Load Shape Adjustment Procedure – Used in the Current IRM Study

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Agenda

- Background
- Current Methodology
- Considerations

Background

Background

- **During the ICS meeting on 1/30/2024, the NYISO presented methodologies and preliminary impact assessments of modeling behind-the-meter (BTM) solar explicitly in the installed reserve margin (IRM) database**
  - The NYISO identified the current IRM load shape adjustment procedure as one of the contributing factors to the results produced by the preliminary impact assessments
- **To assist with understanding this impact, the ICS expressed interest in a review of the current load shape adjustment procedure used in the IRM study**

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IRM Load Model Overview

- **Load Shapes**
  - Annual load shapes consist of 8,760 hours chronologically by zone
    - The NYISO considers historical New York Control Area (NYCA) and zonal load shapes, weather conditions, and other characteristics to determine appropriate load shapes used for IRM study
  - Currently in the IRM study, 2013, 2017, and 2018 load shapes are used, with expected BTM solar impact embedded (provided annually by the NYISO's Demand Forecasting and Analysis [DFA] team)
  - Load shapes capture parameters such as the duration of the peak, number of hours/days near the annual peak, and total energy served by the system

- **Peak Load Forecast (currently the annual peaks occur in summer except for zone D)**
  - Provided by the NYISO's DFA team
  - Two iterations of the peak load forecast
    - Gold Book Peak Forecast → Preliminary Base Case
    - Fall Forecast Update for IRM Study → Final Base Case
  - Peak load forecasts include:
    - Zonal non-coincident peak (NCP) forecasts
    - Zonal coincident peak (CP) forecast (NYCA peak)
    - G-J Locality peak forecast
  - Behind-the-Meter Net Generation (BTM:NG) Resource adjustments
    - Projected peak proxy load for BTM:NG resources are added back to the IRM study peak load forecast (the IRM study explicitly models BTM:NG resources)
    - Load add-back for BTM:NG resources is not included in the NYISO Gold Book peak forecast (manually added to the peak load forecast for the IRM study)

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Current Adjustment Method

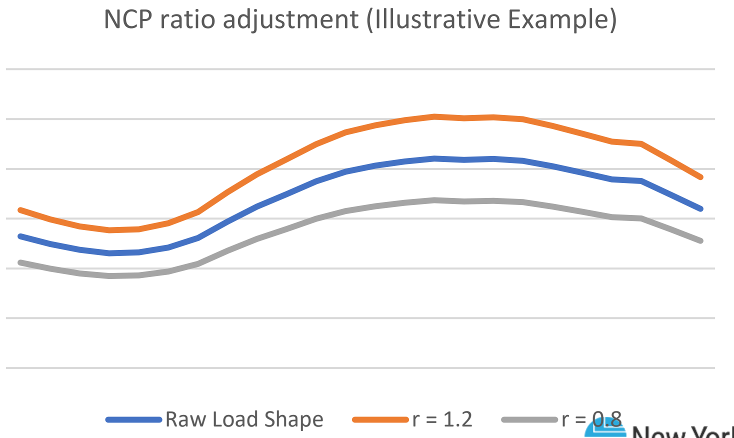
Non-Coincident Peak Ratio Adjustment

- **Calculate the zonal non-coincident peak adjustment ratio**

$$r_{Zone} = \frac{forecasted\ NCP_{Zone}}{historical\ NCP_{Zone}}$$

  - For example, if the historical peak for zone A is 2,000 MW, and the forecasted non-coincident peak for zone A is 2,400 MW, then $r_A = \frac{2{,}400}{2{,}000} = 1.2$
  - Likewise, if the forecasted non-coincident peak for zone A is 1,600 MW, then $r_A = \frac{1{,}600}{2{,}000} = 0.8$

- **Scale up/down the historical zonal load shapes by multiplying the hourly load of the historical load shapes by the corresponding zonal non-coincident peak adjustment ratio**
- **The zonal non-coincident peak adjustment ratio is calculated for each zone and all hours in the zone are multiplied by the same ratio**



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Coincident Peak Hour Match (If applicable)

- As a result of non-coincident peak ratio adjustment, the date and hour of the NYCA coincident peak may change
  - Does not always happen, but if it occurs, it is due to the non-coincident peak scaling in the previous step causing the NYCA coincident demand of another hour to be greater than or equal to the original NYCA coincident peak hour
- If this occurs, a further adjustment is applied to scale down the load of each zone for the observed new NYCA peak hour, according to the ratio of their corresponding zonal load level until the NYCA system load at this hour decreases to 99.95% of the forecasted NYCA peak
  - Excluding the zones that have already achieved zonal NCP for this hour (marked yellow in the example below)

Forecasted CP	99.95% of CP	Adjustment
30,000	29,985	29,985-30,050= -65

	A	B	C	D	E	F	G	H	I	J	K	Sum
	2,600	2,000	2,500	500	1,000	2,500	2,000	500	1,450	10,000	5,000	**30,050**
						Ratio of Load						Adjusted Sum
Each zonal load is divided by the adjusted sum 25,050	0.1038	0.0798	0.0998	0.0200	0.0399	0.0998	0.0798	0.0200	0.0579	0.3992	-	30,050-5,000=25050
						Load Adjustment						
Each zonal ratio is multiplied by the adjustment value -65	-6.75	-5.19	-6.49	-1.30	-2.59	-6.49	-5.19	-1.30	-3.76	-25.95	-	
						New Load Zonal Values						New NYCA Sum
	2,593.25	**1,994.81**	**2,493.51**	**498.70**	**997.41**	**2,493.51**	**1,994.81**	**498.70**	**1,446.24**	**9,974.05**	**5,000**	**29,985.00**

Coincident Peak Adjustment

- **Select the date and hour of the historical NYCA peak as the determined NYCA coincident peak hour, and calculate the difference between the scaled historical coincident peak load and the forecasted coincident peak by zone**

$$d_{Zone}^{CP} = forecasted\ CP_{Zone} - scaled\ historical\ CP_{Zone}$$

  - For example, if the peak for zone A after the NCP adjustment is 2,000 MW, and the forecasted coincident peak for zone A is 2,050 MW, then $d_A^{CP} = 2{,}050 - 2{,}000 = 50$
  - Likewise, if the scaled historical peak for zone B is 1,900 MW, and the forecasted coincident peak for zone B is 1,880 MW, then $d_B^{CP} = 1{,}880 - 1{,}900 = -20$

- **Add the calculated difference d_{Zone}^{CP} to the scaled zonal demand of the coincident peak hour, and verify that the new values of the zonal coincident peak load matches the forecasted coincident peak for each zone**

$$scaled\ historical\ CP_{Zone} + d_{Zone}^{CP} = forecasted\ CP_{Zone}$$

- **To smoothen the load shape around the peak, add 50% of the same difference d_{Zone}^{CP} to the adjacent hours on each side of the coincident peak hour for each zone unless the zonal non-coincident peak is already achieved at this hour**
- **As a result of the coincident peak adjustment, the date and hour of the NYCA peak may change**
  - Follow the steps of “Coincident Peak Hour Match” to scale down the load of each zone for the observed new NYCA peak hour excluding zones that are already at the zonal non-coincident peak for this hour, according to the ratio of their corresponding zonal load level

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Coincident Peak Adjustment Example (after non-coincident peak adjustment)

	A	B	C	D	E	F	G	H	I	J	K	NYCA
CP-2h	2,400	2,000	2,890	450	975	2,450	1,980	480	1,495	10,100	4,520	29,740
CP-1h	2,450	2,050	2,950	510	980	2,480	1,990	490	1,500	10,150	4,500	30,050
CP Hour	**2,480**	**2,040**	**3,060**	**520**	**1,020**	**2,520**	**2,010**	**495**	**1,505**	**10,100**	**4,470**	**30,220**
CP+1h	2,550	2,030	3,000	490	1,050	2,550	2,050	500	1,510	9,900	4,450	30,080
CP+2h	2,545	2,025	2,900	480	1,040	2,540	2,060	490	1,490	9,880	4,430	29,880

Step 1: Identify the CP hour from the scaled historical shape (yellow cells indicate the zonal NCPs)

Step 2: Calculate the difference d_{Zone}^{CP} between the scaled historical CP load and the forecasted CP by zone

Zone	Forecasted CP	Scaled Historical CP	d_{Zone}^{CP}	$\frac{d_{Zone}^{CP}}{2}$
A	2,500	2,480	20	10
B	2,000	2,040	-40	-20
C	3,000	3,060	-60	-30
D	500	520	-20	-10
E	1,000	1,020	-20	-10
F	2,500	2,520	-20	-10
G	2,000	2,010	-10	-5
H	500	495	5	2.5
I	1,500	1,505	-5	-2.5
J	10,000	10,100	-100	-50
K	4,500	4,470	30	15
NYCA	30,000	30,220	-220	-110

Step 3: Add the calculated difference d_{Zone}^{CP} to the scaled zonal load of the CP hour and add 50% of the same difference d_{Zone}^{CP} to the adjacent hours on each side of the CP hour excluding the zones that are already at the zonal NCP for this hour

	A	B	C	D	E	F	G	H	I	J	K	NYCA
CP-2h	2,400	2,000	2,890	450	975	2,450	1,980	480	1,495	10,100	4,520	29,740
CP-1h	2,450+10 =2,460	2,050-20 =2,030	2,950-30 =2,920	510-10 =500	980-10 =970	2,480-10 =2,470	1,990-5 =1,985	490+2.5 =492.5	1,500-2.5 =1,497.5	10,150	4,500+15 =4,515	**29,990**
CP Hour	2,480+20 **=2,500**	2,040-40 **=2,000**	3,060-60 **=3,000**	520-20 **=500**	1,020-20 **=1,000**	2,520-20 **=2,500**	2,010-10 **=2,000**	495+5 **=500**	1,505-5 **=1,500**	10,100-100 **=10,000**	4,470+30 **=4,500**	**30,000**
CP+1h	2,550	2,030-20 =2,010	3,000-30 =2,970	490-10 =480	1,050-10 =1,040	2,550-10 =2,540	2,050-5 =2,045	500+2.5 =502.5	1,510-2.5 =1,507.5	9,900-50 =9,850	4,450+15 =4,465	**29,960**
CP+2h	2,545	2,025	2,900	480	1,040	2,540	2,060	490	1,490	9,880	4,430	29,880

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G-J Locality Peak Adjustment

- **The G-J Locality peak adjustment procedure is similar to the coincident peak adjustment procedure**
- **Select the date and hour of the historical G-J Locality peak as the determined G-J Locality peak hour**
  - If it occurs at the same time as the historical NYCA coincident peak, select the hour preceding the NYCA coincident peak hour as the determined G-J Locality peak hour
- **For each zone of the G-J Locality, calculate the difference between the zonal load of the determined G-J Locality peak hour and the corresponding zonal value associated with the forecast G-J Locality peak**

$$d_{Zone}^{(G-J)} = forecasted\ G-J\ peak_{Zone} - historical\ G-J\ peak_{Zone}$$

- **Add the calculated difference $d_{Zone}^{(G-J)}$ to the scaled zonal load of the coincident peak hour, and verify that the new values of the zonal coincident peak load matches the forecasted coincident peak for each zone**

$$historical\ G-J\ peak_{zone} + d_{Zone}^{(G-J)} = forecasted\ G-J\ peak_{Zone}$$

- **As a result of the G-J Locality peak adjustment, the aggregate statewide load value at the G-J Locality peak hour may become greater than or equal to the forecast NYCA peak load**
  - Follow the steps of “Coincident Peak Hour Match” to scale down the load of zones A-F and K for the G-J Locality peak hour excluding zones that are already at the zonal non-coincident peak for this hour, according to the ratio of their corresponding zonal load level

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External Control Areas

Load Shape Adjustment for External Areas

- **For each External Control Area, the same historical load shapes selected for the NYCA (i.e., currently 2013, 2017 and 2018) are used**
- **These external historical load shapes are adjusted to ensure that the external areas have the same top three peak load days as the NYCA. The procedure is performed as follows:**
  - Identify the dates of top three load level days of the NYCA load shapes and external control areas
    - For Hydro Quebec (HQ), the procedure is only performed for the summer season
  - If the dates of the top three load levels for the external areas are different from that of the NYCA load shapes, swap the daily load shape data (the 24-hour period) of the dates for the external area to match the dates of the top NYCA load days

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Considerations

Considerations (Load Shape Adjustment)

- **The current load shape adjustment method used in the IRM does not account for winter peak or annual energy requirements**
  - The non-coincident peak and coincident peak ratios are developed solely based on the summer peak forecast. Applying these ratios to the entire annual load shapes does not ensure achievement of winter peak forecast values
    - For the past few years, the modeled winter peaks in the IRM study have been relatively consistent with the Gold Book winter peak forecasts (Based on the 2024-2025 IRM study, ~300 MW difference between the 2023 Gold Book winter NYCA peak and the winter NYCA peak modeled in the IRM study is observed)
  - In addition, applying the peak ratios to the entire annual load shapes will likely result in misrepresenting (i.e., overstate or understate) the forecasted annual energy requirements
    - This issue would be more critical with increased penetration of energy storage resources which are anticipated to charge outside of the peak period
- **Load modeling improvements, to capture seasonal peak and annual energy forecast as well as potential synthetic load shapes, has been identified as a priority for 2025 in the Resource Adequacy Modeling Improvement Strategic Plan**
  - Currently, the NYISO's Reliability Needs Assessment (RNA) study performs a load shape adjustment process that accounts for summer and winter peaks, and annual energy forecasts distributed at monthly and zonal level
    - Underlying assumptions are made when distributing the annual energy forecast outside of the peak hour
  - As part of the future load modeling improvement work, model-based synthetic load shapes are currently being assessed/developed

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Considerations (BTM Solar Modeling)

- **The consideration of modeling BTM solar explicitly can advance the need for improvement of the current load modeling**
  - Explicitly modeling BTM solar in the IRM study without changes to the current load shape adjustment procedure will result in an inaccurate impact of the modeling change:
    - To explicitly model BTM solar, the underlying BTM solar production shapes are energy normalized
    - Modeling BTM solar without adjusting for annual energy in the load shapes may over/under-represent solar relative to load
      - The current IRM load shape adjustment method only scales the load shapes based on the summer peak forecasts

Annual Energy of Peak Adjusted Load Shapes Currently used in the IRM Study (TWh)		
Bin 1-2 (2013)	Bin 3-4 (2018)	Bin 5-7 (2017)
153.75	167.30	157.51

Annual Energy of Peak Adjusted Load Shapes used for BTM Solar treatment (TWh)		
Bin 1-2 (2013)	Bin 3-4 (2018)	Bin 5-7 (2017)
159.87	172.14	165.24

2024 GB Baseline Energy Forecast (TWh)
152.14

2024 BTM Solar PV Energy (TWh)
6.53

2024 GB Energy + BTM Solar PV Energy (TWh)
158.67

- As demonstrated in the table above, explicit modeling BTM solar using the production profiles in this case results in underestimating BTM solar production compared to the modeled annual energy levels

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Considerations for 2024

- **For 2024, proceeding with a recommendation to explicitly model BTM solar would require an adjustment to the current load modeling procedures. Development of a comprehensive improvement on the load shape adjustment procedure may not be feasible for the 2025-2026 IRM study**
  - Development of an improvement by the end of 2024 for use in the 2026-2027 IRM study may be possible
- **Changes to the current load shape adjustment procedures will need to be re-examined when synthetic load shapes are developed**
  - The syntenic load shapes would account for the evolving seasonal and hourly impacts of heating electrification, electric vehicle charging, and other technologies
  - Initial synthetic load shape development is underway by the NYISO's DFA team
- **The development of potential interim solutions for the load side adjustment could be considered to facilitate seeking to explicitly modeling BTM solar for the 2025-2026 IRM study:**
  - The RNA's load adjustment method accounts for summer and winter peaks, and annual energy forecast distributed at the monthly and zonal levels and could be assessed for potential use in the IRM study
  - Manually adding BTM solar production shapes on top of the existing IRM load could also be evaluated as a potential interim approach
    - Manual adjustments could potentially be used in conjunction with the load adjustment method used in conducting the RNA

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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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