New York ISO
Independent System Operator

The Case for Dynamic Reserve Allocation in New York

Rana Mukerji

SENIOR VICE PRESIDENT – MARKET STRUCTURES

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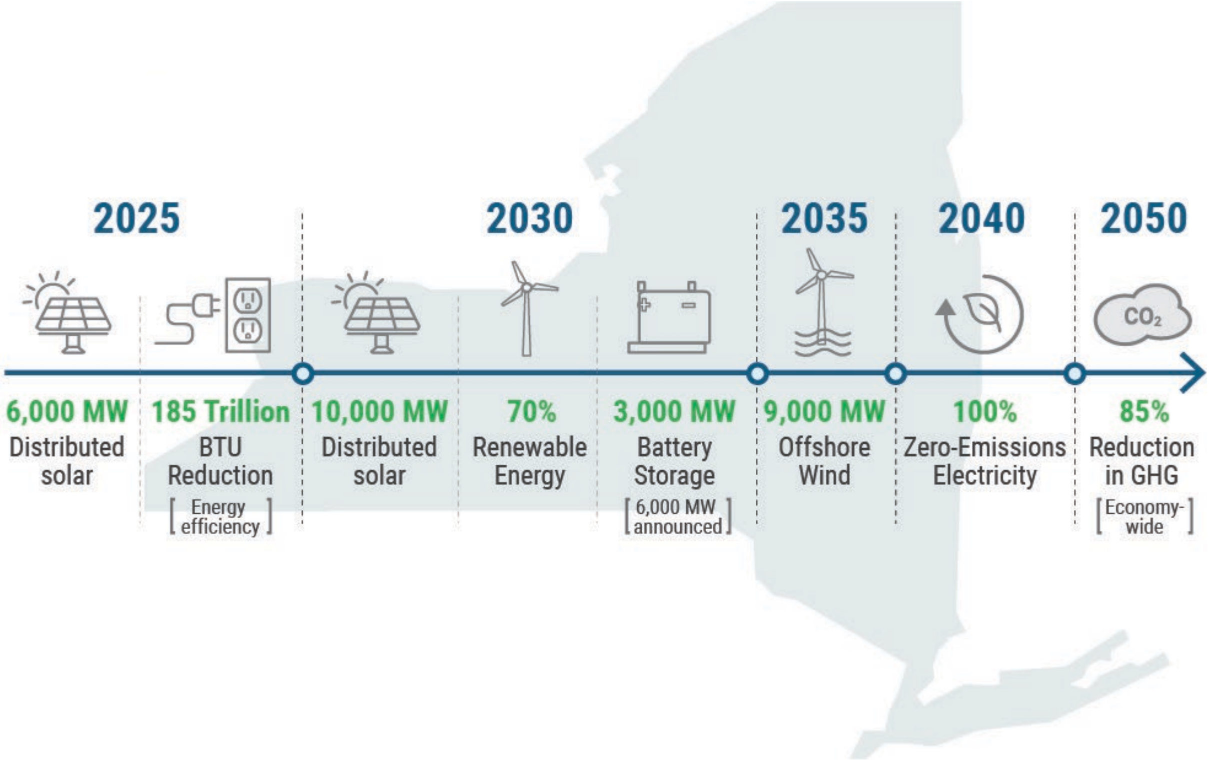
Public Policy and the Changing Resource Mix

Public Policy Influence on Resource Mix

- State and federal policies are increasingly shaping investment on the grid.
- In NY, the CLCPA is driving the most significant change.



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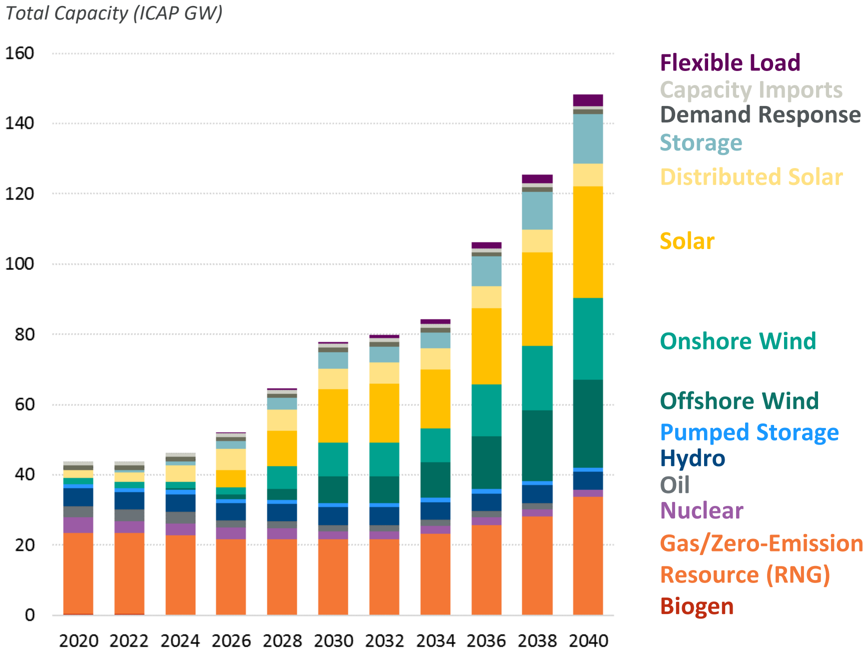
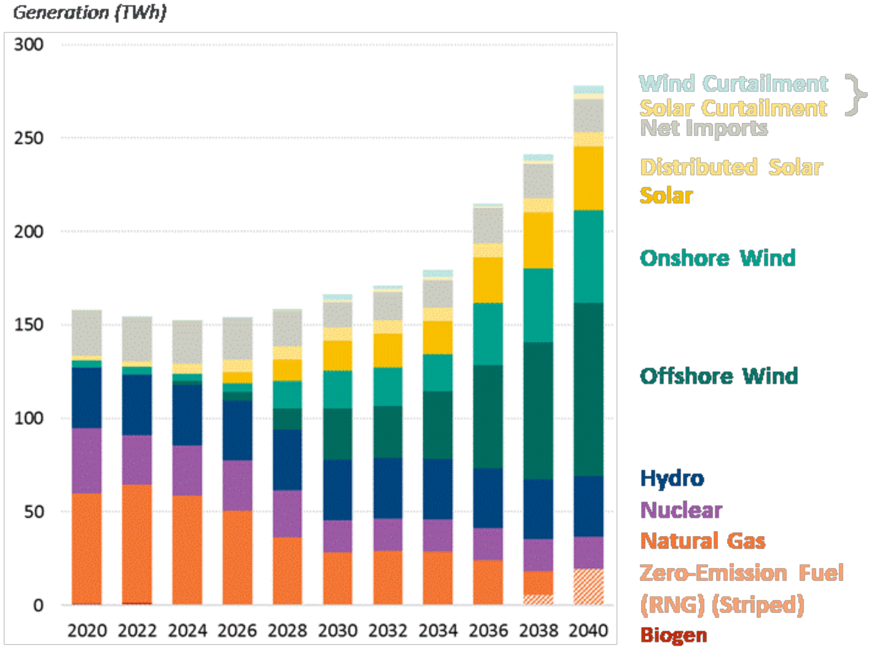
Capacity & Energy Projections with High Electrification





Source: Grid In Transition Modeling (June 2020)

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Price Formation as the System Transitions to a Zero-Carbon Future

- **Energy Markets, the marginal resource is either**
  - Zero variable cost renewable resource, or
  - High cost zero carbon fuel (e.g., hydrogen), or
  - Price Responsive demand, or
  - Opportunity cost offered in by storage resources.

  (Expected to result in increased volatility of real time prices)

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Price Formation as the System Transitions to a Zero-Carbon Future (Cont.)

- **Ancillary Services become increasingly important for price formation (and incenting resource performance in real time and entry of flexible resources)**
  - Set by defining granular areas for procurement of reserves and regulation
  - Guided by demand curves (anchored by value or lost load – VOLL)
  - The definition of granular areas and quantity of resources to be procured likely to be defined dynamically

(Volatility of intermittent resources and the co-optimization with energy also increases price volatility)

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Price Formation as the System Transitions to a Zero-Carbon Future (Cont.)

- **Capacity Markets provide fixed cost recovery (net of energy and ancillary services revenues and subsidies)**
  - Capacity accreditation – important to value resources based on marginal contribution to reliability
  - Granular capacity zones allow for locational capacity prices

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Static Reserves

Deterministic Requirements

- **The NYISO's current reserve requirements are set using deterministic criteria aimed towards:**
  - Securing the system for the largest generator contingency
  - Securing the key transmission interfaces based on the N-1-1 criterion*

* NERC and/or NPCC require that the N-1-1 contingencies be tested. These are events that have two initiating events that occur close together in time. Following the first initiating event, generation and power flows are adjusted in preparation for the next initiating.

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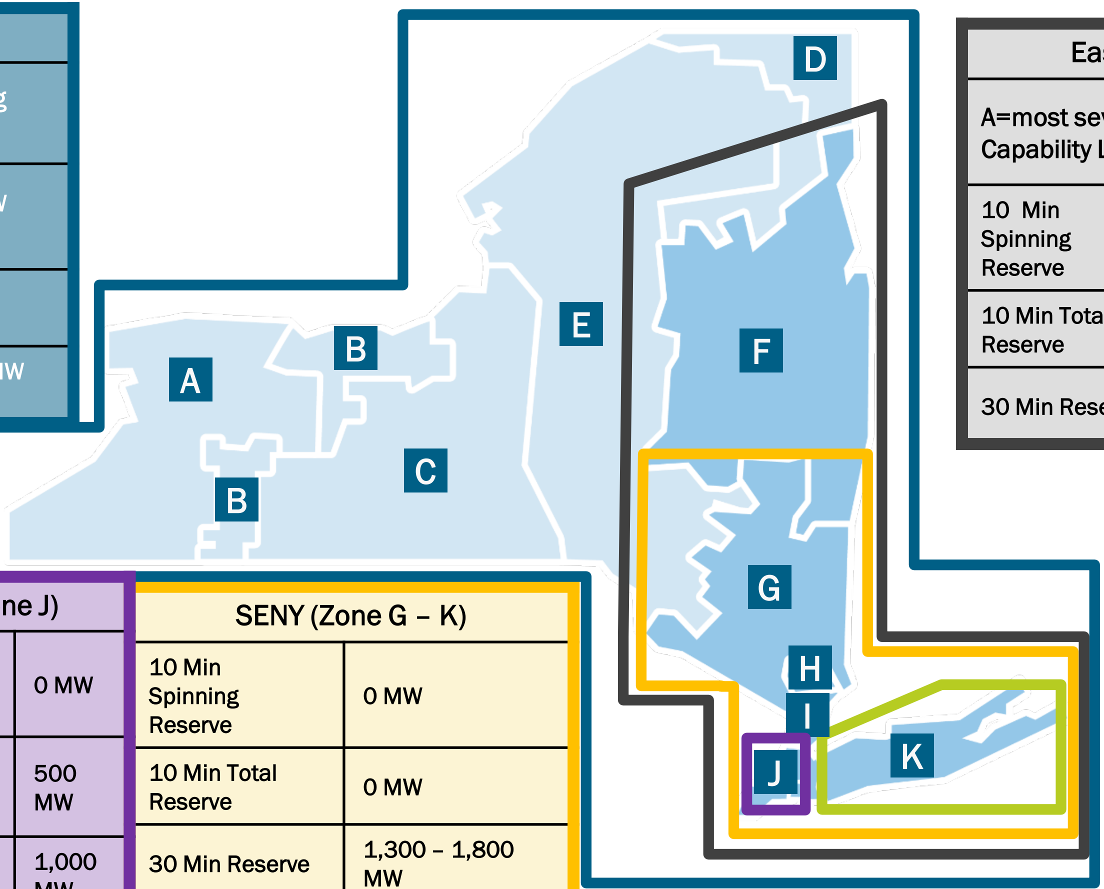
Current Operating Reserve Requirements

NYCA (Zone A – K)	
A=most severe NYCA Operating Capability Loss (1,310 MW)	
10 Min Spinning Reserve	½ A=655 MW NYSRC Rule
10 Min Total Reserve	A=1,310 MW NYSRC Rule
30 Min Reserve	2xA=2,620 MW NYSRC Rule



East (Zone F – K)	
A=most severe NYCA Operating Capability Loss (1,310 MW)	
10 Min Spinning Reserve	¼ A=330 MW NERC, NPCC Rule
10 Min Total Reserve	1,200 MW NYSRC Rule
30 Min Reserve	1,200 MW NERC, NPCC Rule

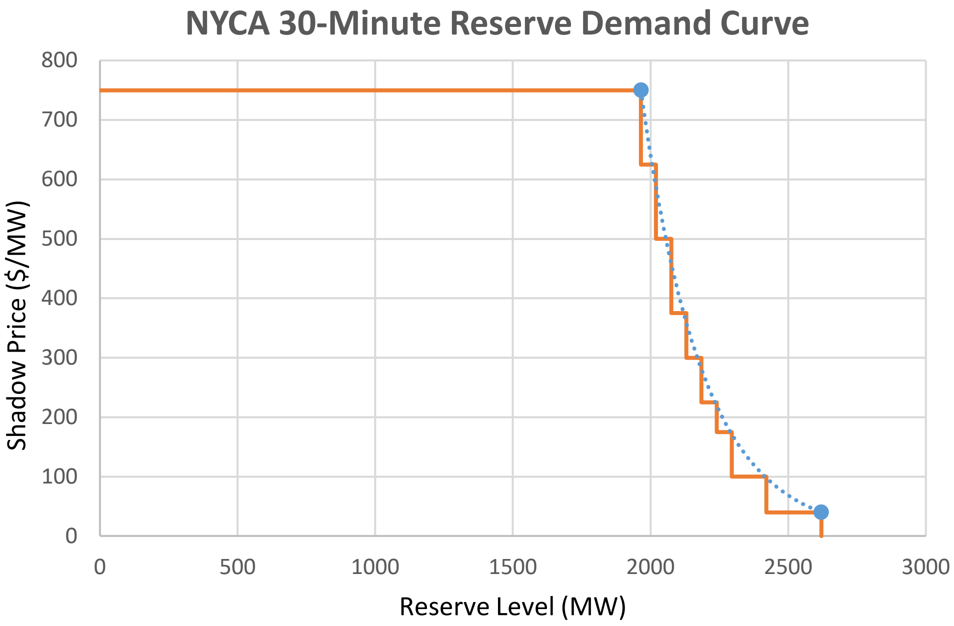
A	WEST
B	GENESE
C	CENTRL
D	NORTH
E	MHK VL
F	CAPITL
G	HUD VL
H	MILLWD
I	DUNWOD
J	N.Y.C.
K	LONGIL

NYC (Zone J)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	500 MW
30 Min Reserve	1,000 MW

SENY (Zone G – K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	0 MW
30 Min Reserve	1,300 – 1,800 MW

Long Island (Zone K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	120 MW NERC, NPCC Rule
30 Min Reserve	270 – 540 MW Max limits NYSRC Rule

Exponential Curve Construct Analysis



Shortage Price ($/MW)	Reserve Level (MW)	Demand Curve (MW)
750	≤ 1,965 to 0	1,965
625	1,965 to 2,020	55
500	2,020 to 2,075	55
375	2,075 to 2,130	55
300	2,130 to 2,185	55
225	2,185 to 2,240	55
175	2,240 to 2,295	55
100	2,295 to 2,420	125
40	2,420 to 2,620	200

Note:

- Highlighted shortage price cells indicate the values from the costs of operator actions analysis

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Managing Uncertainty Efficiently - Dynamic Reserves and Probabilistic Assessments

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Securing Reserve Area for the Loss of: Generation

- **The first concept is that reserves should cover for the largest source contingency, less available headroom**
  - Available headroom would reflect the ability to import reserves into the reserve region
- **Currently, largest source contingency is determined by the maximum generation schedule**

- **In addition to considering the largest single-source contingency, NYISO is proposing additional concepts that would be additional constraints when evaluating the largest source contingency:**
  - Correlated loss of multiple generators: Multiple resources that share a single point of failure (transmission tower, gas regulator valve)
  - Intermittent resource contingencies: Resources in close geographic proximity that may be susceptible to a common weather pattern, which poses a risk of simultaneous loss or reduction of energy output

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Securing Reserve Area for the Loss of: Transmission

- **The second concept is that reserves should account for the loss of transmission (energy imports) into a reserve area**
  - This evaluation calculates the difference between the post-contingency interface limits and the current flow, following the loss of the largest line on the interface

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Tying Loss of Generation and Loss of Transmission Together

- The equations for the generation and transmission constraints are co-optimized along with energy, reserves, and transmission
- The reserve requirements are determined by the most restrictive equation for each reserve product in each reserve area
  - Would be dynamically determined in Day-Ahead (DAM) and Real-Time (RTM) Markets

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Intermittent Resource Contingency: Proposal

- Scheduling of wind resources is based on a Probability of Exceedance (POE) 50 forecast
- NYISO's proposal would use a POE forecast greater than 50 to calculate the quantity of generation that may be at risk
- NYISO proposes to use the difference between the schedules (based on a POE50) and the forecasted values based on a higher POE, in the standard format:

$$Res_{RA_{a_i}}^{30Total} \geq Mult_{\mathrm{RA}_a}^{30Total} * (\sum_{RA_{a_i}} IPP_{Schedule_i} - \sum_{RA_{a_i}} POEXX_{Forecast_i}) - RA_{aRes_{Capability_i}}$$

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Intermittent Resource Contingency (Example)

- **Proposed formula:**

$$Res_{RA_{a_i}}^{30Total} \geq Mult_{\mathrm{RA}_a}^{30Total} * (\sum_{RA_{a_i}} IPP_{Schedule_i} - \sum_{RA_{a_i}} POEXX_{Forecast_i}) - RA_{aRes_{Capability_i}}$$

- **Example:**
  - Assume two intermittent resources with combined energy schedules of 1400 MW
  - Combined POE95 forecast for those resources of 1000 MW
  - Multiplier is 1.0, and headroom is 500 MW

$$300\ \mathrm{MW} \geq 2.0 * \left(\sum\nolimits_{RA_{a_i}} (800 + 600) - \sum\nolimits_{RA_{a_i}} (600 + 400)\right) - 500\ \mathrm{MW}$$

  - The resulting at risk energy would be 400 MW
  - The resultant reserve requirement would be 300 MW

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Possible Applications in New York

Increasing HQ Imports

- Dynamic Reserves allow energy to be scheduled above 1,310 MW if it is economic to do so, while also securing the reserves needed to cover that contingency

- The quantity of each reserve product would be based on a multiplier, similar to how NYCA Spin, 10-Minute Total, and 30-Minute Total reserves are set today
  - NYCA Spin is .5*1,310=655; 10-Total is 1,310; and 30-Total is 2*1,310=2,620
    - If the largest energy schedule is greater than 1,310, the reserve requirement would be larger for all products, compared to existing levels
- Prototyping completed in 2021 demonstrated that scheduling of more economic energy from HQ would result in a lower cost solution, even with more reserves being scheduled
- Increasing HQ imports supports CLCPA goals through increasing use of hydropower

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Utilize Transmission Headroom to Procure Reserves Outside of Reserve Area

- **Currently, reserve requirements must be met by resources internal to each reserve area, which does not allow for the consideration of transmission headroom**
  - Considering transmission headroom would allow for the ability to import reserves in instances where cheaper reserves may be available outside of the reserve area
- **Dynamic Reserves account for transmission headroom in determining the reserve requirement**
  - Dynamic Reserves allow the calculation and co-optimization of transmission interface flows and limits as well as largest generation contingencies
  - Results are typically lower locational reserve requirements and lower, more competitive clearing prices for reserves

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Intermittent Resource Contingencies

- **There is a need to secure reserves for intermittent resources that may be faced with a localized, common external factor that poses a risk of simultaneous loss (or reduction of energy output)**
  - This would include intermittent resources that don’t share a single point of interconnection but are in the same geographic area
- **Dynamic Reserves allow for reserves to be set based on a determination of this risk**
  - This improves system security by accurately modeling system conditions and adjusting reserves accordingly
  - NYISO is proposing to introduce a constraint that quantifies this risk by calculating the difference between facilities schedules and a higher confidence forecast

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Securing of Reserves in Export Constrained Areas (e.g., Long Island)

- Export constraints limit the flow of power and reserves out of Long Island
- Presently, static reserve limits do not allow Long Island generators to provide additional reserve capability for the SENY, East, or NYCA reserve regions when it may be economic and feasible for them to do so
    - Static requirements are based on limits set for worst-case transmission scenarios
- Dynamic Reserves allow full participation of Long Island reserve providers by accounting for export capability based on real-time conditions
- Prototyping completed in 2021 demonstrated that dynamic modelling of transmission capabilities on LI contributed to lower production costs and increased reserve schedules for LI reserve providers

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Enable More Granular Reserves

- Dynamic Reserves would provide an efficient and effective solution to implement load pocket reserves within certain constrained load pockets
- Static requirements in load pockets could result in situations where holding reserves on internal supply is infeasible because supply is providing economic energy
- Dynamic determination of requirements would account for available transmission capability into a load pocket, which could potentially reduce the quantity of reserves in load pockets

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Dynamic Reserve Benefits

Benefits of Dynamic Reserve Scheduling

- **Considers transmission headroom, largest resource contingency and evaluates uncertainty and correlated resource availability in setting reserve requirements thereby:**
  - Increasing System Performance
  - Enhancing reliability
  - Enhancing system efficiency and reducing consumer costs compared to static reserves

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Questions?

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Our Mission & Vision

Mission

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

Vision

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

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