Review of the Alternative Load Adjustment Method

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Agenda

- Background
- Peak Adjustment (The Alternative Method)
- Load Distribution Comparison
- Next Steps

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Background

Background

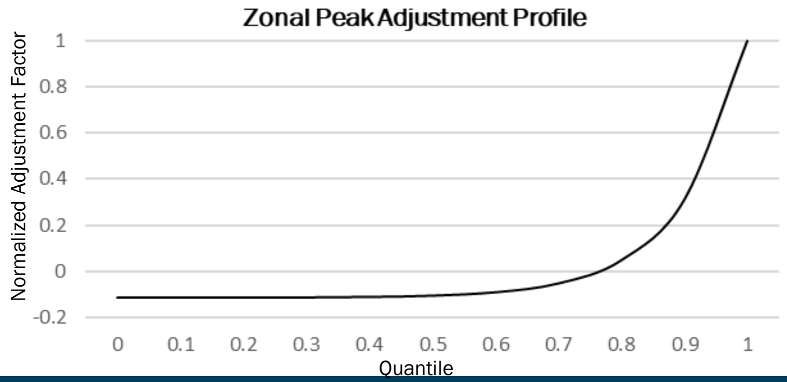
- **During the ICS meeting on 2/27/2024, ICS indicated that a comprehensive improvement of the load modeling should be developed before proceeding with efforts to explicitly model the Behind-the-Meter (BTM) solar as a supply resource**
  - Changes in the future load profiles are expected due to heating electrification and electric vehicle demand
- **During the ICS meeting on 5/1/2024, the NYISO presented an overview, impact assessment, and various risk metrics of adopting a potential alternative load shape adjustment method**
  - The alternative load shape adjustment method adjusts the seasonal peaks and the annual energy requirement to be aligned with the forecasts
  - The alternative method aligns with the methodology used in the NYISO's Reliability Needs Assessment (RNA)
- **ICS expressed interest in further details of the alternative load shape adjustment method and load distribution analysis in comparison to the raw load shapes and the current adjustment method used in the Installed Reserve Margin (IRM) study**

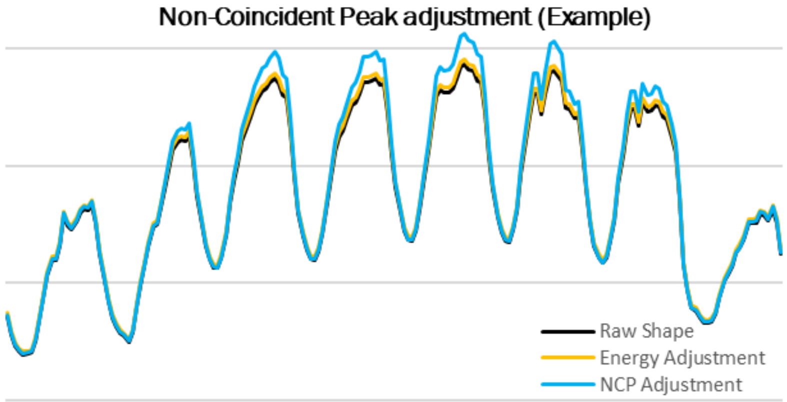
Peak Adjustment Treatment

- The Alternative Method

Zonal Peak Adjustment

- **With the alternative method, zonal (non-coincident) peak adjustment adjusts all load hours within the month**
  - Zonal peak adjustments are made after the energy adjustment
- **Zonal peak adjustment follows a normalized adjustment profile, based on the Golden Ratio $\varphi = \frac{1+\sqrt{5}}{2}$**
  - ❖ The following adjustment profile is used:
    $f(x) = \varphi^{20x} - 1571.66$
    Where x represents the quantile (percentile) of the load values within the month
  - The adjustment profile is normalized before being applied





- **Zonal load values for the adjusting month get ranked, and adjusted based on the percentile**
  - Load values that are greater than the upper quartile are positively adjusted, whereas the load values that are less than the upper quartile are negatively adjusted to maintain the previously adjusted energy level as much as possible
- **This adjustment method maintains the distribution of loss of load triggering hours to be generally consistent with those hours in the load shapes created by using the current method**

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Group Peak Adjustment

- The alternative method's group peak (NYCA coincident peak and G-J Locality peak) adjustment adjusts 12 hours of load before and after the target peak hour
- Group peak adjustment follows a normalized adjustment profile, based on the Gaussian function
  - Gaussian functions are used to represent the probability density function of a normally distributed random variable
  - ❖ The general form for Gaussian function is:

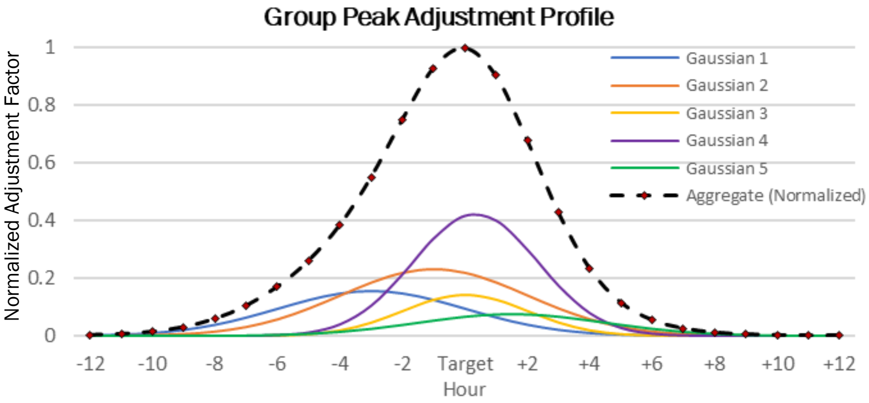
$$g(x) = \frac{a}{\sqrt{2\pi c}} \cdot e^{-\frac{(x-b)^2}{2c^2}} + d$$

where e represents the Euler constant

  - The following coefficients are used for the group peak adjustment profile:

	Gaussian 1	Gaussian 2	Gaussian 3	Gaussian 4	Gaussian 5
a	0.67	1	0.5	1.5	0.33
b	-3	-1	0	0.33	1.5
c	3	3	2	2	3
d	0	0	0	0	0

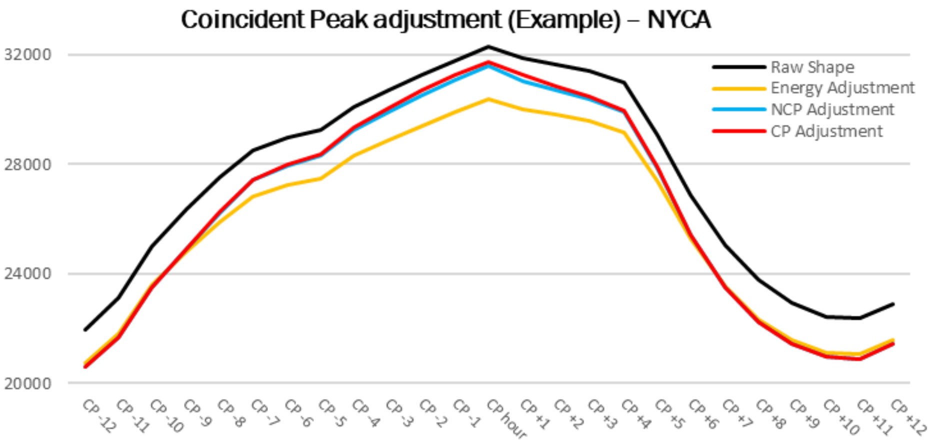
- The needed adjustment for the target peak hour gets multiplied by the normalized aggregate Gaussian profile to calculate the needed adjustments for the near-peak hours

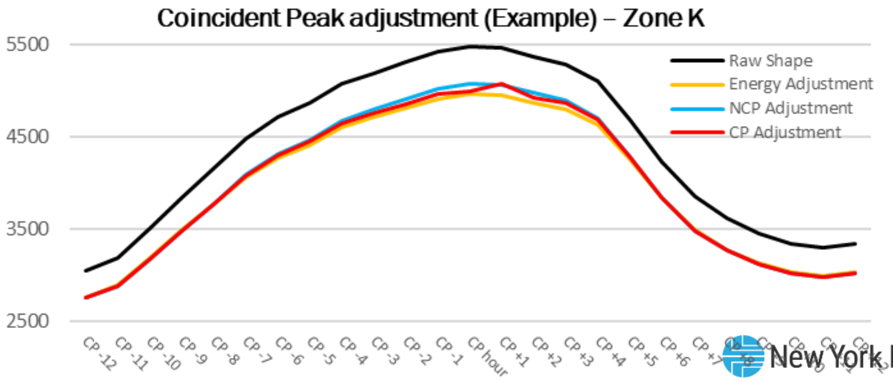


- The group peak adjustment profile is designed to have a small positive skew to accurately represent daily load profile
- The near-peak adjustment amount for each load hour gets distributed to all the zones based on the ratio of their corresponding zonal load level, excluding the zones that are non-coincident peak at this hour
- If a non-coincident peak occurs at the same time as the target coincident peak hour, the non-coincident peak load value gets swapped with the greater of the two adjacent hour's load value

Group Peak Adjustment – Example

- **The load value for the NYCA system peak load hour is adjusted to match the forecasted coincident peak**
  - Group peak adjustments are made after the zonal peak adjustment
- **According to the adjustment profile, the 12 hours of load before and after the target peak hour are adjusted**
  - Hours that are closer to the target peak hour are adjusted by greater amount compared to the hours that are farther from the target hour
- **In 2013, the non-coincident peak of Load Zone K occurred at the same time as the NYCA coincident peak**
  - The non-coincident peak load value is swapped with the load value of the adjacent hour, shifting the non-coincident peak hour for Load Zone K
- **This adjustment method creates smooth load transition around the peak hour without significant changes in the load profile**





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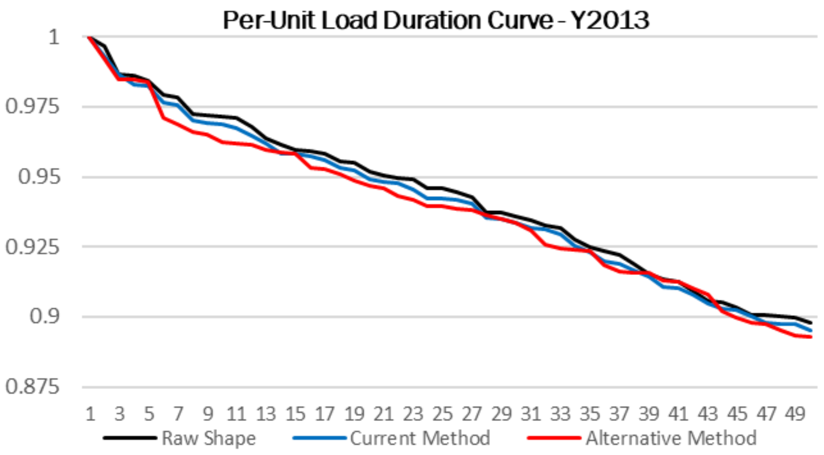
Load Distribution Comparison

Load Duration Curve – Y2013

- The NYISO conducted a load duration curve (LDC) comparison analysis based on the per-unit loads (relative to annual peak) of top 50 hours of the historical load shapes used in the 2024-2025 IRM Final Base Case (FBC)
- 2013 load shapes show minimal differences in the load profiles between the current and the alternative load adjustment method
- The current load shape adjustment method overrepresents the annual energy requirement in the 2013 load shape by 1.5 TWh compared to the alternative method which is equivalent to a 171.2 MW reduction per hour using the alternative method (1,500,000/8,760)
- Between the current method and the alternative method, the average load delta during the top 50 load hours is 58 MW less using the alternative method
  - This implies that most of the reduction in load occur during the hours that are distant from the peak hours and the near-peak hours



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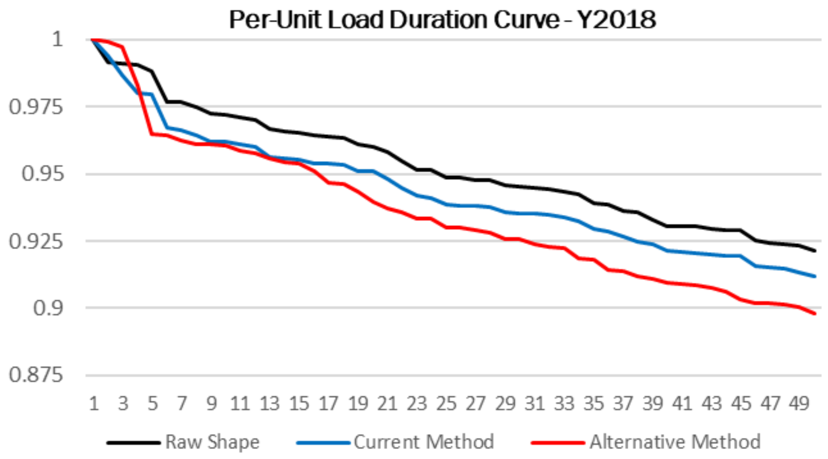
Load Duration Curve – Y2018

- **2018 load shapes show greater reduction in the load between the current and the alternative load adjustment method compared to the 2013 load shapes**
  - The modeled annual energy of 2018 load shape is greater than 2013 load shape, which results in greater reduction in load when the annual energy is aligned
- **The current load shape adjustment method overrepresents the annual energy requirement in the 2018 load shape by 5.3 TWh compared to the alternative method, which is equivalent to a 605 MW reduction per hour using the alternative method (5,300,000/8,760)**
- **Between the current method and the alternative method, the average load delta during the top 50 load hours is 255 MW less using the alternative method**
  - This implies that most of the reduction in load occur during the hours that are distant from the peak hours and the near-peak hours



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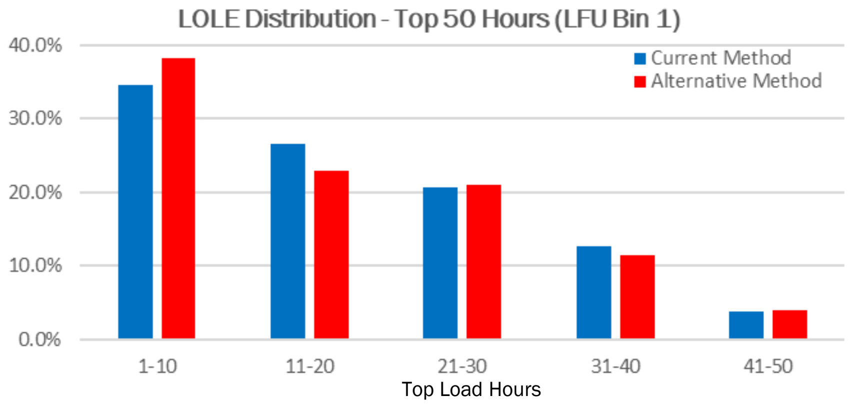
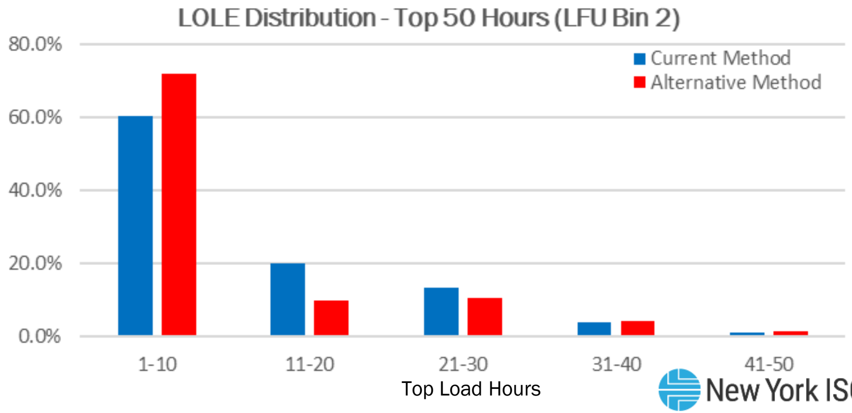
LOLE Distribution – Y2013 (LFU Bins 1-2)

- The NYISO analyzed the top 50 load hours of the load shapes in different load forecast uncertainty (LFU) bins for the Loss of Load Expectation (LOLE) distribution based on the 2024-2025 IRM FBC
- Using the alternative load adjustment method, the proportion of LOLE during the top 1-10 load hours would increase
- Between the load shapes created using the current method and the alternative method, the distribution and the proportion of the hours that trigger loss of load events remain relatively consistent

LOLE Distribution

	LFU Bin 1		LFU Bin 2	
	Current Method	Alternative Method	Current Method	Alternative Method
Top 1 - 10 Load Hours	34.6%	38.3%	60.3%	72.0%
Top 10 - 20 Load Hours	26.6%	22.9%	19.9%	9.9%
Top 20 - 30 Load Hours	20.6%	21.1%	13.3%	10.5%
Top 30 - 40 Load Hours	12.6%	11.5%	3.7%	4.2%
Top 40 - 50 Load Hours	3.8%	4.0%	0.9%	1.3%
Total	**98.2%**	**97.8%**	**98.1%**	**97.9%**





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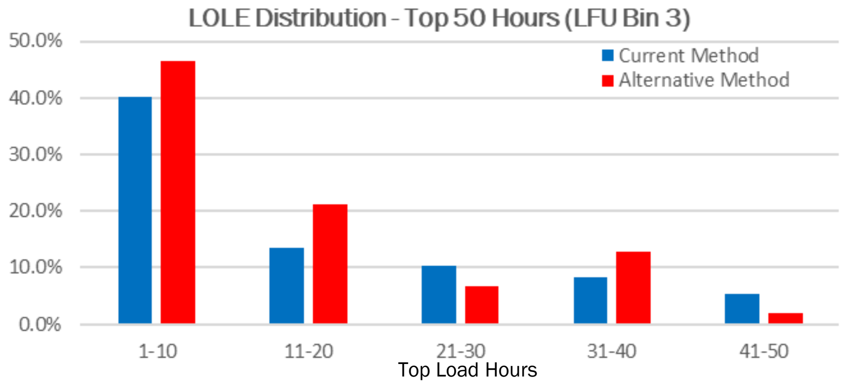
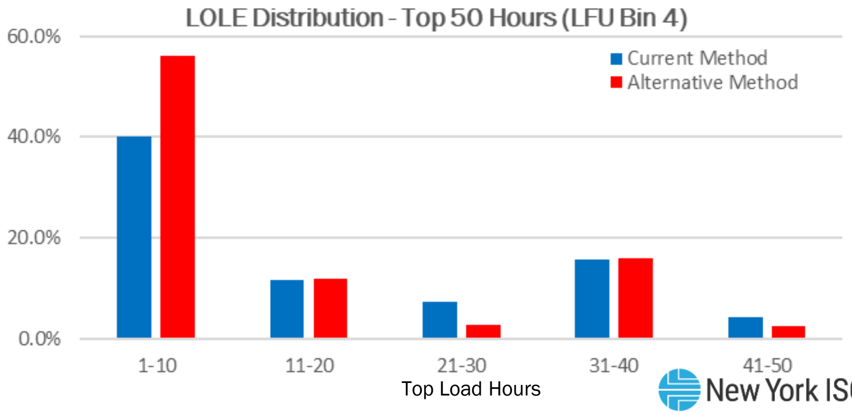
LOLE Distribution – Y2018 (LFU Bins 3-4)

- **Using the alternative load adjustment method, the proportion of LOLE during the top 1-20 load hours in LFU bin 3, and the top 1-10 load hours in LFU bin 4 would increase**
  - Greater load reduction is observed during the lower load hours, which results in a greater proportion of LOLE represented in the top load hours
- **During the top 50 load hours, the load shape created using the alternative method would represent ~10% more relative LOLE hours**

LOLE Distribution

	LFU Bin 3		LFU Bin 4	
	Current Method	Alternative Method	Current Method	Alternative Method
Top 1 - 10 Load Hours	40.2%	46.5%	40.0%	56.0%
Top 10 - 20 Load Hours	13.4%	21.2%	11.6%	12.0%
Top 20 - 30 Load Hours	10.4%	6.7%	7.3%	2.7%
Top 30 - 40 Load Hours	8.2%	12.8%	15.8%	16.0%
Top 40 - 50 Load Hours	5.4%	2.0%	4.2%	2.6%
Total	**77.6%**	**89.2%**	**78.9%**	**89.4%**





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Observations

- **With the alternative method, the zonal (non-coincident) peak adjustment adjusts all load hours within the month based on the quantile of the load values**
  - Load values that are greater than the upper quartile are positively adjusted, whereas the load values that are less than the upper quartile are negatively adjusted to maintain the previously adjusted energy level as much as possible
- **The group (NYCA coincident and G-J Locality) peak adjustment of the alternative method adjusts 12 hours of load before and after the target peak hour based on the Gaussian (normal distribution) profile**
  - Load hours that are closer to the target peak hour are adjusted by a greater magnitude, and the hours that are farther away from the target peak hour are adjusted by a smaller magnitude
- **Based on the load duration curve analysis of 2013 and 2018 load shapes, most of the reduction of load using the alternative method occurs during the hours that are more distant from the peak hours and the near-peak hours, as compared to the current method**
- **Based on the LOLE distribution of LFU bins 1-4 in 2024-2025 IRM FBC, the distribution and the proportion of the hours that trigger loss of load generally remain consistent with either load adjustment method**

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Next Steps

Next Steps

- The NYISO will continue to review the alternative load shape adjustment method with inputs from the ICS
- The NYISO proposes to revisit the previously explored explicit modeling of BTM solar in the IRM model to understand the combined impact of the alternative load shape adjustment method with the explicit modeling of BTM solar resource
  - Explicitly modeling BTM solar resource would likely mitigate some of the downward impact on IRM, which was previously observed by using the alternative load adjustment method
- The NYISO will provide ongoing updates to the ICS to share progress and solicit feedback

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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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