NYISO Comprehensive Scarcity Pricing

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Increasing Market and Planning Efficiency through Improved Software

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NYISO Comprehensive Scarcity Pricing

- **Scarcity pricing is the process by which the NYISO includes the value of Emergency Demand Response Program (EDRP) resources and/or Special Case Resources (SCRs) in pricing outcomes during reliability demand response (DR) activations**
- **Comprehensive Scarcity Pricing (CSP) is a more efficient methodology of setting prices during such activations**
  - ***The objective is to ensure all resources are compensated on a comparable basis by reflecting DR activations directly within NYISO's scheduling tools***
  - ***CSP improves upon the NYISO's prior scarcity pricing methodology (Enhanced Scarcity Pricing)***

Improvement Upon Enhanced Scarcity Pricing

- Enhanced Scarcity Pricing used an ex-post methodology
  - *If DR resources were needed to avoid a shortage of reserves, then real-time prices were adjusted accordingly (i.e. set to a maximum of $500 or the resulting LBMP)*
- Issues
  - *Potential to cause inconsistencies between resource scheduling and pricing outcomes*
  - *Potential for higher uplift cost*
  - *Only applied to internal buses while excluding Proxy Generator Buses, resulting in an inconsistent price signal for imports and exports*

Comprehensive Scarcity Pricing Benefits

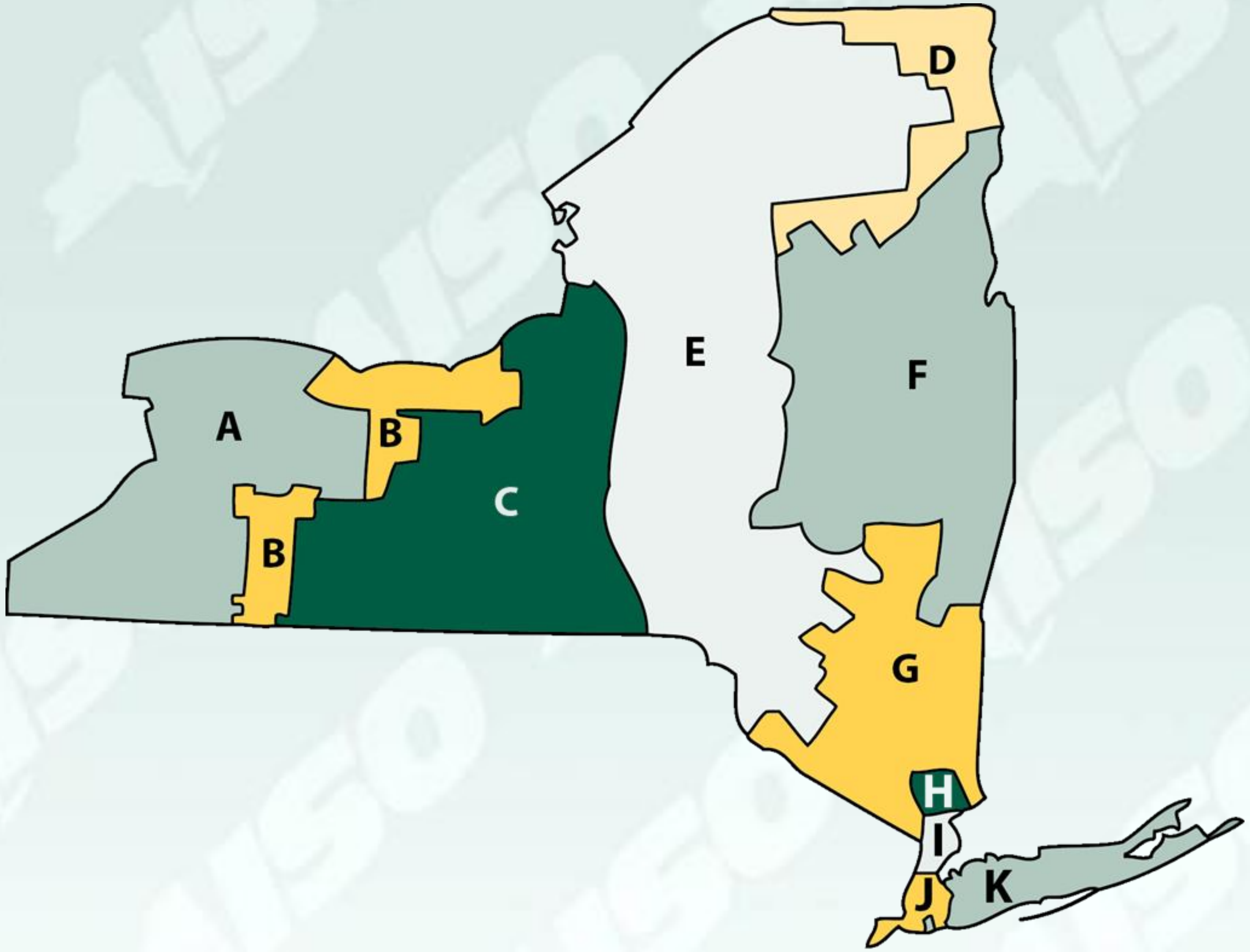
- **Addresses inefficiencies of the prior solution by incorporating scarcity pricing into the real-time optimization and modeling the impact of scarcity pricing at Proxy Generator Buses**
- **Relative to Enhanced Scarcity Pricing, this approach features:**
  - ***Increased price signal transparency***
  - ***Consistent prices and schedules***
  - ***More appropriately valued interchange transactions***

Overview of Real-Time Scheduling (RTS)

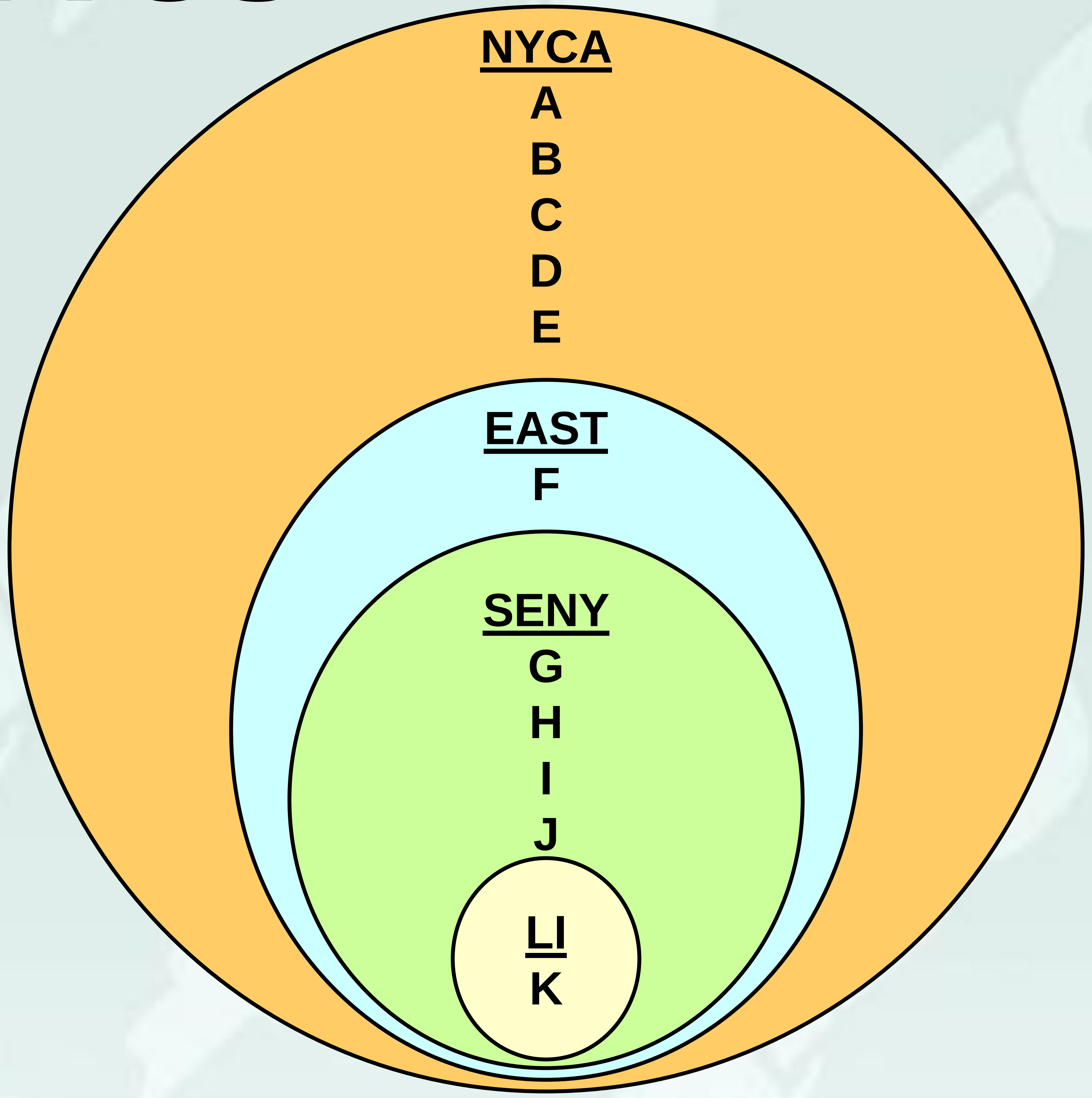
- NYISO RTS processes include Real-Time Commitment (RTC) and Real-Time Dispatch (RTD)
- RTC is a ten-period unit commitment process that runs every 15 minutes
  - *Time periods are ten 15-minute blocks (2 and ½ hours)*
  - *Solves to least production cost solution over the entire time period*
  - *Economically evaluates for commitment 10 and 30-minute start units, hourly transactions, and 15-minute transactions*
- RTD is a five-period dispatch process co-optimizing energy, reserves, and regulation
  - *First time period is the binding dispatch for the next 5 minutes*
  - *Next 4 time periods fall on the quarter hours points (syncs with RTC periods)*
  - *Commitment is fixed from RTC*
    - Though 10-minute offline GTs can be considered for commitment and are priced (price includes incremental costs and startup costs)
  - *Operators are allowed to run a Corrective Action Mode (RTD CAM) to secure system when events occur outside the 5-minute runs*

Demand Response Activation

- **DR resources are activated by Load Zone in real-time**
- **Activated Load Zones are assigned to scarcity reserve region(s)**
  - ***For example, if zones G,H,I,J,K were called, these Load Zones could be assigned to a Southeastern New York (SENY) scarcity reserve region***
- **Scarcity reserve region reserve requirements and reserve demand curves can be created automatically**



Reserve Requirements & Reserve Demand Curves



Reserve Region	Locational 30-Minute Reserve Requirement	MW1	Dollar1	MW2	Dollar2	MW3	Dollar3	MW4	Dollar4
NYCA	2620	300	25.00	355	100.00	300	200.00	1665	750.00
EAST	1200	1200	25.00						
SENY	1300	1300	500.00						
LI	270 to 540*	540**	25.00						

*Depends on the hour

**Assume the 30-minute reserve demand curve in effect for this hour is 540 MW

- **The NYISO procures the 30-minute locational reserve requirements above, each associated with a 30-minute reserve demand curve**
- **The 30-minute reserve demand curve defines the cost associated with the 30-minute reserve shortage slack variable (SRR)**

Design Overview

- **Comprehensive Scarcity Pricing utilizes dynamic reserve regions, reserve requirements and reserve demand curves during DR activations**

DR resources activated

- *Assign activated Load Zone(s) to scarcity reserve region(s)*

→

Assign calculated scarcity reserve requirement to the scarcity reserve region

- *Scarcity reserve requirement is equal to the Expected EDRP/SCR MW minus Available Operating Capacity*

→

Update 30-minute reserve requirements

- *Create scarcity reserve requirement(s) for the scarcity reserve region(s)*
- *Increase reserve requirement for locational reserve regions within which the scarcity reserve region is nested*

→

Update demand curves

- *Create demand curve(s) for scarcity reserve region(s)*
- *Modify NYCA demand curve price points below $500 to $500*

→

Co-optimize reserve, regulation and Energy scheduling

- *Calculate zonal reserve clearing prices*

Scarcity Reserve Requirements

- **The scarcity reserve requirement is:**
  - *Calculated as the expected DR response minus the Available Operating Capacity*
    - Available Operating Capacity is the unscheduled capability of resources to provide Energy in greater than 30 minutes, but less than or equal to 60 minutes
  - *Updated every 5 minutes*
  - *Added to existing locational reserve region(s) within which it is nested*

$$SCRR_i = \sum_{z=1}^{n} (SCRA_z - AOC_z)$$

SCRRi = Scarcity reserve requirement in MW for a scarcity reserve region i

SCRAz = Expected DR response in MW for a Load Zone z

AOCz = Available Operating Capacity in MW for Load Zone z (as further described on the following slide)

i = 1,…, k   Scarcity reserve region(s) in a DR activation

z = 1,…,n   Load Zone(s) belonging to a scarcity reserve region i

Scarcity Reserve Requirements (2)

$$AOC_z = \sum_{h=1}^{m} POTRES_h + \sum_{c=1}^{q} Min[POTRES_c, (RRR30*60) - (RRR30*30)]$$

$$POTRES_i = Max[UMX_i - Esch_i - REGsch_i - (RRR_{30}*30), 0]$$

POTRES = Potential reserve in MW for an eligible offline or online unit

UMX = Unit's maximum operating limit in MW (based on its energy curve)

Esch = Unit's energy schedule in MW

REGsch = Unit's regulating reserve schedule

h = 1,…, m Eligible offline unit(s) belonging to Load Zone z

c = 1,…,q Eligible online unit(s) belonging to Load Zone z

i = 1,…, m + q Eligible unit(s) belonging to Load Zone z

RRR30 = 30-minute reserve ramp rate in MW per minute

A unit is an eligible online unit if:

- ***The unit is online and it is capable of providing 10-minute or 30-minute spinning reserves***

A unit is an eligible offline unit if:

- ***The unit is offline and it is capable of providing 10-minute non-synchronized reserves or 30-minute non-synchronized reserves and the unit's off time meets its minimum downtime requirement***

Scarcity Reserve Requirement Modeling

Mathematical presentation of the 30-minute reserve requirement constraint in the optimization engine (RTS):

Applies to all reserve regions

$$\sum_{i \in A a} \sum_{m=1}^{3} RSCH_{mit} + SRR_{at} \geq RR_{at} + SCRR_{a}$$

Applies only to the LI reserve region

$$\sum_{i \in LI} \sum_{m=1}^{3} RSCH_{mit} - SRP_{LIt} \leq RR_{LIt} + SCRA_{LI}$$

The SCRR and SCRA terms are only added during DR activation periods

RRat = 30-minute reliability reserve requirement in MW for reserve region a at interval t

RSCHmit = Reserve schedule in MW for unit i at interval t and reserve type m

SRRat = Slack variable for 30-minute reserve shortage in MW for reserve region a at interval t

SRPat = Slack variable for 30-minute reserve surplus in MW for reserve region a at interval t

a = Scarcity reserve region and reserve region(s) within which it is nested

t = Time interval of the real-time scheduling study horizon

i = Units belonging to reserve region a

m = Reserve types; 1=Spinning Reserve, 2=10-minute reserve, 3= 30-Minute Reserve

Scarcity Reserve Demand Curve

- **During a DR activation, a demand curve is created for the scarcity reserve requirement**
  - *The example below shows a SENY DR activation with a resulting scarcity reserve requirement of 100 MW*
- **Additionally, NYCA reserve demand curve cost points below $500 are increased to $500 effective during any DR activation**

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EAST	1200	1200	25.00						
SENY	1300	1300	500.00						
LI	270 to 540*	540**	25.00						

Reserve Region	30-Minute Reserve Requirement	MW1	Dollar1	MW2	Dollar2
NYCA	2720 (2620+100)	955	500.00	1765	750.00
EAST	1300 (1200+100)	1300	25.00		
SENY	1400 (1300+100)	1400	500.00		
LI	270 to 540*	540**	25.00		

*Depends on the hour

**Assume the 30-minute reserve demand curve in effect for this hour is 540 MW

Zonal Reserve Clearing Prices

- For each Load Zone and each reserve type at any interval t a zonal reserve clearing price is calculated as follows:

$$RCPR_{mz} = \sum_{i \in Aa} \sum_{m=1}^{3} RSHP_{ma}$$

RCPRmz = Clearing price in dollar for reserve type m in Load Zone z

RSHPma = Shadow price in dollar for reserve type m, in reserve region a

a = Reserve regions which zone z belong to

m = Reserve types; 1=Spinning Reserve, 2=10-minute reserve, 3= 30-Minute Reserve

Summary

- **Comprehensive Scarcity Pricing is expected to provide:**
  - ***Increased price signal transparency, consistent prices and schedules, and more appropriately valued interchange transactions***
  - ***Potential consumer savings during DR activations, as the market software more appropriately considers the value of such resources when scheduling reserves and setting prices***

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:

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

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