New York ISO
Independent System Operator

Dynamic Reserves: Price Formation and Settlements

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Agenda

- Background
- Congestion Rent Settlements Discussion
- "Forecast Reserves" Settlements Proposal
- Other Settlement Elements
- Next Steps

Background

Previous Presentations

Title/Topic	Link
March 7, 2023 MIWG	https://www.nyiso.com/documents/20142/36639552/Dynamic%20Reserves%20-%2020230307%20MIWG_final.pdf/a29ccf5d-4c26-5cbf-0103-5bece7edb276
March 31, 2023 MIWG	https://www.nyiso.com/documents/20142/36828420/MIWG%20March%2031%20Dynamic%20Reserves%20Postings%20and%20LMP.pdf/81c35384-2438-1e03-e021-6e7ecc18f9d7
September 5, 2023 MIWG	https://www.nyiso.com/documents/20142/39768278/2%2020230905%20MIWG%20-%20Dynamic%20Reserves.pdf/d58e28ab-de87-7a86-4296-a8c21f7c764f
September 14, 2023 MIWG	https://www.nyiso.com/documents/20142/40004830/20230914%20MIWG%20-%20Dynamic%20Reserves.pdf/a1c6d806-5b67-a8fc-9d04-a1669a926f54
September 18, 2023 MIWG	https://www.nyiso.com/documents/20142/40044890/5%2020230918%20MIWG%20-%20Dynamic%20Reserves.pdf/0b1b7e63-737d-5bee-4abc-be65c234aa3b
September 26, 2023 MIWG	https://www.nyiso.com/documents/20142/40204141/4%2020230926%20MIWG%20-%20Dynamic%20Reserves.pdf/90e8c0b2-aeaf-0935-5c4e-bd260c948f3c
October 3, 2023 MIWG	https://www.nyiso.com/documents/20142/40342797/20231003%20MIWG%20-%20Dynamic%20Reserves.pdf/51657652-ac7e-c9e2-ed5f-85b52e7e49f7
October 12, 2023 MIWG	https://www.nyiso.com/documents/20142/40559142/Dynamic%20Reserves.pdf/a17ba0a7-8e59-53b9-e028-4942f595c2f1
October 19, 2023 MIWG	https://www.nyiso.com/documents/20142/40696384/20231019%20MIWG%20-%20Dynamic%20Reserves.pdf/ef4371c2-5bff-7adb-5871-1d77d6fa98eb
November 8, 2023 MIWG	https://www.nyiso.com/documents/20142/41049783/20231108%20MIWG%20-%20Dynamic%20Reserves.pdf/e38b6d72-aa3f-69f3-b43f-8b3591b0e314

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Congestion Rent Settlements

Congestion Rent Settlements

- On 11/8/2023, the NYISO presented DAM settlement examples (Slides 6-14 of the Nov 8 MIWG on Dynamic Reserves) that illustrated the charges and payments for energy, congestion, and reserves.
  - MMU provided feedback on those examples and has recommended that NYISO consider their proposal to handle congestion rent settlements/allocation and reserve settlements
- Using numbers from the same examples, today's presentation will further explain NYISO's position on congestion rent settlements/allocation
- Slides 7-15 walk through the examples presented on 11/8/2023

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Illustrative DAM Settlements

- **The NYISO developed a set of simplified scheduling examples to demonstrate the flow of energy and reserve costs under Dynamic Reserves**
  - Prices and schedules are optimal based on economic dispatch
  - The intent of this exercise is to demonstrate how NYISO's price formation proposal for Dynamic Reserves and existing settlement mechanisms would effectively charge LSEs for energy, congestion, and reserves; and how those payments would be allocated to generators and transmission owners
  - NYISO prepared three examples: a base case example with a static reserve requirement and a dynamic reserves example with a 10-Minute locational reserve requirement (no NYCA reserves and no 30-Minute reserves) and a second dynamic reserve case highlighting TCC interactions.
  - The example shows that existing settlement mechanisms will continue to function appropriately under dynamic reserves
    - Note, this example does not model the forecast energy constraint. The forecast energy constraint will require settlement changes, which NYISO will discuss in this presentation.

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Assumptions: Example 1 Base Case

- The base case example demonstrates a static reserve requirement, as would be seen today
- The transmission constraints are base case energy scheduling constraints for NYC: energy flows can't exceed Normal limits or N-1 MTE limits. The example assumes four transmission elements with the following Normal/LTE/MTE ratings:
  - Line A: 798/998/1048
  - Line B: 799/999/1049
  - Line C: 800/1000/1050
  - Line D: 801/1001/1051
- The example utilizes the following shift factors:
  - Load = pre-contingency: 0.25, post-contingency: 0.33
  - Generators = pre-contingency: -0.25, post-contingency: -0.33

	Rest-of-state (ROS)	Load Pocket (NYC)
Load (MW)	0	3500
Reserve requirement (MW)	0	150
Energy Offer ($/MW)	5	50
Reserve Offer ($/MW)	1	2

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Results: Example 1 Base Case

- **The table illustrates the charges and payments for energy, congestion, and reserves**
- **Total charges collected from LSEs: $175,300**
  - Energy Charges (17,500) + Congestion Charges (157,500) + Reserve Charges (300)
- **Total payments owed: $175,300**
  - Energy Payment (Gen) (1,765) + Congestion Payment (Gen)(15,885) + Congestion Rents (141,615) + Reserve Payment (Gen) (300)

	Rest-of-State	Load Pocket (NYC)
LBMP	$5	=System Lambda-Congestion SP*Shift Factor =5-(-135)*.33 =$50
Energy Charges (LSEs)	N/A	=System Lambda*Load =5*3500=$17,500
Energy Payment (Gens)	=System Lambda*Energy Schedule =5*3147=$15,735	=System Lambda*Energy Schedule =5*353=$1,765
Congestion Charges (LSEs)	N/A	=Congestion SP*Shift Factor*Load =135*.33*3500=$157,500
Congestion Payments (Gens)	N/A	=Congestion SP*Shift Factor*Energy Schedule =135*.33*353=$15,885
Congestion Rents	N/A	=Flow on Constrained Element*Congestion SP =(1049)*135=$141,615
Reserve Charges (LSEs)	N/A	=Rate Schedule 4 Load Ratio Share Payments of $300
Reserve Payments (Gens)	N/A	=Reserve Schedule*Reserve Price =150*2=$300

Results: Example 1 Base Case

- **The results from the base case are:**
  - Energy Schedules:
    - ROS Generators: 3147 MW
    - Load pocket generators: 353 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 150 MW
  - System Lambda = $5
  - Load pocket Operating Reserve clearing price = $2
  - Shadow price for energy scheduling transmission constraint = $135

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Results: Example 1 Base Case (continued)

- Total charges collected from LSEs equals energy, congestion, and reserve payments owed to generators, and Congestion rents

	Energy	Congestion	Reserves
LSE Charges	$ (17,500.00)	$ (157,500.00)	$ (300.00)
Generator Payments	$ 17,500.00	$ 15,885.00	$ 300.00
Congestion Rents	$ -	$ 141,615.00	$ -
Net	$ -	$ -	$ -

Assumptions: Example 2 Dynamic Reserves Case

- Example 2 introduces a dynamic reserve requirement to solve for N-1 post-contingency transmission flows into the load pocket
  - There are no 30M reserve constraints or Forecast Load in this example
  - There is no static requirement
- Example 2 utilizes the same assumptions as Example 1 for:
  - Load
  - Energy and reserve offers
  - Energy scheduling constraints
  - Pre/post-contingency shift factors

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Results: Example 2 Dynamic Reserves (continued)

- Total charges collected from LSEs equals energy, congestion, and reserve payments owed to generators, and Congestion Rents

	Energy	Congestion	Reserves
LSE Charges	$ (17,500.00)	$ (157,500.00)	$ (300.00)
Generator Payments	$ 17,500.00	$ 15,885.00	$ 300.00
Congestion Rents	$ -	$ 141,615.00	$ -
Net	$ -	$ -	$ -

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Results: Example 2 Dynamic Reserves

- **The results from the dynamic reserves case are:**
  - Energy Schedules:
    - ROS Generators: 3147 MW
    - Load pocket generators: 353 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 150 MW
  - System Lambda = $5
  - Load pocket generator Operating Reserve price = $2
  - Total shadow price for transmission constraint = $135
    - Shadow price for binding N-1 dynamic reserve constraint = $6, plus
    - Shadow price for energy scheduling transmission constraint = $129

Results: Example 2 Dynamic Reserves

- **The table illustrates the charges and payments for energy, congestion, and reserves**
- **Total charges collected from LSEs: $175,300**
  - Energy Charges (17,500) + Congestion Charges (157,500) + Reserve Charges (300)
- **Total payments owed: $175,300**
  - Energy Payment (Gen) (1,765) + Congestion Payment (Gen) (15,885) + Congestion Rents (141,615) + Reserve Payment (Gen) (300)

	Rest-of-State	Load Pocket (NYC)
LBMP ($/MW)	$5	=System Lambda-[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)] =5-[(-129*0.33)+(-6*0.33)] =$50
Energy Charges (LSEs)	N/A	=System Lambda*Load =5*3500=$17,500
Energy Payment (Gens)	=System Lambda*Energy Schedule =5*3147=$15,735	=System Lambda*Energy Schedule =5*353=$1,765
Congestion Charges (LSEs)	N/A	=[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)]*Load =[(129*0.33)+(6*0.33)]*3500=$157,500
Congestion Payments (Gens)	N/A	=[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)]*Energy Schedule =[(129*0.33)+(6*0.33)]*353=$15,885
Congestion Rents	N/A	=Flow on Constrained Element*Transmisson Congestion SP + Flow on Constrained Element *Reserve Congestion SP =(1049*129) + (1049*6)=$141,615
Reserve Charges (LSEs)	N/A	=Rate Schedule 4 Load Ratio Share Payments of $300
Reserve Payments (Gens)	N/A	=Reserve Schedule*[(Reserve Congestion SP*SF)] =150*(6*0.33)=$300

Congestion Rent Allocation and Settlements Example

- The table compares the congestion rent allocation and settlement results from the dynamic reserves case with existing construct and Potomac recommendation
- The example demonstrates that the total load charges across both proposals are the same
  - Potomac recommendation would lead to more locational allocation of reserve charges to loads

		Congestion Rent Allocation and Settlements	
		TODAY	Potomac Recommendation
ROS LMP	($/MWh)	$ 5	$ 5
Locality LMP	($/MWh)	$ 50	$ 50
ROS OR Price	($/MWh)	$ -	$ -
Locality OR Price	($/MWh)	$ 2	$ 2
ROS Energy Sched	(MW)	3147	3147
Locality Energy Sched	(MW)	352	352
ROS OR Sched	(MW)	0	0
Locality OR Sched	(MW)	150	150
Load LMP Payments	($)	$ (175,000)	$ (175,000)
Energy LMP Payments	($)	$ 33,385	$ 33,385
TCC Congestion Payments	($)	$ 141,615	$ 141,315
Load OR Payments (RS4)	($)	$ (300)	$ -
OR Supply Payments	($)	$ 300	$ 300
	(non-wholesale)		
Load Congestion Rent Offset	($)	$ 141,615	$ 141,315
TOTAL LOAD CHARGES	**($)**	**$ (33,685)**	**$ (33,685)**

Congestion Rent Allocation and Settlements Proposal

- Potomac Economics has recommended that NYISO consider revising congestion rent settlements, congestion rent allocation, and Rate Schedule 4 settlement allocation as part of Dynamic Reserves.
  - Decrease the share of congestion rent payments to TCC holders. Use reduced congestion rent payments to TCC holders to compensate Locality Operating Reserve Suppliers. These two exactly net out.
  - As a result, Loads would not pay Rate Schedule 4 costs for Locality reserves and would pay increased transmission usage charge (non-wholesale). The net effect is likely that some load would see reduced costs while others would see increased costs.
- The NYISO believes the Dynamic Reserves project has the potential to improve the efficiency of the reserve requirement setting process, represents a large effort in moving to nodal reserves, and that the time and complexity associated with cost allocation discussions has the potential to delay these benefits.

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Interaction between Dynamic Reserves and TCCs

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Example 3 Dynamic Reserves Case with Expensive Operating Reserves

- Examples 1 and 2 produced identical transmission Congestion Rent
- When locational Operating Reserves are expensive, the optimal outcome (i.e., minimal production cost) may be to respect transmission constraints and not schedule reserves
- Example 3 shows how Congestion Rent would change in such a case

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Assumptions: Example 3 Dynamic Reserves Case with Expensive Operating Reserves

- **Example 3 increases the cost of locational Operating Reserves**
  - There are no 30M reserve constraints or Forecast Load in this example
  - There is no static requirement
- **Example 3 utilizes the same assumptions as Example 1 and 2 for:**
  - Load
  - Energy
  - Energy scheduling constraints
  - Pre/post-contingency shift factors
- **The OR offer for locational reserves is increased from $2 to $47**

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Results: Example 3 Dynamic Reserves

- **The results from the dynamic reserves case are:**
  - Energy Schedules:
    - ROS Generators: 3997 MW
    - Load pocket generators: 503 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 0 MW
  - System Lambda = $5
  - Load pocket generator Operating Reserve price = $45
  - Total shadow price for transmission constraint = $135
    - Shadow price for binding N-1 dynamic reserve constraint = $135, plus
    - Shadow price for energy scheduling transmission constraint = $0

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Results: Example 3 Dynamic Reserves

- **The table illustrates the charges and payments for energy, congestion, and reserves**
- **Total charges collected from LSEs: $175,000**
  - Energy Charges (17,500) + Congestion Charges (157,500) + Reserve Charges (0)
- **Total payments owed: $175,000**
  - Energy Payment (Gen) (17,500) + Congestion Payment (Gen) (22,635) + Congestion Payment (TOs) (134,865) + Reserve Payment (Gen) (0)

	Rest-of-State	Load Pocket (NYC)
LBMP ($/MW)	$5	=System Lambda-[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)] =5-[(-129*0.33)+(-6*0.33)] =$50
Energy Charges (LSEs)	N/A	=System Lambda*Load =5*3500=$17,500
Energy Payment (Gens)	=System Lambda*Energy Schedule =5*2997=$14,985	=System Lambda*Energy Schedule =5*503=$2,515
Congestion Charges (LSEs)	N/A	=[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)]*Load =[(135*0.33)+(0*0.33)]*3500=$157,500
Congestion Payments (Gens)	N/A	=[(Transmission Congestion SP*SF)+(Reserve Congestion SP*SF)]*Energy Schedule =[(135*0.33)+(0*0.33)]*503=$22,635
Congestion Rents	N/A	=Flow on Constrained Element*Transmisson Congestion SP + Flow on Constrained Element *Reserve Congestion SP =(999*135) + (999*0)=$134,865
Reserve Charges (LSEs)	N/A	=Rate Schedule 4 Load Ratio Share Payments of $0
Reserve Payments (Gens)	N/A	=Reserve Schedule*[(Reserve Congestion SP*SF)] =0*(135*0.33)=$0

Comparison across Examples

		Example 1 TODAY	Example 2 DR- Cheap OR	Example 3 DR - Expensive OR
Transmission DAM Congestion Rent	[A] = [E] * [F]	$ 141,615	$ 141,615	$ 134,865
Assumed TCC Sale Quantity	[B], assumed	1049	1049	1049
Assumed TCC Price	[C], assumed	$ (135)	$ (135)	$ (135)
TO TCC Revenue	[D] = [B] * -[C]	$ 141,615	$ 141,615	$ 141,615
Actual DAM Flow	[E], optimization output	1049	1049	999
Actual DAM Congestion Price	[F], optimization output	$ (135)	$ (135)	$ (135)
DAM Congestion Residual (DCR)	[G] = ([E] - [B]) * -[F]	$ -	$ (0)	$ (6,750)
TO Net of TCC Revenue and DCR	[H] = [D] + [G]	$ 141,615	$ 141,615	$ 134,865

This example assumes the TCC Sale Price equals the actual DAM Congestion Price. If the price of TCCs is consistent with Congestion Rents collected in the DAM, the impact on TCC auction revenue resulting from having sold these TCCs will be offset by the impact of these TCCs on the DAM congestion rent shortfall, so the net congestion revenue that the TOs collect will be equal to total Congestion Rents collected in the DAM. TOs would be exposed to an unhedged DAM Congestion Residual if the price of TCCs is inconsistent with Congestion Rents collected in the DAM.

Discussion: Example 3 Results

- It was not economic to schedule Operating Reserves to enable line flows over the baseline transmission limit, thus, line flows decreased relative to Example 2
  - Additional transmission capacity was available but uneconomic to utilize
  - Congestion costs still accrued across the facility at the lower flow levels
- Reduced line flows decrease total transmission DAM Congestion Rent
- Under today's TCC rules, and if TCCs continue to be sold at today's quantities:
  - DAM Congestion Rents may be insufficient to fund TCC awards;
  - Residual short-fall will be allocated to TOs.
  - See next slide for details
- NYISO is continuing to review whether the interaction of Dynamic Reserves and today's TCC rules creates the need for further modifications

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Settlement Proposal

Definitions: Dynamic Reserves

- **Forecast Reserves:**
  - In this presentation, forecast reserves refer collectively to reserve constraints based on Forecast Load for NYCA 30M reserves and locational 30M reserve constraints
  - For NYCA 30M reserves, forecast reserves refers to any reserves scheduled due to Forecast Load>Bid Load in the DAM.
    - NYCA 30-Minute Total: Equal to the output of the Largest Generator + Second Largest Generator + max(0,(Forecast Load – Bid Load)
  - For locational 30M reserves, forecast reserve refers to reserves scheduled to meet Forecast Load when Forecast Load > Bid Load
- **Bid Load**
  - Sum of Fixed Load + Price-capped Load + Virtual Load – Virtual Supply
- **30F Forecast Reserve Shadow Price**
  - The shadow price of the NYCA 30min Operating Reserve constraint ensures total physical energy, imports and reserves equal or exceed the NYCA Forecast Load plus 30T NYCA Contingency Requirements.
- **Locational Reserve Constraint Shadow Prices**
  - Shadow price for each defined reserve transmission constraint, applicable to DAM and RTM
- **Locational Marginal Operating Reserve Price (LMORP)**
  - Nodal reserve price for each Operating Reserve product
- **Forecast Reserve Price$_{ZN}$**
  - Sum of shadow prices for constraints that solve to Forecast Load at the zonal level (i.e., NYCA 30T, locational forecast reserve constraints)
- **Contingency Reserves**
  - Reserves scheduled to meet constraints that do not consider Forecast Load (i.e., 10-minute reserves)

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LBMP Formation

Price Formation : Overview

- **As part of implementing dynamic reserve constraints, the NYISO has identified and previously discussed impacts to LBMP and reserve price formation (i.e., how reserve constraint shadow prices are used to determine the generator nodal LBMP and zonal LMBP)**
  - Locational reserve shadow prices will be incorporated into the LBMP and reserve prices
  - Energy suppliers will continue to be paid their nodal LBMP and Load will continue to pay the zonal Load weighted average LBMP
    - The LBMP and reserve prices determined within the software will be used along with energy and reserve schedules to determine payments and charges for energy and reserves
  - Operating Reserve suppliers will be paid their nodal LMORP (which will replace the current uniform reserve region price) and Load will continue to pay for Operating Reserves on a load-weighted average basis (i.e., existing Rate Schedule 4)

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LBMP Formation

- LBMP at a bus represent the marginal value of energy at that bus.
- Dynamic Reserve proposal creates new tradeoffs between energy and reserves and their effect needs to be included in the LBMP calculation.
- The subsequent slides describe the Dynamic reserve formulation and how it will impact the price formation/calculation

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LBMP Formation – NYCA 30M Reserves

- **The NYCA 30-Minute reserve requirement will procure additional reserves to cover the difference between Forecast and Bid Load:**
  - 30-Minute NYCA Reserves = Output of the Largest Generator + Second Largest Generator + max(0,(Forecast Load –Bid Load))
- **When Forecast Load > Bid Load, clearing more bid load or scheduling more Physical Gen/Imports in day-ahead market reduces the amount of 30-min NYCA reserve requirement.**
  - The reserves scheduled when Forecast Load > Bid Load will produce a shadow price representing the cost to secure that product
  - This shadow price will be included in the energy component of the nodal generator LBMP and zonal LBMP
  - All resources are considered to have a unity shift factor to NYCA reserve constraints

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LBMP Formation – 10-Minute Locational Reserve Constraints

- **10-Minute reserve constraints**
  - The 10-minute reserve constraints will be developed to ensure that following a single transmission line or generator contingency, flows on modelled transmission elements will be under LTE limits in 10 minutes
  - The amount of flow used in the reserve constraint will be based on cleared Bid Load in the DAM
  - This constraint will be defined as:
    - $\sum Sf_l * Gen + \sum Sf_l * (FixedLoad_{ZN} + PCL_{ZN} + VL_{ZN} - VS_{ZN}) + \sum_{Sf_l<0} Sf_l * Reserves \leq Line\ Limit$
      - Where Gen = Physical Gens & Net Imports; PCL = Price Capped Load, VL = Virtual Load, VS = Virtual Supply
      - Where l: Index for all reserve constraints; Sf_l = Shift factor for constraint l

LBMP Formation – 30-Minute Locational Reserve Constraints

- **30-Minute reserve constraints**
  - The 30-minute reserve constraints will be developed to ensure that following the loss of two elements (line/line, gen/gen, line/gen), flows on modelled transmission elements will be under applicable limits in 30 minutes
  - The amount of flow used in the reserve constraint will consider both Bid Load and Forecast Load in the DAM
  - The constraint considering Bid Load will be defined as:
    - $\sum Sf_l * Gen + \sum Sf_l * (FixedLoad_{ZN} + PCL_{ZN} + VL_{ZN} - VS_{ZN}) + \sum_{Sf_l<0} Sf_l * Res \leq Line\ Limit$
  - The constraint considering Forecast Load will be defined as:
    - $\sum Sf_l * Gen + \sum Sf_l * (ForecastLoad_{ZN}) + \sum_{Sf_l<0} Sf_l * Res \leq Line\ Limit$

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Locational 30 min Operating Reserve Constraints

- **NYISO is proposing to calculate Operating Reserve requirements using Bid Load and also procure additional reserves to Forecast Load to ensure sufficient Energy is available to serve Real-Time Load**
  - Bid Load represents the marketplace's view of market conditions and the marketplace's willingness to schedule Energy for the coming day. Securing additional Operating Reserves when Forecast Load exceeds Bid Load supports reliable scheduling and sends a market signal to satisfy Forecast energy needs.
  - When Bid Load exceeds Forecast Load, no additional Operating Reserves will be procured
- **Potomac Economics has recommended that NYISO consider only Forecast load to calculate the locational 30-min reserve requirements**
- **NYISO considered the recommendation and continues to propose to use Bid Load, representing the marketplace view, as the primary mechanism for establishing the reserve requirement with the Forecast Load as a backstop to support sufficient scheduling**
  - This ensures consistency with energy scheduling in DAM which is based on Bid load
  - Additional reserves to secure for forecast load will be procured only if Forecast load is higher than Bid load

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LBMP Formation – 30-Minute Locational Reserve Constraints

- The locational 10-min and 30-min reserve requirement is based on ensuring transmission security following a contingency
- The shadow prices of these constraints will be included in the congestion component of Nodal and Zonal LBMPs based on the shift factor of gen/load bus with respect to these constraints

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Forecast Reserve Shadow Prices

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Settlements: Overview

- **NYISO has identified settlement changes to accommodate constraints that procure reserves to NYISO DAM Forecast Load**
  - Dynamic reserves will procure reserves based on Forecast Load for NYCA 30M reserves and locational 30M reserve constraints in DA. These constraints will not exist in the RT market
    - These constraints collectively will be referred to as forecast reserves in this presentation
    - Forecast reserves will be scheduled when Forecast Load > Bid Load in the DAM
  - The Shadow prices of Forecast reserve constraints will be included in DA nodal/zonal LBMPs as described in the subsequent slides on LBMP Formation.
  - The proposed changes are necessary to ensure
    - Only the suppliers that can help the forecast reserve constraints are paid the shadow prices of these constraints
    - All loads including the loads that do not have a DA contract are charged the cost of procuring Forecast reserves in DAM
  - These changes will ensure consistent incentives to schedule Load in the DAM and RT markets and mitigate arbitrage opportunities

Settlements: Overview (cont’d)

- **The scope of the required settlement changes will be:**
  - Create a Forecast Reserve Charge, which will be applicable to Virtual Supply, RT Load that did not schedule in the DAM, and imports that do not materialize in real-time
    - The Forecast Reserve Charge ($/MWh) will be the NYCA forecast reserve shadow price plus the sum-product of the applicable locational forecast reserve shadow prices and shift factors.
  - Apply these revenues toward the overall cost of operating reserves

Forecast Reserve Price

- The forecast reserve price at a bus is the component of LBMP attributed to the shadow price of Forecast Reserve constraints. For Settlement purposes, NYISO will calculate Forecast Reserve price for each load zone and for each proxy bus
- These prices will be derived as :
  - Zonal Forecast Reserve price

$$\text{ForecastReservePrice}_{\text{ZN}} = \text{NYCA 30F price} + \sum_{l \in L} \left(Sf_l^{ZN} * 30FShadowPrice_l \right)$$

  - Proxy Forecast Reserve price

$$\text{ForecastReservePrice}_{Proxy} = \text{NYCA 30F price} + \sum_{l \in L} \left(Sf_l^{Proxy} * 30FShadowPrice_l \right)$$

  - There is no shift factor applied to the NYCA 30F constraints since it utilizes a unity shift factor
  - These equations are based on the shadow prices developed in DAM
- The Forecast Reserve Price$_{ZN}$ will be used to determine a Forecast Reserve Charge$_{ZN}$ for Virtual Supply, and LSEs, as described in Subsequent slides
- The Forecast Reserve Price$_{Proxy}$ will be used to determine a Forecast Reserve Charge$_{ZN}$ for Imports, as described in Subsequent slides

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Zonal Forecast Reserve Price: Virtual Supply

- Virtual Supply will incur a new charge to represent that the zonal LBMP includes the shadow price of the forecast reserves constraint, which Virtual Supply cannot meet
  - Virtual Supply cannot solve any 30M constraints which utilize Forecast Load
  - Virtual Supply will be able to solve 10M constraints which utilize Bid Load
- The Forecast Reserve Charge to Virtual Suppliers will be calculated as:
  - $ForecastReserveCharge_{VS} = ForecastReservePrice_{ZN} * DA\ \text{Scheduled Virtual Supply}$
- This charge would be outside of any existing settlement charges or payments
- This charge would offset the total reserve charges to LSEs based on load ratio-share

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Zonal Forecast Reserve Price: LSEs

- LSEs will incur a new charge when Actual RTM Withdrawals > DAM Scheduled Withdrawals
- This charge is necessary for loads because:
  - The zonal DAM LBMP will include the shadow price of forecast reserves (and no there are forecast reserves in RTM)
  - The Forecast Reserve Charge should be assessed to all loads to facilitate consistent scheduling incentives between DA and RT
    - When Forecast Load > Bid Load, it is expected that more load will bid into the RTM than bid into the DAM (i.e., load is under scheduled in the DAM) and that load should be charged
- The Forecast Reserve Charge to LSE will be calculated as :
  - $ForecastReserveCharge_{\mathrm{LSE}} = \max(0, ForecastReservePrice_{ZN} * (Actual\ Withdrawal - DA\ Scheduled\ Withdrawals))$
- This charge would be outside of any existing settlement charges or payments
- This charge would offset the total reserve charges to LSEs based on load ratio-share

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Zonal Forecast Reserve Price: Imports

- **Suppliers located outside the NYISO will incur a new charge when Actual Imports < DAM Scheduled Imports**
- **The Forecast Reserve Charge to Imports will be calculated as :**
  - $ForecastReserveCharge_{\text{Imports}} = \max(0, ForecastReservePrice_{Proxy} * (\text{Actual Imports} - DA\ Scheduled\ \text{Imports}))$
  - This charge would be outside of any existing settlement charges or payments
  - This charge would offset the total reserve charges to LSEs based on load ratio-share
- **This charge is necessary for imports because:**
  - The DAM LBMP paid to imports will include the shadow price of forecast reserves
  - This charge would disincentivize scheduling of "virtual" imports that are not likely to materialize in Real time operations
- **Potomac Economics has recommended that NYISO consider categorizing imports as firm vs non-firm and only allow firm imports to solve the Dynamic Reserve constraints**
  - NYISO believes that the Forecast Reserve charge mitigates the concern that "virtual" imports may exploit the chance to get a payment for providing Forecast Reserve day-ahead
  - Characterizing an import as firm vs non-firm before the market solves is outside the scope of Dynamic Reserves project

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Zonal Forecast Reserve Charge - Example

- **This example demonstrates the Forecast Reserve charges only with NYCA level forecast reserve requirement**
- **DAM Results:**
  - DAM Bid Load: 28,000 MW; Resource mix = 27,000 MW physical generation, 500 MW Imports; 500 MW virtual generation;
  - Forecast Load=RTM Load: 30,000 MW
  - Total Operating Reserves: 5,500 MW
    - Forecast Reserves: 3,000 MW; Forecast Reserves Shadow Price: $5/MW
    - Contingency Reserves: 2,500 MW; Contingency Reserve Shadow Price: $5/MW
  - DAM Zonal LBMP: $45/MW (includes Forecast Reserves Shadow Price)
- **Total Reserve Payments to Generators:**
  - 3,000*$5 + 2,500*$5 = $27,500
- **Forecast Reserve Price = $5/MW**
  - Equal to the NYCA Forecast Reserve Shadow price

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Zonal Forecast Reserve Charge - Example

- **Calculation of Forecast Reserve Charges:**
  - Virtuals:
    - Forecast Reserve Charge for VS = -500 MW * $5/MW = - $2,500
    - DAM Energy Settlement = 500 MW * $45/MW = $22,500
    - Total Effective Energy Payment = $22,500 - $2,500 = $20,000 = $40/MW
      - This is fair because virtual supply cannot meet the forecast reserve constraint, for which the shadow price is included in the zonal LBMP
  - LSEs:
    - Forecast Reserve Charge for Load that didn’t bid into DAM = - $5/MW *(RT Actual Withdrawals – DAM Scheduled Withdrawals) = -$5/MW*(30,000 MW – 28,000 MW) = - $10,000
      - This charge will offset the total reserve payments

Zonal Forecast Reserve Charge – Example (continued)

- Imports:
  - Assume actual imports are 400MW
  - Forecast Reserve Charge for Imports= $5/MW *(Actual Imports – DAM Scheduled Imports) = $5/MW*(400 – 500 MW) = -$500
    - – This charge will offset be the total reserve payments

- **Total Reserve Payments to be recovered by load-ratio share:**
  - Total Reserve Payments to Generators – Zonal NYCA Forecast Reserve Charges (Loads + VS) = $27,500 – $10,000 – $2,500 - $500 = $14,500

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Other Settlement Elements

Payment for Largest and Second Largest Units

- **Potomac Economics has recommended that NYISO consider a charge to the generators with largest and second largest Energy plus Operating Reserve schedules to reflect their contribution to the contingency reserve requirement**
- **The NYISO proposes to recover contingency reserve costs under the existing structure, i.e., the existing Rate Schedule 4 reserve cost allocation and is not proposing to create a differentiated payment structure for first and second largest units vs other units**
  - The production cost minimization objective ensures that cost tradeoffs are considered when arriving at the optimal solution. That is, the optimization will appropriately consider whether it is economic to back down the largest unit(s) to avoid procuring more reserves, and if so, will back such large units down
  - Instituting such a charge is inequitable for units that have been in operation for decades now.
  - The NYISO believes that such charge may also create friction with policy goals that require large quantities of renewable resources to satisfy emission reduction targets.

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Next Steps

Next Steps

- The deliverable for 2023 is Market Design Complete
- Timeline to completion of MDC
  - Review market design elements and present additional examples at November MIWGs
  - Present MDC and tariff at December BIC
- NYISO will continue prototyping and testing the proposed functionality through early 2024 and will return to stakeholders should any issues be identified.
- Per the 2023 Market Vision, these concepts are expected to be deployed in 2026, assuming prototyping and testing are successful.

Questions?

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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