



2024 Summer Load Shape Analysis for NPCC Reliability Assessments

Introduction

Currently, the CP-8 Working Group (WG) uses the historical load shape based on the summer of 2021 for the months of May – September in NPCC multi-area probabilistic reliability assessments. The selection of the summer load shape assumption is reevaluated on a periodic basis.

This report compares the summer 2021 load shape currently in use with a corresponding representation of the 2024 load profile. Both profiles were scaled consistent with the load forecast assumptions used in the NPCC 2025 Summer Multi-Area Probabilistic Reliability Assessment.¹ The purpose of this evaluation is to determine if the load shape used in the Multi-Area Probabilistic Reliability Assessment is the most conservative for the NPCC Region. Since both the 2021 and 2024 load shapes are scaled to the Areas' 2025 load forecast, the most conservative load shape for the probabilistic assessment may not be the season in which the most severe weather was observed. **Appendix A** includes weather data for the Top 10 peak demand days of the summers 2021 and 2024.

Load Shapes

The 2024 load profiles were provided to GE by each of the five NPCC Areas, as well as by PJM for their own representation. These profiles reflect the actual load, with any demand response added back into the hourly load provided.

Load Scaling Adjustment Methodology

This report illustrates what the loads would be if used to model them in GE Multi-Area Reliability Simulations (MARS) for the 2025 NPCC Summer Multi-Area Probabilistic Reliability Assessment. The 2021 and 2024 shapes are compared in this analysis.

2021 Shape

The 2021 current load shape is the result of the model from the 2025 NPCC Summer Multi-Area Probabilistic Reliability Assessment (i.e., each month's Area peak loads scaled to match the Area's 2025 demand and energy forecasts). For Québec, and the Maritimes, monthly demand values are provided for the 2025 Summer Assessment. For New York, New England, and Ontario the summer peak is provided, and the monthly values are determined by scaling the 2021 load shape to match the 2025 summer peak.

2024 Shape

The 2024 shape is the resulting shape from the NPCC Area's, with each Area's sub-areas (or zones) scaled by a consistent ratio to achieve the same coincident peak as modeled in the 2025 NPCC Summer Multi-Area Probabilistic Reliability Assessment when using the 2021 Shape. This represents the load shape methodology that would be used in the MARS program if the 2024 load shape was used in the 2025 Summer Assessment and the summer peak value was matched.

¹ See: [Load Shape Analysis Report](#).



For a consistent evaluation across the two years, the shapes in this analysis for most of the NPCC Areas correspond to gross load values, i.e., the load without the effect of distributed energy resources (DER) applied to it. For Québec, Maritimes and Ontario, the amount of DER is currently negligible and both years utilized gross load values. New York provided the load shape for the year 2024 with an estimate of DER generation added back in, which represents the gross load in 2024. For New England, the 2024 shape represents the net load (i.e., gross load minus DER). For consistency in this analysis to compare to the 2021 load shape, New England estimated what the hourly generation would have been of the amount of DER present in the 2025 summer assessment, by using irradiance and other weather data for the year 2021. That estimated DER generation was netted from the 2021 observed load to obtain the load shape for that year.

Daily Peaks

The current NPCC CP-8 WG model utilizes the 2021 load shape for the summer months, May through September. A plot of the daily peaks for the months of June through September as represented in the 2025 NPCC Summer Multi-Area Reliability Assessment is shown in **Figure 1**. Traditionally, the Summer Load Shape Analysis has focused on the months June through August. In 2023, several NPCC Areas had their summer peak demand occur in September which prompted the CP-8 WG to consider the September load shape in this year's analysis. Note that these plots only show the summer-peaking Areas within the NPCC Region: New England, New York, Ontario, PJM, and the aggregated shape for the NPCC Region.

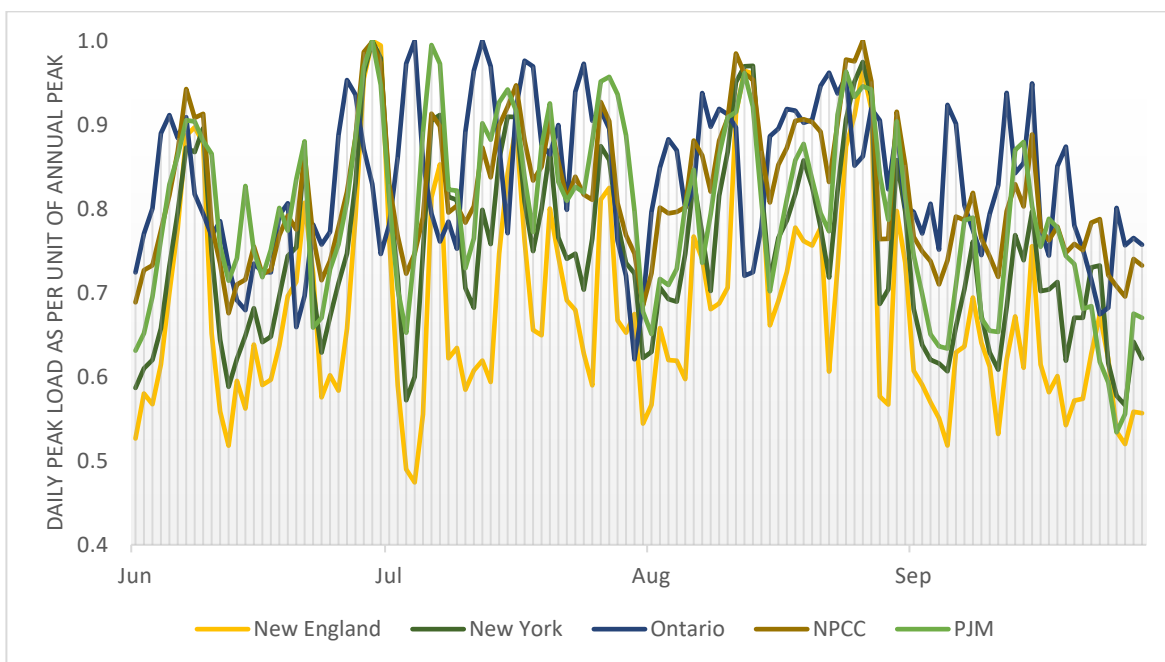


Figure 1 - Daily Peak Loads – 2021 Load Shape



Figure 2 shows the same plot, rendered for the 2024 load shape, after only scaling the sub-area non-coincident peaks to achieve the same Area annual coincident peaks as observed with the 2021 load shape.

Table 1 below shows the number of days above a percent of Area summer peak using this adjustment methodology.

Considering September data for the 2024 shape, 7, 18, and 36 days had a daily peak for the NPCC Region at or above 95%, 90% and 85% of the NPCC peak respectively, for the 2024 shape. This is in comparison to the 2021 shape, where 10, 25, and 42 days were at or above 95%, 90%, and 85% of the NPCC peak, respectively.

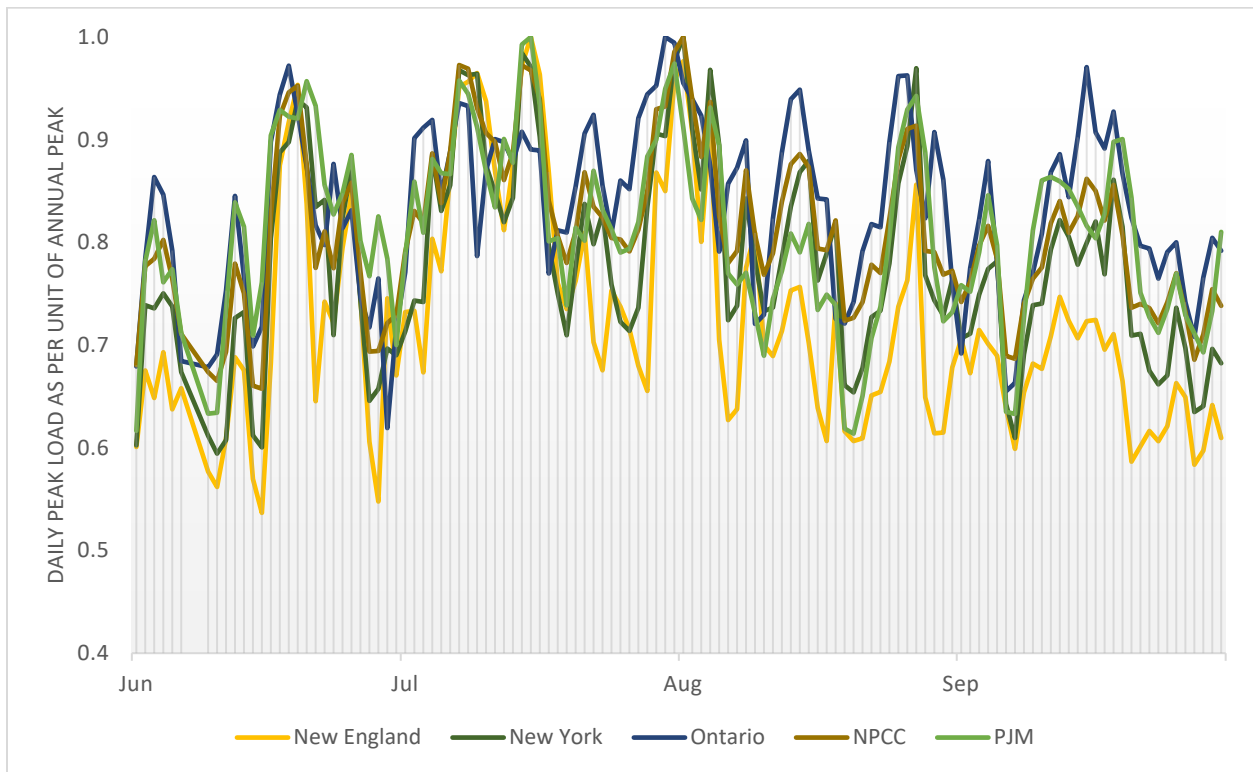


Figure 2 - Daily Peak Loads - 2024 Load Shape

Table 1 - Number of days above a percent of Area summer peak

Region	2021 Shape			2024 Shape		
	95%	90%	85%	95%	90%	85%
New England	6	9	15	9	13	20
New York	8	14	25	9	15	28
Ontario	11	33	57	8	29	57
PJM	8	25	40	5	21	39
NPCC	10	25	42	7	18	36



Statistics for the two profiles are shown in **Table 2** below. This table shows the peak load and load factor² for NPCC and the summer-peaking Areas. The statistics are shown for June, July, August, and September and provides a simple comparison of the monthly peaks across the two load shapes.

Table 2 - Statistics for 2021 and 2024 shapes, scaled to seasonal and monthly peaks ³

		Month	June	July	August	September
New England	2021 Shape	Peak (MW)	26,348	27,593	26,641	22,003
		Energy (GWh)	10,792	11,865	12,430	10,280
		Load Factor (%)	56.9	57.8	62.7	64.9
	2024 Shape	Peak (MW)	26,307	27,593	26,941	20,610
		Energy (GWh)	11,132	13,714	12,207	11,224
		Load Factor (%)	58.8	66.8	60.9	75.6
New York	2021 Shape	Peak (MW)	30,417	31,650	30,847	27,152
		Energy (GWh)	13,862	16,134	16,233	13,543
		Load Factor (%)	63.3	68.5	70.7	69.3
	2024 Shape	Peak (MW)	29,707	31,154	31,650	27,251
		Energy (GWh)	13,939	16,209	16,244	13,614
		Load Factor (%)	65.2	69.9	69.0	69.4
Ontario	2021 Shape	Peak (MW)	22,088	23,182	22,291	21,997
		Energy (GWh)	11,257	12,889	12,641	11,400
		Load Factor (%)	70.8	74.7	76.2	72.0
	2024 Shape	Peak (MW)	22,530	23,182	22,310	22,496
		Energy (GWh)	11,257	12,889	12,641	11,400
		Load Factor (%)	69.4	74.7	76.2	70.4
PJM	2021 Shape	Peak (MW)	153,397	158,365	152,559	143,164
		Energy (GWh)	72,716	83,270	79,423	68,112
		Load Factor (%)	65.8	70.7	70.0	66.1
	2024 Shape	Peak (MW)	151,544	158,365	149,285	142,616
		Energy (GWh)	74,341	83,838	75,972	75,295
		Load Factor (%)	68.1	71.2	68.4	73.3
NPCC	2021 Shape	Peak (MW)	101,170	102,412	102,556	93,881
		Energy (GWh)	49,911	56,210	56,936	49,841
		Load Factor (%)	68.5	73.8	74.6	73.7
	2024 Shape	Peak (MW)	101,123	104,603	106,150	91,493
		Energy (GWh)	50,107	58,156	56,697	50,289
		Load Factor (%)	68.8	74.7	71.8	76.3

² Monthly load factor calculated by (Energy)/ (Peak * hours in month).

³ **Highlighted** Area values represent the non-coincident summer peak. The **NPCC highlighted** values represent the coincident peak for NPCC (which do not match because the values are matched at the individual Area level).



Table 3 shows the day of the NPCC peak load for summer 2025 and the corresponding Area's percent of peak load for that day when using the 2021 and 2024 load shapes.

Table 3 – NPCC Peak Load Day

	Date	Québec	Maritimes	New England	New York	Ontario
2021 Shape	28-AUG-2025	99%	100%	97%	97%	86%
2024 Shape	01-AUG-2025	100%	100%	98%	100%	95%



Comparison to Historical Years for the Top 31 Days of the Summer Period

Figure 3 shows the results using the Annual Load Scaling Adjustment methodology. This represents the load shape methodology that would be used in the MARS program.

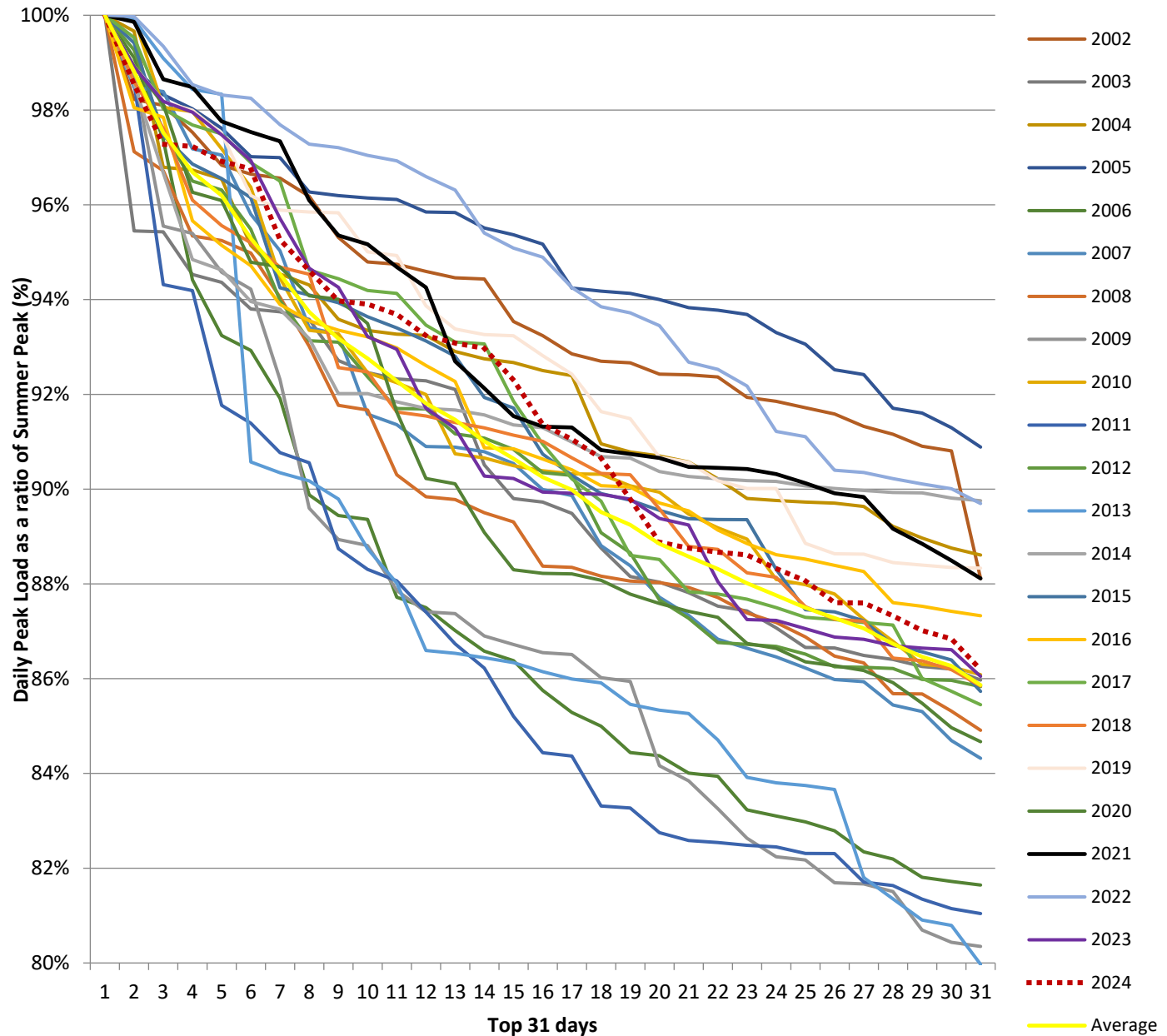


Figure 3 - Comparison of NPCC Summer (May-Sep) Peak Loads for 2002 through 2024 ⁴

One of the factors affecting the “stress” a load shape puts on the system is to consider the number of days where the load was at or near the seasonal peak, as these are the days when a loss of load event is most

⁴ The 31st day of the 2002 load shape drops to 84% (from 91%).



likely to occur. **Figure 3** shows a duration plot of the NPCC peak loads for the top 31 days of the summer periods of the years 2002 through 2024.⁵

Figure 4 isolates the 2021 and 2024 shapes for a more direct comparison. The curves have been normalized to the respective seasonal peak.

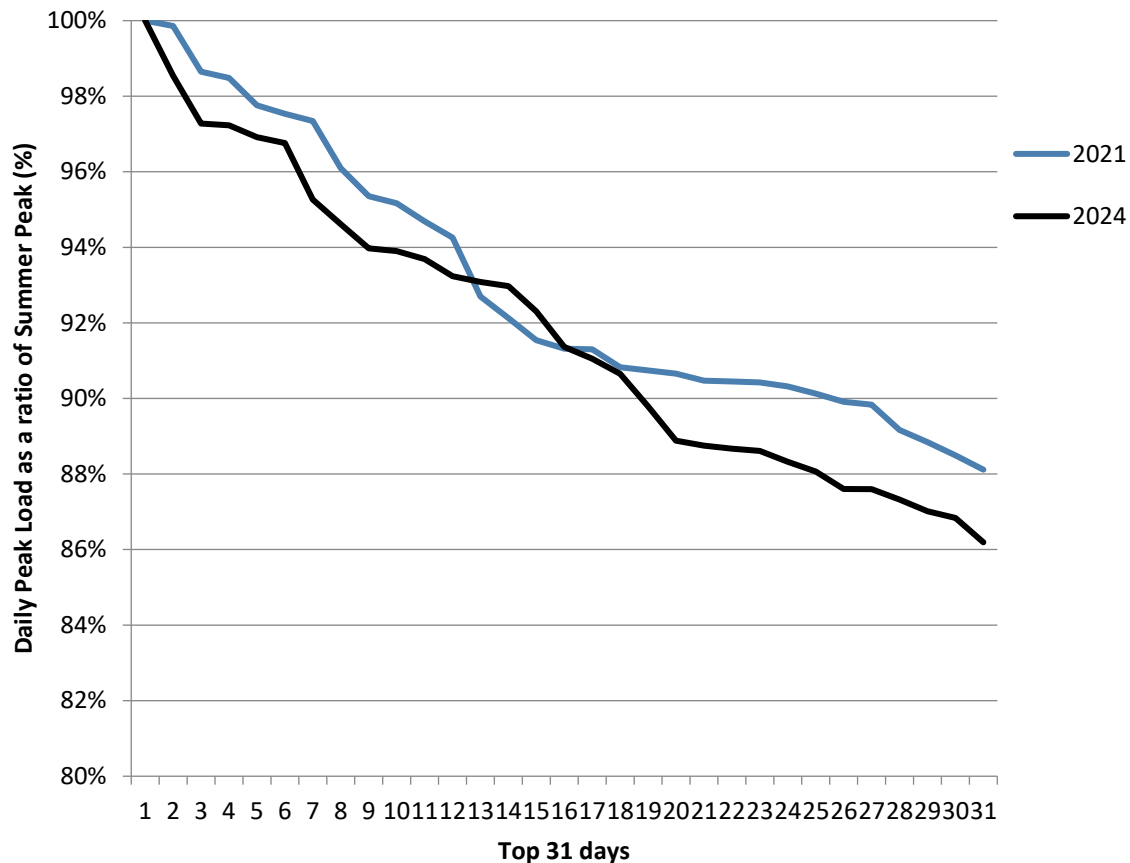


Figure 4 - Comparison of Normalized NPCC Summer Peak Loads for 2021 and 2024

⁵ The 2002 and 2013-2024 data were provided by the NPCC Areas. NPCC loads for 2003 through 2012 were sourced from ABB – Velocity Suite.



Figure 5 also shows the 2021 and 2024 shapes, but the curves have not been normalized. The figures show the actual MW of peak daily load for the highest 31 days.

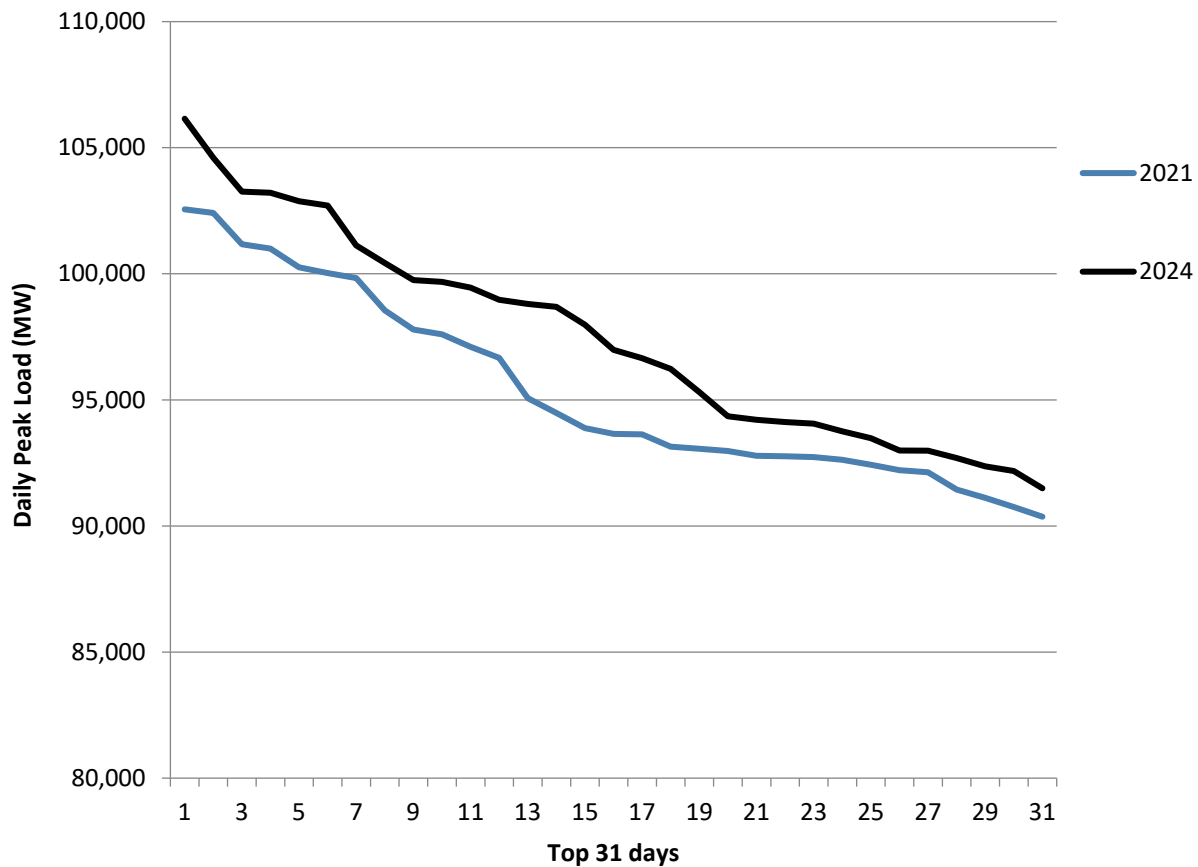


Figure 5 - Comparison of MW NPCC Summer Peak Loads for 2021 and 2024

Conclusion

On a region-wide basis, the 2024 shape appears to be similarly stressful to the 2021, although there is indication that the 2024 load shape produces a higher NPCC-wide coincident peak load (shown in **Figure 5**). The number of days above 95%, 90%, and 85% of the peak load for the 2024 shape is lower when compared to the 2021 load shape (shown in **Table 1**). To assess the reliability impacts of each load shape on an interconnected system, it is crucial to consider the number of days when the load was at its annual peak or near peak, as these are the days when a loss of load event is most likely to occur.

The CP-8 Working Group compared the results of the 2025 NPCC Summer assessment for both the 2021 and 2024 hourly load shape assumptions, finding a slight difference in the results. As can be seen in **Figure 4** and **Table 1**, almost all the top 31 days for the 2021 load shape when normalized to the respective 2025 seasonal peak load is higher compared to the 2024 load shape.



Recommendation

For the reasons concluded above, the CP-8 WG recommended simulating the forthcoming 2025 NPCC Summer Multi-Area Probabilistic Reliability Assessment with both the 2021 and the 2024 load shapes, modified to meet each Area's specified 2025 forecast peaks to understand which is the most conservative option.

The CP-8 Working Group compared the results of the 2025 NPCC Summer assessment for both the 2021 and 2024 hourly load shape assumptions, finding a slight difference in the results. The resulting loss of load and estimated operating procedure (EOP) usage outcomes were similar. Given that the 2024 load shape patterns may be influenced by energy efficiency improvements and other demand response technologies, the 2021 demand profile better represents typical high-demand events for risk analysis. Therefore, the CP-8 Working Group recommends retaining the 2021 load shape as the basis for summer shapes in future assessments to more accurately predict the system's performance during typical high-demand events.



Appendix A. Weather Data

The weather data below consists of the averages of each region in °F.

Table 1. Average temperatures in 2021 for top 10 days

2021							
Top Day		Quebec	Maritimes	New England	New York	Ontario	PJM
1	8/28/2021	62.5	67.6	68.0	72.4	66.6	79.2
2	7/1/2021	65.4	71.1	73.8	73.8	75.5	74.4
3	6/30/2021	71.0	70.5	82.0	81.6	69.0	80.1
4	8/13/2021	78.7	79.8	81.3	82.1	74.4	80.3
5	8/26/2021	79.1	79.9	81.2	81.6	75.2	79.7
6	8/27/2021	67.0	74.0	79.7	79.7	69.5	80.1
7	7/2/2021	61.9	57.3	63.0	68.9	81.5	69.5
8	8/14/2021	72.7	77.3	79.7	78.0	74.1	77.1
9	8/15/2021	65.0	75.7	71.2	71.0	77.4	72.9
10	8/29/2021	65.5	67.9	66.5	71.9	61.8	77.1

Table 2. Average temperatures in 2024 for top 10 days

Top Day		Quebec	Maritimes	New England	New York	Ontario	PJM
1	8/1/2024	78.1	70.6	81.3	80.6	78.2	82.1
2	7/31/2024	74.6	73.0	76.7	78.4	78.1	80.5
3	7/7/2024	72.1	69.0	79.8	78.8	72.8	80.5
4	7/14/2024	75.4	75.6	79.1	78.4	75.4	80.8
5	7/8/2024	75.0	73.2	79.8	79.1	76.0	81.3
6	7/15/2024	75.7	75.6	80.1	79.7	74.9	82.9
7	6/19/2024	83.5	74.9	80.3	79.3	81.8	80.8
8	6/18/2024	79.4	66.9	78.5	78.1	79.6	81.2
9	7/16/2024	74.5	70.8	81.4	80.5	74.2	83.5
10	8/2/2024	78.7	77.2	79.6	78.8	77.3	80.4