New York ISO
Independent System Operator

Balancing Intermittency: Market Design Concept Proposed

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Previous Presentations

Date	Working Group	Discussion Points and Links to Materials
10-12-2023	ICAPWG/MIWG	1hr notification/4hr sustainability Reserves Product: https://www.nyiso.com/documents/20142/40342797/Balancing%20Intermittency_100323%20ICAPWG_MIWG_final.pdf/71269f5b-1e84-4bda-3219-b36a71a9be24
10-03-2023	ICAPWG/MIWG	Introductory Analysis regarding Uncertainty Reserve product : https://www.nyiso.com/documents/20142/40342797/Balancing%20Intermittency_100323%20ICAPWG_MIWG_final.pdf/71269f5b-1e84-4bda-3219-b36a71a9be24
09-18-2023	ICAPWG/MIWG	Analysis and proposal regarding Uncertainty Reserve requirement locational distribution: https://www.nyiso.com/documents/20142/40044890/3%20Balancing%20Intermittency_09182023%20ICAPWG_MIWG.pdf/0d0e82b7-1d3a-7af0-fef7-237dbf5c1b77
09-05-2023	ICAPWG/MIWG	Analysis and proposal regarding Uncertainty Reserve requirement calculation methodology: https://www.nyiso.com/documents/20142/39768278/6%20Balancing%20Intermittency_ICAPWG_MIWG_090523.pdf/23391d26-0559-5757-1289-d043e833e16c
07-19-2023	ICAPWG/MIWG	Initial analysis regarding the need to address net load uncertainty: https://www.nyiso.com/documents/20142/38852999/Balancing%20Intermittency%20Initial%20Analyses_ICAPWG_MIWG_071923_Final.pdf/c4adb509-3c09-0361-7f52-b52cae880997
04-17-2023	ICAPWG/MIWG	Kick-off for Regulation Requirements study (Stakeholder vote passed at May OC): https://www.nyiso.com/documents/20142/37014190/Proposed%20Regulation%20Requirements_20230406_SOAS_v1.pdf/a2d7d51a-5511-37c6-ad04-a177d69f5424
02-21-2023	ICAPWG/MIWG	Project Kickoff: https://www.nyiso.com/documents/20142/36339783/Balancing%20Intermittency_MIWG_022123_FINAL%20(002).pdf/5ff99fc1-1eb2-8bec-d385-b4983568802a

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Definitions

- DAM : Day-Ahead Market
- DAM Net Load Forecast : Day-Ahead gross load forecast – Day-Ahead behind-the-meter (BTM) solar forecast
- Net Load Actual : Observed real-time actual load, which captures the effect of BTM Solar
- DAM Net Load Forecast Error : Net Load Actual– DAM Net Load Forecast
- Reserve Notification Time : The lead time that a reserve product is scheduled for (e.g., 10-minute reserves, 30-minute reserves, etc.)
- Duration Availability Requirement ("DAR"): The duration (number of hours) that reserve providers can sustain energy output upon conversion from reserves to energy. The current requirement in the NYISO markets is 1 hour.
- MHFE : Multi-Hour Forecast Error
- Uncertainty Reserves: Reserves to address forecast error.

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Background

- **Leveraging the findings in the 2022 Grid in Transition Study, the Balancing Intermittency effort is evaluating whether new market products are necessary to continue reliably maintaining system balance, given a future grid characterized by large quantities of intermittent renewable resources, ESR, and DER.**
    - Update regulation requirements [Completed]
    - Determine if there is a need for additional ancillary services to balance intermittency [Completed]
    - Determine the Uncertainty Reserve requirement calculation methodology [Completed]
    - Examine locational distribution and ORDCs for the Uncertainty Reserves [Completed]
    - New Reserve Product Evaluation [Completed]
    - Reserve Duration Availability Evaluation [Completed]
- **The 2023 project deliverable is a Market Design Concept Proposed.**

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Balancing Intermittency Market Design Considerations

- **Forecast error drives RT energy needs that exceed DAM scheduled energy.**
  - Data observed during the time period of 2021-2022 indicate the need to address forecast errors to support grid reliability.
    - Single-hour DAM Net Load forecast errors exceeding the size of our largest contingency exist today.
- **This presentation describes proposed enhancements to the Operating Reserves market to address grid needs driven by forecast errors.**
  - These market-based solutions aim to reduce the need for out-of-market actions, reduce Operating Reserve shortages, and strengthen grid resilience.

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Objective of Today's Discussion

- Today's presentation will propose the Market Design Concept for the Balancing Intermittency project.

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Uncertainty Reserve Requirement Proposal

Uncertainty Reserve Requirement

- Observed forecast error data drives a need to procure additional operating reserves to balance forecast uncertainty.
- The discussion in this section summarizes the NYISO's proposed data-driven methodology for procuring Uncertainty Reserves.

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Uncertainty Reserve Requirement Calculation Methodology

Uncertainty Reserve Requirement Proposal

- **Today:**
  - Contingency Reserves
    - 2620 MW (NYCA 30-min)

- **Proposal:**
  - Contingency Reserves
    - 2620 MW (NYCA 30-min (Unchanged))
  - Uncertainty Reserves
    - Net Load (Load with BTM Solar Impacts) Uncertainty Reserve Requirement MW
      - FTM Solar will be incorporated in the Net Load component of the calculation as it enters service.
    - Land-based Wind Uncertainty Reserve Requirement MW
    - Offshore Wind Uncertainty Reserve Requirement MW

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Uncertainty Reserve Requirement Methodology Proposal

- **The NYISO is proposing an Uncertainty Reserve requirement-setting methodology that incorporates the following:**
  - An annual historical error metric to comprise 80% of the Uncertainty Reserve requirement, combined with a 2-month rolling historical error metric to comprise 20% of the Uncertainty Reserve requirement.
    - The 80% / 20% division in the requirement represents a balance between long-term data (good characterization of overall error distribution) and short-term data (capturing recent forecast errors).
      - The annual component of the formula will update once per year.
      - The 2-month rolling average component of the formula will update once per month, with the exact process timing to be decided as part of Market Design Complete.
  - This method will be applied to DAM and RT separately to establish DA and RT reserve requirements, which will differ due to the general reduction in uncertainty as we approach RT. See the Appendix for additional information.
  - The design will allow Uncertainty Reserves to scale independently with respect to load with solar (which tend to be correlated) and wind.
  - In-front-of the Meter ("FTM") Solar uncertainty will be incorporated once sufficient FTM Solar resources have been added to the system to enable analysis of historical FTM Solar forecast error.
- **Distribution of the Uncertainty Reserve requirement between operating reserve products will be evaluated as part of the 2024 work under the Balancing Intermittency project.**

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Locational Distribution of Uncertainty Reserve Requirements

Locational Distribution of Uncertainty Reserves

- **Locational distribution of Uncertainty Reserves is necessary to allow the scheduled Uncertainty Reserves to address localized forecast error needs.**
  - Setting the Uncertainty Reserve requirement on a NYCA-wide basis could result in reserves being scheduled on resources that are unable to address forecast error in other regions due to transmission constraints.
    - For example, if the Uncertainty Reserves were scheduled upstate and forecast error occurs in N.Y.C., these reserves could be unable to address the forecast error in N.Y.C. due to transmission constraints.
    - Other ISO/RTOs have faced this issue where the reserves scheduled to address forecast error were unable to be utilized due to deliverability issues and are revising their market designs to incorporate deliverability.

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Locational Distribution: General Approach

- **NYISO proposes to establish reserve requirements that align with the locations where forecast errors are likely to occur.**
  - Uncertainty Reserve requirements will be assigned both to NYCA and locationally in proportion to the underlying share of the causal variable.
    - Uncertainty Reserves for Net Load Forecast Error will be assigned in proportion to forecast Load in each Locational Reserve region.
    - Uncertainty Reserves for land-based Wind and offshore Wind will be assigned in proportion to respective forecast wind Energy output in each Locational Reserve region.

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Locational Distribution of Uncertainty Reserves – Net Load

- Locational Uncertainty Reserve requirements will be calculated based on the locational share of Net Load.
- The load share percentage for each reserve region will be multiplied with the NYCA Net Load Forecast MW to determine regional Net Load Uncertainty Reserve Requirements.
  - Locational Uncertainty Reserve requirements will be nested just as contingency reserves are.

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Wind-Based Components of Uncertainty Reserves

- **As additional land-based and offshore wind resources are installed on the system, the wind components of the Uncertainty Reserve Requirement will be tailored to Reserve Regions based on the regions in which wind resources are connected, similar to the net load share ratio methodology proposed in prior slides, but rather using the wind share ratio.**
  - Locational land-based and offshore wind Uncertainty Reserve requirements will be nested for each type of wind facility, just as net load Uncertainty Reserves and contingency reserves are.
- **The Uncertainty Reserve Requirement percentage will be calculated by using NYCA-wide data for new intermittent technologies such as offshore wind in their first year by using the 2-month rolling historical error data.**
  - Thereafter, the 80/20 blending method will be employed to calculate the offshore wind Uncertainty Reserve requirement percentage.

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Locational Distribution of Uncertainty Reserves – Land-Based Wind

- **Locational Uncertainty Reserve Requirements for the land-based wind component will be calculated for regions in which land-based wind resources are connected.**
  - This component of the Uncertainty Reserve requirement-setting methodology will leverage the magnitude of forecasts using bins.
  - It will also leverage the 80%/20% blending methodology, consistent with the net load component.
- **Currently, land-based wind resources are only interconnected in Zones A-E.**
  - Therefore, at this point in time, the land-based wind component of the Uncertainty Reserve Requirement will be NYCA-wide.

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Locational Distribution of Uncertainty Reserves – Offshore Wind

- **Likewise, Locational Uncertainty Reserve Requirements for the offshore wind component will be calculated for regions in which offshore wind resources are connected.**
  - As with the land-based wind and net load components, this component of the Uncertainty Reserve requirement-setting methodology will leverage the magnitude of forecasts as well as the 80%/20% blending methodology.
- **At the time of Uncertainty Reserve deployment, Offshore Wind resources would likely only be connected to Zone K.**
  - Therefore, at that time, the offshore wind component of the Uncertainty Reserve Requirement will be calculated for Long Island alone.

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ORDCs for Uncertainty Reserves

ORDCs for Uncertainty Reserves

- **Operating Reserve Demand Curves ("ORDCs") are employed to efficiently price energy and operating reserves when market conditions are tight.**
  - These curves establish a price above which the optimization will choose to be deficient of certain products/services rather than procure resources at costs that exceed established values.
- **NYISO proposes to add an additional step to the applicable ORDCs, with a MW value equal to the Uncertainty Reserve Requirement.**
  - Since the Uncertainty Reserve requirement can vary from interval to interval based on the forecast values, the MW value associated with the step would change from interval to interval.
- **NYISO will determine the necessary Uncertainty Reserve Requirement price step for each reserve product and location as part of the Market Design Complete phase in 2024.**

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Uncertainty Reserve Requirement Proposal Summary

Uncertainty Reserve Requirement Proposal Summary

- **The Uncertainty Reserve Requirement will be established using percentages calculated from historical data, which will be individually applied to net load, land-based wind, and offshore wind forecasts.**
  - Each of these components will leverage an 80% prior year and 20% previous 2-month blend of historical data for purposes of calculating the Uncertainty Reserve Requirement percentages.
  - Uncertainty Reserve Requirements for each of these components will also have locational requirements, which will apply NYCA-based Uncertainty Reserve Requirement percentages to the respective net load/land-based wind/offshore wind forecast share ratio.
    - Locational requirements for each respective component of the Uncertainty Reserve Requirement will be nested.
- **The Uncertainty Reserve Requirement percentage will be calculated by using NYCA-wide data for new intermittent technologies such as offshore wind in their first year using the previous 2-month rolling historical error data.**
  - Thereafter, the 80/20 blending method will be employed to calculate the offshore wind Uncertainty Reserve Requirement percentage.
- **An additional price step will be added to the applicable Operating Reserve Demand Curves with a MW value equal to the calculated Uncertainty Reserve Requirement MW, which will change interval to interval.**

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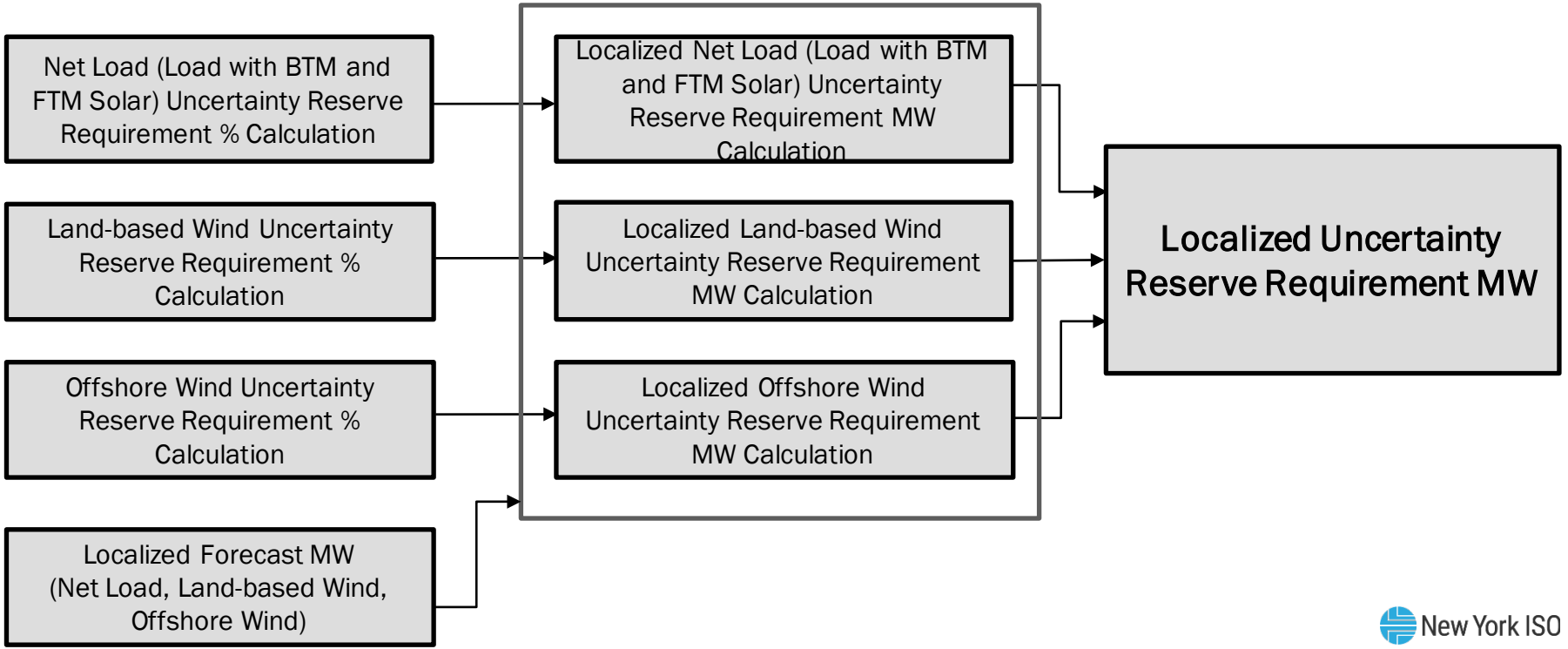
Uncertainty Reserve Requirement Proposal Summary



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New Reserve Product Proposal

Proposed Reserve Product Context

- **As detailed in the coming slides, the proposed new reserve product is targeted to facilitate a more robust market-based solution for addressing forecast uncertainty.**
  - The proposed product will be incremental to, and upon implementation help fulfill, the NYISO's previously discussed proposal to procure reserves to manage DAM net load forecast errors ("Uncertainty Reserve Requirement").
    - The features of the proposed new reserve product include a longer Notification Time and a longer Duration Availability Requirement.

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Longer Notification Time

60-Minute Notification Time

- **The new reserve product will have a longer notification time of 60 minutes as opposed to 10/30 minutes.**
  - As previously discussed in the net load forecast error evolution analysis, there is a certain degree of persistence of DAM net load forecast error between the DAM forecast through to the 30-min ahead forecast.
  - Rather than carrying the entire uncertainty reserves requirement as part of the 10- and 30-minute products, a portion of this requirement can be allocated to the new reserve product, which could be fulfilled by resources having longer startup times and slower ramp rates.
- **A longer notification time product addresses the differences between uncertainty reserves and contingency reserves.**
  - Contingencies occur without any warning, and thus 10-minute reserves are needed to address the energy need that results from a contingency event.
  - Uncertainty can be expected throughout the various XX-Min ahead forecasts, as observed in the historical analysis in the appendix of this presentation, and thus a 60-minute notification time reserve product can be used to address a substantial share of the energy needs that are driven by uncertainty.

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Longer Duration Availability Requirement

4-Hour Duration Availability Requirement

- **As discussed in previous MIWG presentations, forecast errors often persist for multiple hours.**
  - The existing 1-hour reserve Duration Availability Requirement increases the challenge of ensuring that adequate reserves are scheduled, and that energy is available in RT, to address multi-hour energy needs that are not anticipated day-ahead.
- **A longer Duration Availability Requirement will facilitate scheduling of resources that can be available to provide energy during hours of extended need.**
  - Ensuring an uncertainty reserve provider Duration Availability for 4 hours to address the sustained uncertainty can provide leeway for longer lead time resources to be committed to address any further needs that online resources are unable to address due to limited duration/fuel supply issues.
  - It will also send a market signal for the value of resources with greater Duration Availability.
- **Studies of the DAM, 90-min ahead, and 30-min ahead multi-hour forecast error durations show that the four-hour duration covers a significant amount of the sustained uncertainty observed in all these error metrics, as illustrated in the appendix of this presentation.**

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New Operating Reserve Product Proposal Summary

New Operating Reserve Product Summary

- The new uncertainty reserve product will have a Notification Time of 60 minutes and a Duration Availability Requirement of 4 hours.
- This product will have a NYCA-wide requirement and nested locational requirements.
- It is yet to be determined whether this product will be cascaded with the existing products or not.

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Project Timeline and Next Steps

Balancing Intermittency Timeline

- **Short-term (2025 target implementation)**
  - Implement Uncertainty Reserve Requirements as incremental requirements on the 10-minute and 30-minute Reserve Notification Time products.
    - This enhancement will address the near-term needs to address uncertainty that we are observing today.
- **Medium-term (2026 target implementation)**
  - Implement new 60-minute/4-hour reserve product.
  - It may be prudent to continue to evaluate best target implementation date for this component of the project based on the actual evolution of the resource mix.
    - This product will have particular value in a future grid characterized by more duration-limited resources.

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Next Steps

- **2024 Project Milestone: Market Design Complete**
  - Determine the error percentiles for the Uncertainty Reserve requirement calculations.
  - Determine the ORDC Price Step for the Uncertainty Reserves.
  - Determine cascading/non-cascading structure of the new product.
  - Uncertainty reserve requirement distribution between the new and current products.
  - Consumer Impact Analysis
  - Develop integration with reserve market changes being proposed in Dynamic Reserves
  - Prototyping to ensure proposed market design is implementable and is implementable when coupled with Dynamic Reserves

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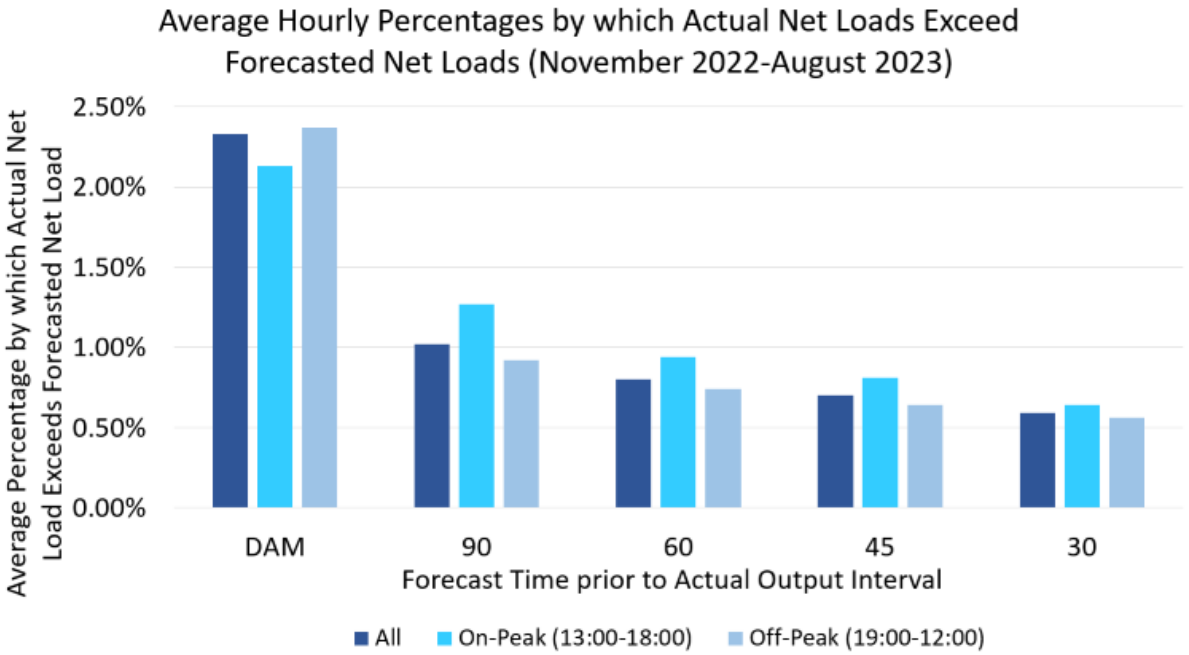
Appendix

Net Load Forecast Evolution



Creating a new notification time product would enable scheduling a portion of the uncertainty reserve requirement with a longer lead time.

- On average, roughly 34% of DAM Net Load Forecast Error is still present 60 minutes out from the actual output interval, and 25% is still present 30 minutes out.

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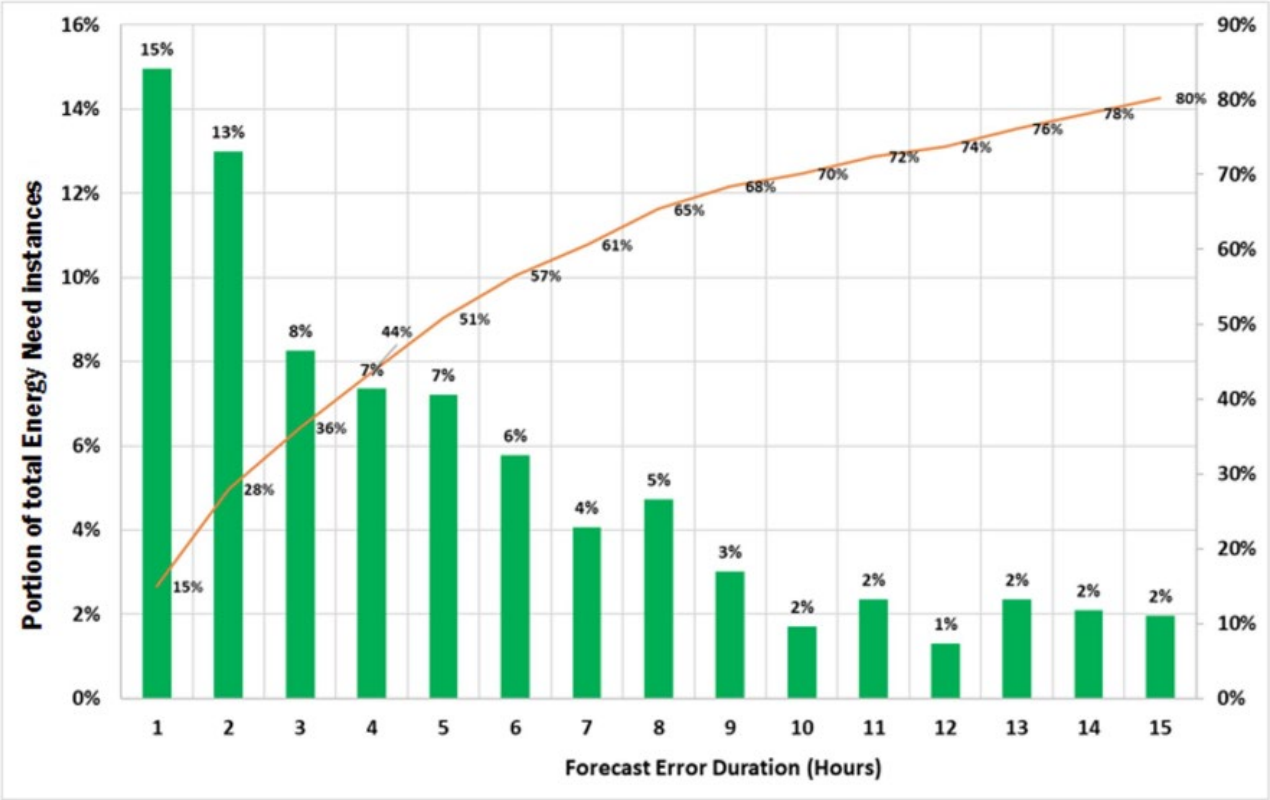
DAM Net Load Multi-Hour Forecast Error Duration Histogram with Cumulative % (Jan '21 – Dec '22)*



*Net Load Errors in this chart include Load, BTM Solar, and Wind.

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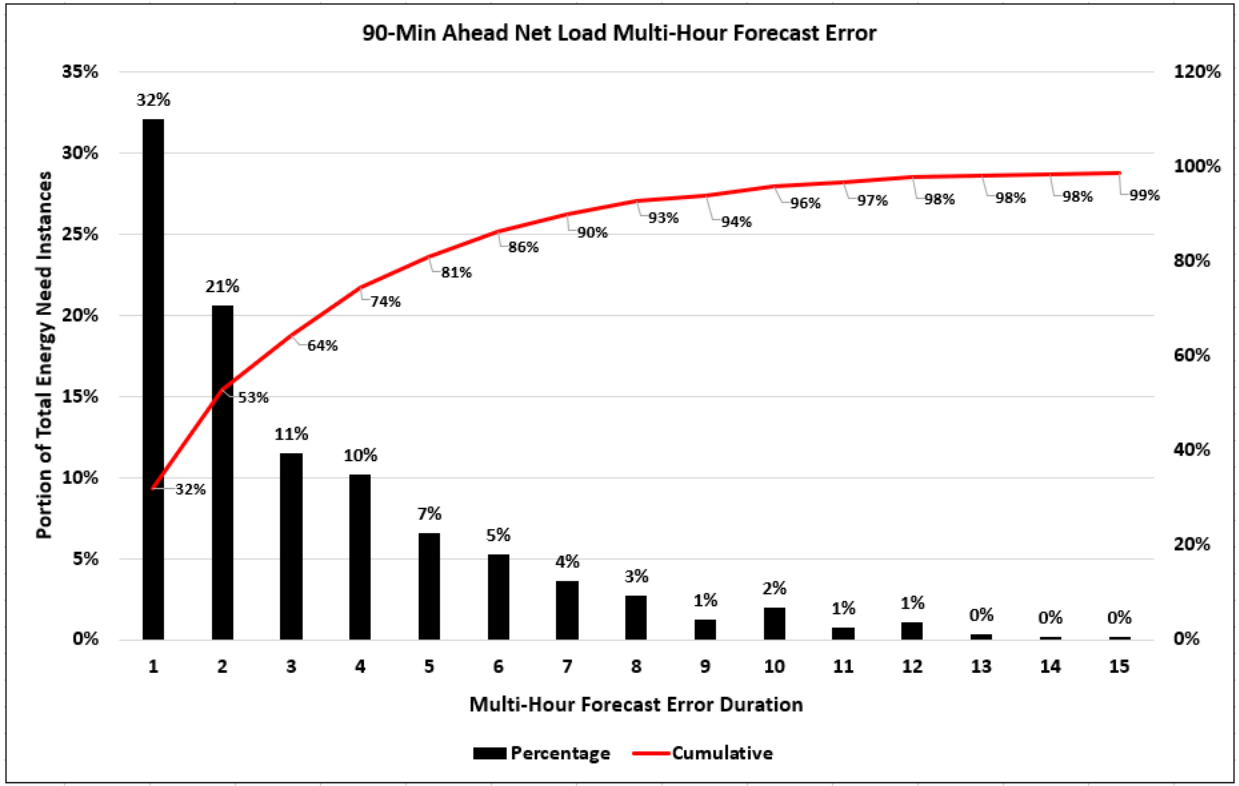
90-Min Ahead Net Load Multi-Hour Forecast Error Duration Histogram & Cumulative % (Nov '22 – Apr 23')



*Net Load Errors in this chart include Load, BTM Solar, and Wind.

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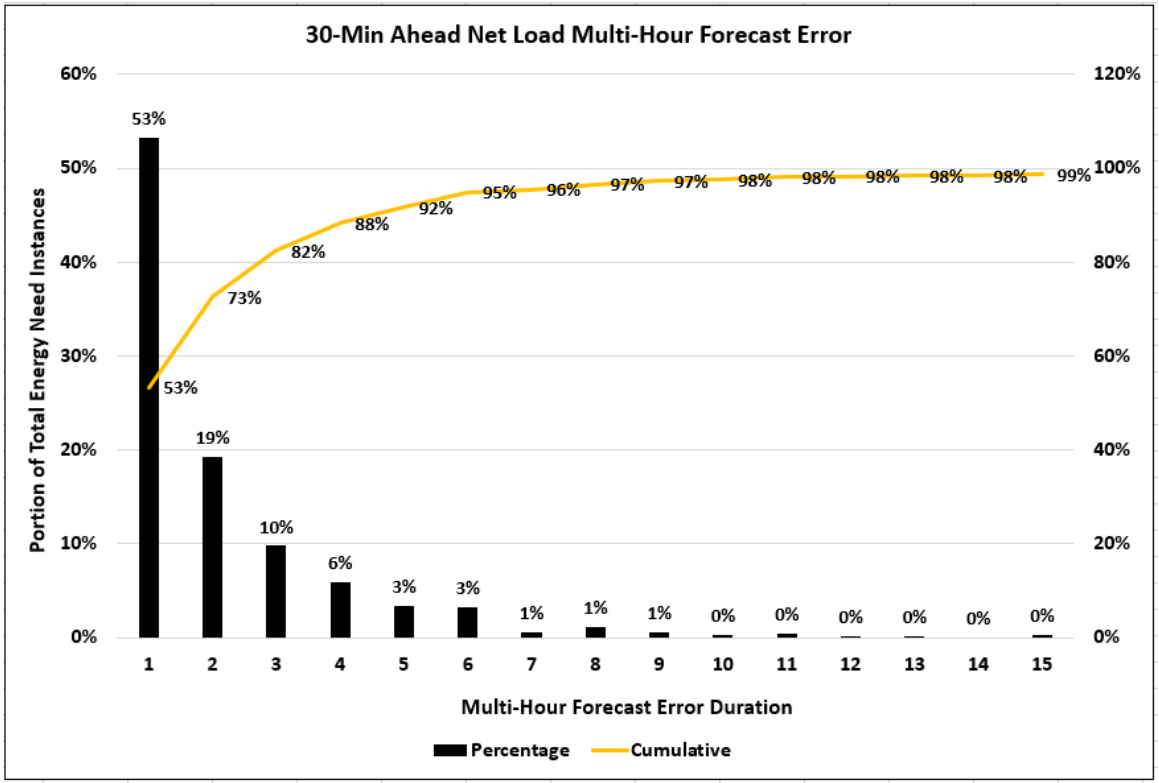
30-Min Ahead Net Load Multi-Hour Forecast Error Duration Histogram & Cumulative % (Nov '22 – Apr 23')



*Net Load Errors in this chart include Load, BTM Solar, and Wind.

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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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