Load Forecast Uncertainty Modeling: Phase 3 Scope Discussion

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Agenda

- **Background and Motivation**

- **Existing LFU Study Work**

- **Primary Phase 3 Study Topics**
  1. Off-peak load variability
  2. Winter LFU development
  3. Load shape weather assumptions (at upper LFU bins)

- **Additional Phase 3 Study Topics (as time allows)**
  4. Model based load shape development
  5. On-peak solar variability

- **Questions and Discussion**
  Additional suggestions for potential Phase 3 study topics and areas of future interest are welcomed

- **Next Steps**

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Background and Motivation

- Load Forecast Uncertainty (LFU) models quantify the impact of extreme weather variability on seasonal peak loads. The resulting LFU multipliers are a significant input into resource adequacy simulations in both the NYISO planning reliability studies, and in the IRM study approved by the New York State Reliability Council (NYSRC). LFU models and results are discussed with and reviewed by the Load Forecasting Task Force and the NYSRC Installed Capacity Subcommittee (ICS).

- The LFU Phase 1 Study and Whitepaper focused largely on the analysis of weather distributions and their impacts on the year-over-year variability of NYCA and regional peak loads
  - Particular attention paid to the distributions of peak load and temperature analysis
  - Comparison of Temperature Humidity Indices
  - Long-term CTHI Distribution Analyses (extreme temperatures, goodness of fit of the Normal distribution)
  - Inter-Annual Weather Sensitivity and LFU Trends

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Background and Motivation

- **LFU Phase 2 focused primarily on load shape analysis, along with follow-up work stemming from select Phase 1 findings**
  - Recommendation of the 2013, 2017, and 2018 load shapes for use in future reliability studies, following a review of historical load shapes, duration curves, and weather conditions
  - Introduced procedures to account for the increasing impact of BTM solar on load shapes (i.e., calculation of historical gross load shapes, and load shapes adjusted to reflect a projected increase in BTM solar capacity)
  - Assessed the change in load duration curves and peak day shapes resulting from increasing penetration of BTM solar
  - Quantified potential impacts of increasing BTM solar penetration on LFU multipliers

- **LFU Phase 3 will address remaining areas of inquiry on LFU and load shape assumptions, with a focus on issues that will become more critical over time**
  - The NYISO is projected to trend toward a winter peaking system due to the increasing penetration of electric vehicles and electric heating
  - Impacts of climate change will enhance focus on extreme weather assumptions and scenarios
  - Increasing levels of BTM solar will continue to add to load variability and contribute to evolving shapes

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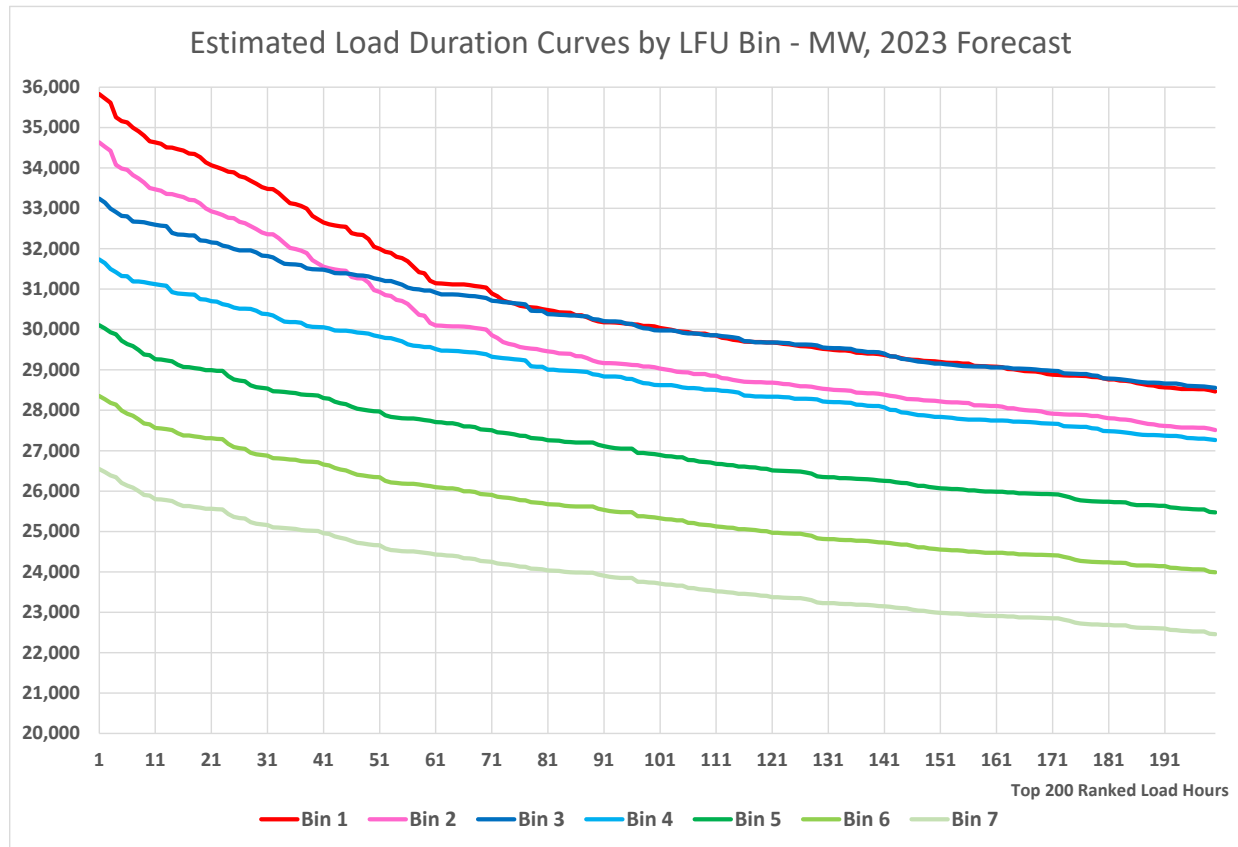
Existing LFU Study Work

- **LFU Phase 1 Whitepaper**
  - March 2021 ([Paper](#), [Presentation](#))

- **LFU Phase 2 Scope Discussion**
  - May 2021 ([link](#))

- **Load Duration Curve Review - 2002 through 2020**
  - May 2021 ([link](#))

- **Load Duration Curve Review – BTM Solar Impacts**
  - July 2021 ([link](#))

- **Impact of BTM Solar on LFU Multipliers**
  - July 2021 ([link](#))

- **Updated Load Shape Recommendation**
  - March 2022 ([link](#))

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Primary Phase 3 Study Topics

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1 - Off-Peak Load Variability

- Examine the relative variability of off-peak summer load hours relative to the variability of the summer peak load hour, as defined by the current LFU process

- Currently, the same LFU multiplier is applied to all summer load hours

- Background material on this topic is included in the upcoming slides

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NYCA Load Duration Curves by Bin

Estimated Load Duration Curves by LFU Bin - MW, 2023 Forecast

Top 200 Ranked Load Hours

Bin 1 — Bin 2 — Bin 3 — Bin 4 — Bin 5 — Bin 6 — Bin 7

- This graph shows estimated hourly summer load duration curves by LFU bin.

- The underlying historical load shapes are 2013 for bins 1&2, 2018 for bins 3&4, and 2017 for bins 5 to 7, per the updated load shape recommendation.

- Duration curves are calibrated to the current 2023 coincident summer peak forecast, and to current LFU bin multipliers.

- These curves are meant to reflect approximate net load that would be used in reliability studies. They may not match the actual values used in the studies.

Annual Energy vs. Seasonal Peak Variability

Gold Book Extreme Weather Forecasts Relative to Baseline
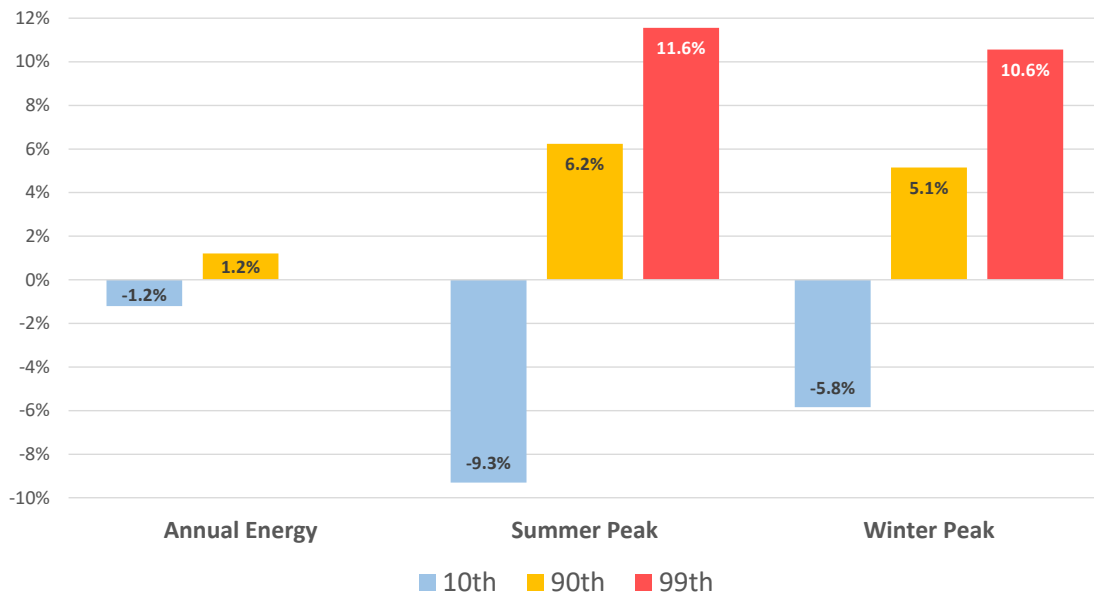
2022 Gold Book Energy and Peak Forecasts				
Forecast	**Baseline**	**10th**	**90th**	**99th**
Energy (GWh)	151,260	149,430	153,090	--
Summer Peak (MW)	31,765	28,810	33,747	35,436
Winter Peak (MW)	23,893	22,497	25,123	26,417

- This graph compares the uncertainty due to weather across the annual energy, summer peak, and winter peak forecasts.

- These ratios are from the 2022 Gold Book. The seasonal peak ratios are defined using the LFU process. Annual energy ratios are based on the historical distribution of weather-related impacts on annual energy usage.

- The load variability due to weather is much greater on seasonal peak demand than on energy usage. This implies that the variability on the peak hour is larger than that on an average hour.

Per-Unit Coefficient of Variation
June to September Ranked Hours, 2002 - 2020
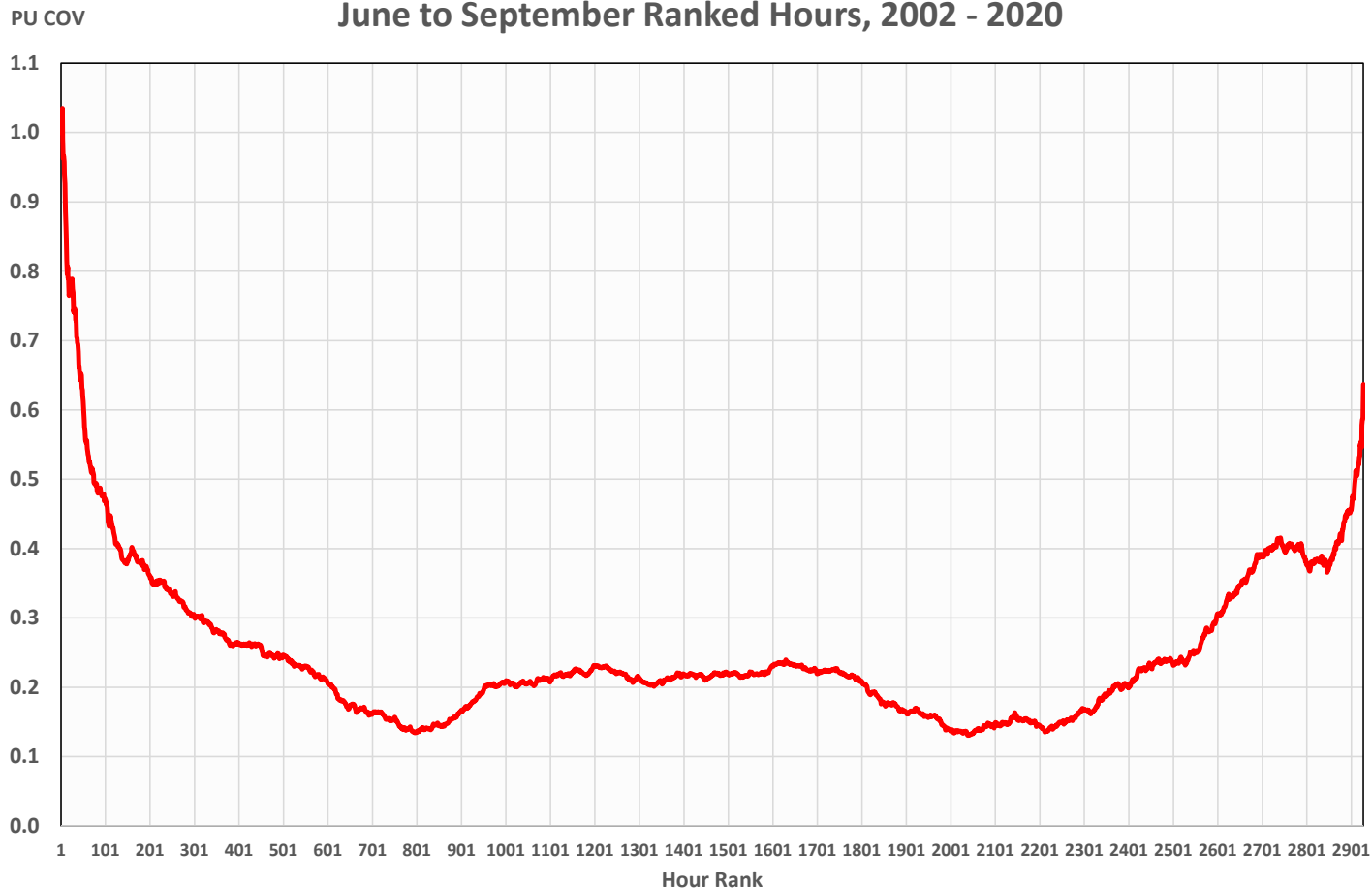
- This graph shows the hourly per-unit coefficient of variation of load sorted by hourly load rank

- The Coefficient of Variation (CV) is the standard deviation divided by the average

- There is a significant drop off in variability over the top 100 ranked summer hours

Note: From the May 2021 LFTF LDC review presentation

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2 – Winter LFU Development

- As the NYCA trends towards becoming a winter peaking system during the 2030s, winter LFU modeling will become more impactful on reliability analyses

- Subtask – development of an improved winter weather variable that better correlates with winter peak loads (akin to CTHI used for summer modeling)
  - Historically, average temperature and/or heating degree days (HDD) were used for winter LFU modeling
  - The recent LFU models used an alternate variable based on a composite of minimum temperature, maximum temperature, and the 6 PM temperature
  - Other variables including wind speed may be included in future analyses

- Subtask – development of regional models for winter LFU, reflecting the five areas used for summer modeling. Comparison of these results with the NYCA-wide winter model

- Potential subtask (if time allows) – investigate the potential impact that building electrification may have on future LFU results, as the saturation of electric heating increases

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3 – Load Shape Weather Assumptions

- Upper bin LFU multipliers and the resulting summer load shapes are representative of extreme weather conditions on peak, and throughout the remainder of the year or season

- Subtask – quantify the assumed weather conditions underlying the current upper bin load shapes used in MARS, across the entire summer seasonal (and potentially winter) load shape

- Potential subtask – compare these underlying weather conditions against existing or proposed extreme weather scenarios

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Additional Phase 3 Study Topics

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4 – Model Based Load Shape Development

- Begin development of 8760 model-based hourly load shapes for each LFU bin

- Potential features and benefits:
  - Accounts for weather variability during the seasonal peak hours
  - Allows for differing variability across the non-peak hours
  - Would account for anticipated changes load shapes driven by future load modifying impacts (for example, the impacts of BTM solar, EV charging, and building electrification)
  - Could account for the uncertainty in the future level or penetration/saturation of these technologies

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5 – On-Peak Solar Variability

- Review historical BTM solar generation and variability on summer peak-type load days

- Link this variability to future BTM solar capacity levels and projected peak day load shapes

- Quantify the potential variability of BTM solar generation during future peak load days and hours

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Questions/Discussion

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Next Steps

- Review LFU Phase 3 topics and scope at NYSRC ICS in June

- Present pertinent analyses and findings to LFTF and/or ICS as available

- Target 2023 Q1 to deliver conclusions on primary study topics

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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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