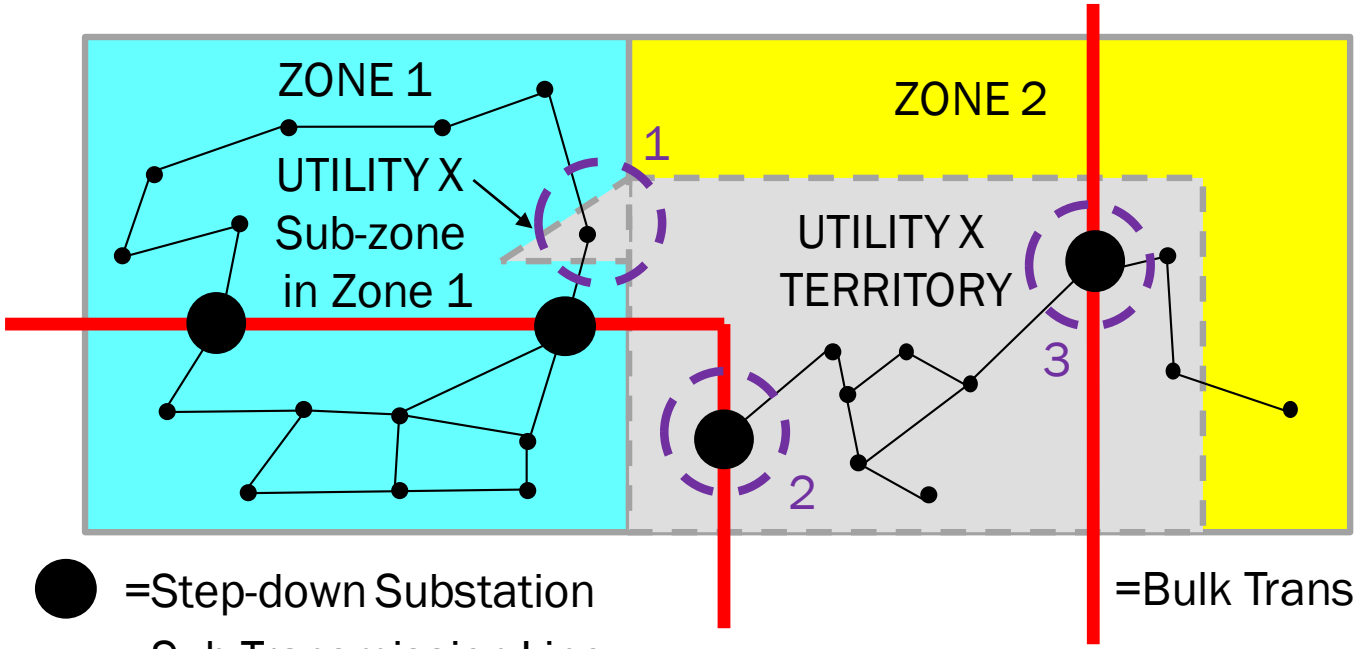
Minimum Nodes for each Zone

- NYISO intends to develop at least one Transmission Node per sub-zone
- Additionally there will be at least one Transmission Node per step-down interface from the bulk transmission system to distribution lines under Utility jurisdiction

Minimum Nodes for each Zone



UTILITY X will have a minimum of 3 Transmission Nodes

=Step-down Substation

=Sub-Transmission Line

=Load Substation

=Bulk Transmission Line

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Transmission Nodes - Utility Review of Load Nodes

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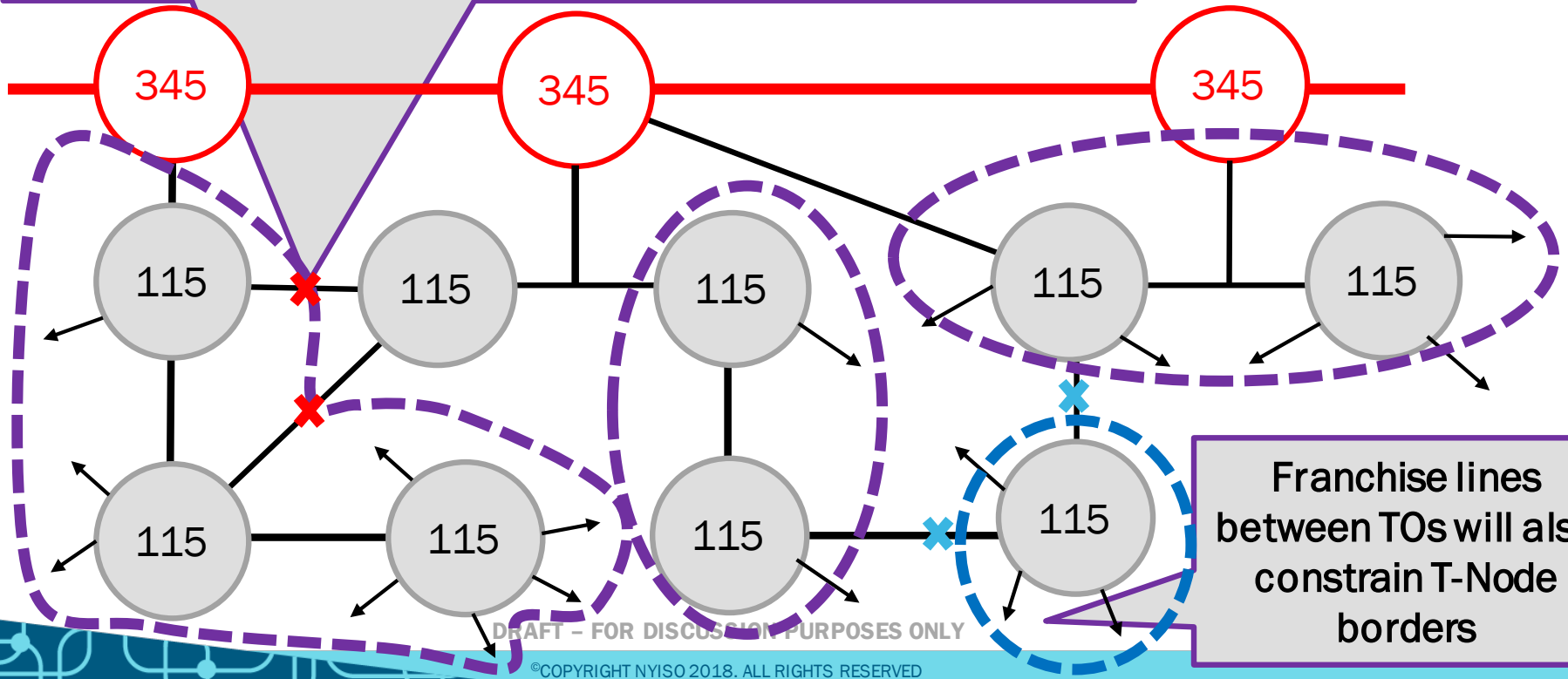
Utility Review of the Transmission Nodes

- **The applicable utility will identify the distribution facilities that DER should not aggregate across**
  - These facilities will be classified as a distribution constraint
    - Examples of constraints are: thermal overload potentials, franchise demarcations, and normally open circuits
- **The distribution constraints will delineate the circuits that can be considered electrically similar**
  - System sectionalization between Load Nodes at voltages lower than NYISO modeled Load Substations may necessitate multiple Transmission Nodes at a Load Substation
  - Multiple Load Substations can be considered electrically similar and may be combined into a single Transmission Node if no constraints are present between facilities

Potential Transmission Nodes after Utility Review

The potential for an overload between two 115 kV substations would prohibit DER to aggregate across the constraint



Franchise lines between TOs will also constrain T-Node borders

Transmission Nodes - Mechanics

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Splitting Transmission Nodes

- **Proliferation of DER has the potential to disrupt the current models for power flow on the Distribution System**
  - Circuits that can be considered electrically similar today, may diverge with increased wholesale dispatch of aggregated DER or a change in load shapes
- **A new operational distribution constraint may arise within the circuits of a single Transmission Node that is then aggravated by wholesale dispatch**
  - Issues that appear chronically, suggest that the Transmission Node at issue, would be best modeled as two or more discrete Transmission Nodes

Changes to the List Transmission Nodes

- **The initial list of Transmission Nodes created for the deployment of the DER participation model may be reviewed for potential changes:**
  - Prior to a planned, permanent change to the system topology
    - A new Load Substation may require a new Transmission Node
    - The relief of a previously binding distribution constraint may allow DER to aggregate within a larger circuit
  - As requested by the NYISO or the applicable Utility
    - Chronic out of market actions related to the re-dispatch of DER at a Transmission Node may indicate a need to review Transmission Node boundaries

Transmission Node Mechanics

- **A Transmission Node will be priced similarly to a Generator Node today**
  - All Aggregations mapped to the same Transmission Node will receive the same prices
  - Aggregations will be able to set price
- **There will be no external Transmission Nodes**

Transmission Node Overview

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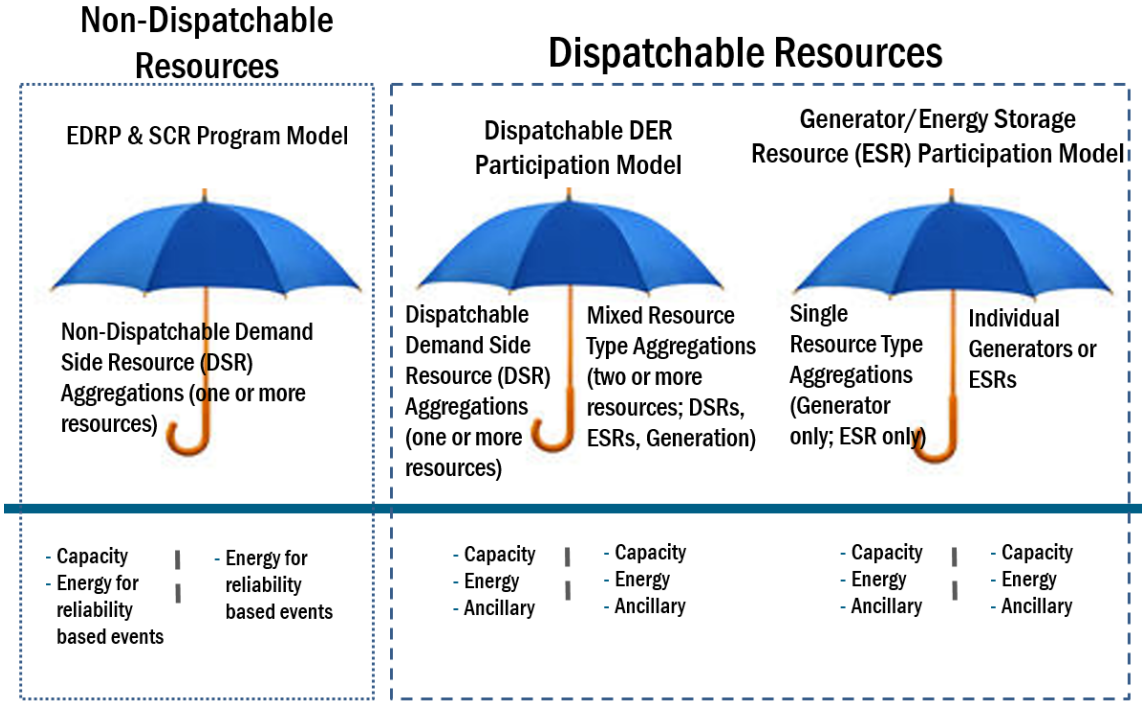
Transmission Node Overview

- ISO identified Transmission nodes are dynamic and may change over time
  - Based on changing topography/price separation
- The ISO shall review these changes on an annual basis and update, if needed
  - Addition/Removal/Merging of Transmission Nodes will take effect at the beginning of a Capability Year
- The Aggregator is responsible for notifying the ISO of the Aggregations in their portfolio which will be affected by these Transmission Node updates

Appendix C: All Participation Models

Participation Models Available to DER

6/19
MIWG



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Appendix D: Registration and Bidding Parameters for DER Facilities and Aggregations

Sample DER Facility Registration Parameters

DER	Category	Name
DER Facility	Registration	Facility Name
DER Facility	Registration	TO Account #, TO, TO Voltage Level
DER Facility	Registration	Physical address, Street, City, Zip (match utility bill)
DER Facility	Registration	Transmission Node
DER Facility	Registration	Zone
DER Facility	Registration	Facility Contact
DER Facility	Registration	Maximum MW injection limit
DER Facility	Registration	Maximum MW generation capability
DER Facility	Registration	Maximum MW load reduction capability
DER Facility	Registration	Maximum MW storage capability
DER Facility	Registration	DMNC/DMGC
DER Facility	Registration	Meter Authority
DER Facility	Registration	Metering configuration (net facility only or direct metering), Meter Device, Seriel #, Manufacturer, Model #, Accuracy
DER Facility	Registration	Telemetry Configuration (Alternative Telemetry/Real)
DER Facility	Registration	Interconnection Agreement (Yes/No/Not Applicable)
DER Facility	Registration	CRIS
DER Facility	Registration	Facility One-Line Diagram
DER Facility	Registration	DER Type : Injection, Load Reduction, Both
DER Facility	Registration	DER Asset type(s): Generator, Energy Storage, Curtailable Load, Hybrid (two or more of the other Asset types)
DER Facility	Registration	Generator Fuel Type
DER Facility	Registration	Nameplate Capacity
DER Facility	Registration	Asset kW Rating
DER Facility	Registration	Asset kW HR Rating
DER Facility	Registration	Asset Fuel Type
DER Facility	Registration	Emissions Compliance (Details of any environmental permit if applicable, otherwise Y/N)
DER Facility	Registration	Estimated DER Facility Host Load

Sample DER Aggregation Registration/Bid Parameters

DER	Category	Name
Aggregation	Registration	Maximum Run Time
Aggregation	Registration	Estimated Summer Operating Capacity
Aggregation	Registration	Estimated Winter Operating Capacity
Aggregation	Registration	Authorization Flag - Fixed Energy
Aggregation	Registration	Authorization Flag - Dispatch Energy
Aggregation	Registration	Authorization Flag - 10 Minute Spinning Reserves
Aggregation	Registration	Authorization Flag - 10 Minute Non-Synchronized Reserves
Aggregation	Registration	Authorization Flag - 30 Minute Non-Synchronized Reserves
Aggregation	Registration	Total Number of DER
Aggregation	Registration	ICCP Communication Installed
Aggregation	Registration	Target Commercial Operation Date
Aggregation	Registration	Communication and Data Management Plan
Aggregation	Registration/Bid	Emergency Response Rate
Aggregation	Registration/Bid	Regulation Capacity Response Rate
Aggregation	Registration/Bid	Normal Response Rate 1
Aggregation	Registration/Bid	Normal Response Rate 1
Aggregation	Registration/Bid	Normal Response Rate 2
Aggregation	Registration/Bid	Normal Response Rate 2
Aggregation	Registration/Bid	Normal Response Rate 3

DER Aggregation Parameters

DER	Category	Name
Aggregation	Bid	Market – DAM/RT
Aggregation	Bid	Date/Time (including each hour being offered)
Aggregation	Bid	Upper Operating Limit (MW)
Aggregation	Bid	Lower Operating Limit (MW)
Aggregation	Bid	Emergency Upper Operating Limit (MW)
Aggregation	Bid	Operating Mode: Self Committed Fixed and Self Committed Flex
Aggregation	Bid	Self Scheduled MW – 15 minute MW schedule values
Aggregation	Bid	Bid Curve (MW/$ per MW) – up to 11 point curve for positive supply and negative generation representing the incremental cost
Aggregation	Bid	Fuel Type (optional)
Aggregation	Bid	Burdened Fuel Price ($/mmBTU, optional)
Aggregation	Bid	10 Minute Spinning Reserves ($/MW) - single $ cost value (DAM only)
Aggregation	Bid	10 Minute Non-Synchronized Reserves ($/MW) – single $ cost value (DAM only)
Aggregation	Bid	30 Minute Spinning Reserves ($/MW) – single $ cost value (DAM only)
Aggregation	Bid	30 Minute Non-Synchronized Reserves ($/MW) – single $ cost value (DAM only)
Aggregation	Bid	Regulation Movement ($/MW) – single $ cost value (DAM & RTM)
Aggregation	Bid	Regulation Capacity (MW and $/MW) – both the MW amount and single $ cost value (DAM & RTM)
Aggregation	Bid	Unit Operation Offer Options
Aggregation	Bid	Fuel Type
Aggregation	Bid	Opportunity Cost

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits 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 policy makers, stakeholders and investors in the power system

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