



# 2023 Reserve Requirement Study (RRS) Results

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- The study results will re-set the FPR and IRM for 2024/25, 2025/26, 2026/27 and establish initial FPR and IRM for 2027/28.
- The study was conducted using two software tools and therefore, two sets of assumptions (the assumptions were approved at the June PC meeting)
  - PRISM (Assumptions Set #1)
  - Hourly loss of load model used to perform the ELCC study (Assumptions Set #2)
- The PRISM Load Model (LM) is based on the 2013-2019 time period and 2023 PJM Load Forecast (LM was approved at the August PC meeting)
- The Capacity Model (CM) was built with GADS data from 2018-2022 time period for all weeks of the year except the winter peak week.
  - For the winter peak week, the capacity model is created using historical actual RTO-aggregate outage data from time period DY 2007/08 – DY 2022/23

# Capacity Benefit of Ties (CBOT) in the 2023 RRS

- The study assumptions consider calculating the CBOT to be used in the 2023 RRS as the average of the most recent historical CBOT values since the 2017 RRS (including the value calculated this year with PRISM)

| RRS        | CBOT |
|------------|------|
| 2017       | 1.6% |
| 2018       | 1.5% |
| 2019       | 1.6% |
| 2020       | 1.5% |
| 2021       | 1.4% |
| 2022       | 1.0% |
| 2023 PRISM | 2.2% |

**Average Value = 1.5%**  
**(to be used in the 2023 RRS)**



# 2023 RRS Results: Choice between PRISM vs Hourly Loss of Load Model

The main difference between the inputs to PRISM and the Hourly Loss of Load Model is the load model used to represent load uncertainty.

However, in both software tools the objective is to replicate the load uncertainty from the PJM Load Forecast.

To decide between the PRISM and Hourly Loss of Load Model results, PJM calculated the 2027/28 IRM and FPR values directly using the peak load distributions from the PJM Load Forecast.

| Load Model          | 2027/28 FPR | 2027/28 IRM |
|---------------------|-------------|-------------|
| PJM Load Forecast   | 1.1193      | 17.9%       |
| PRISM               | 1.1165      | 17.6%       |
| Hourly Loss of Load | 1.1231      | 18.3%       |



**Because the values produced by using the PRISM load Model are closer to the values produced by using the PJM Load Forecast, PJM is recommending to use the PRISM Results as the 2023 RRS Results.**

2023 RRS Study results - PRISM:

| RRS Year | Delivery Year Period | Calculated IRM | Average EFORD | Calculated FPR* |
|----------|----------------------|----------------|---------------|-----------------|
| 2023     | 2024 / 2025          | 17.7%          | 5.10%         | 1.1170          |
| 2023     | 2025 / 2026          | 17.7%          | 5.09%         | 1.1171          |
| 2023     | 2026 / 2027          | 17.7%          | 5.08%         | 1.1172          |
| 2023     | 2027 / 2028          | 17.6%          | 5.06%         | 1.1165          |

2023 RRS Study results - Hourly Model:

| RRS Year | Delivery Year Period | Calculated IRM | Average EFORD | Calculated FPR* |
|----------|----------------------|----------------|---------------|-----------------|
| 2023     | 2024 / 2025          | 18.5%          | 5.10%         | 1.1246          |
| 2023     | 2025 / 2026          | 18.4%          | 5.09%         | 1.1237          |
| 2023     | 2026 / 2027          | 18.4%          | 5.08%         | 1.1239          |
| 2023     | 2027 / 2028          | 18.3%          | 5.06%         | 1.1231          |



# 2023 RRS Results vs 2022 RRS Results

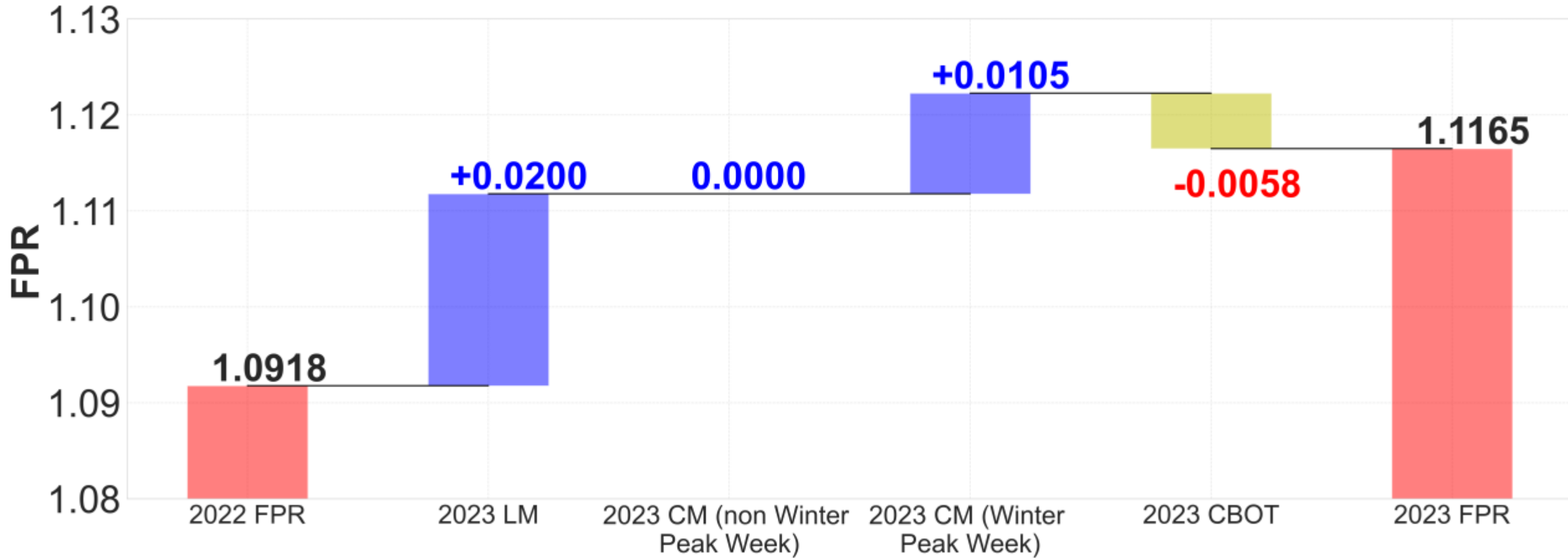
## 2023 RRS results:

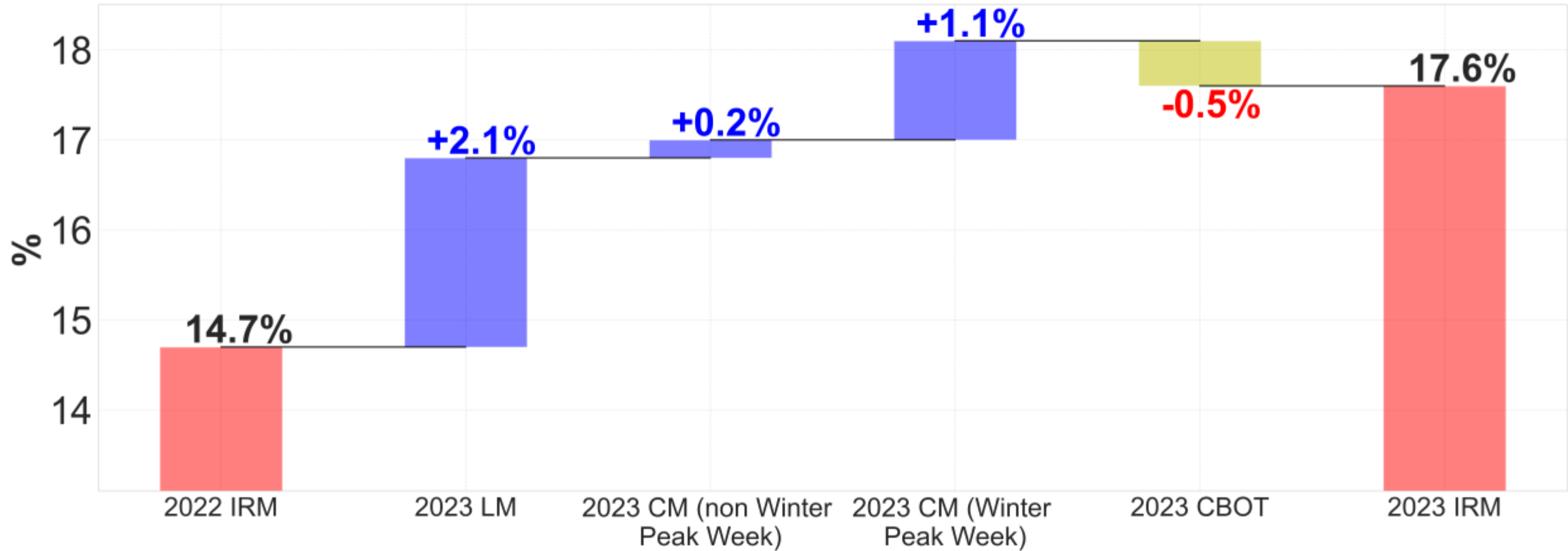
| RRS Year | Delivery Year Period | Calculated IRM | Average EFORD | Calculated FPR* |
|----------|----------------------|----------------|---------------|-----------------|
| 2023     | 2024 / 2025          | 17.7%          | 5.10%         | 1.1170          |
| 2023     | 2025 / 2026          | 17.7%          | 5.09%         | 1.1171          |
| 2023     | 2026 / 2027          | 17.7%          | 5.08%         | 1.1172          |
| 2023     | 2027 / 2028          | 17.6%          | 5.06%         | 1.1165          |

## 2022 RRS results:

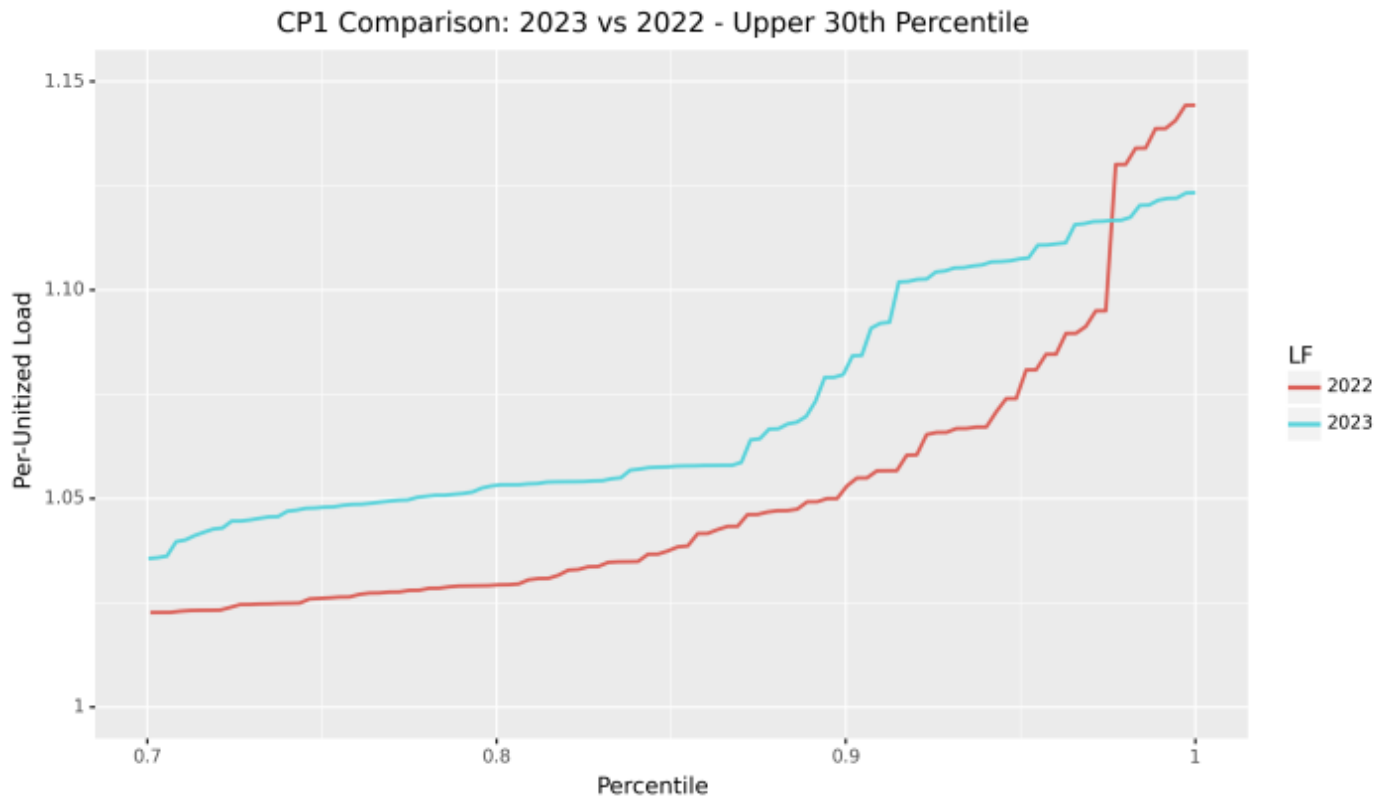
| RRS Year | Delivery Year Period | Calculated IRM | Average EFORD | Calculated FPR* |
|----------|----------------------|----------------|---------------|-----------------|
| 2022     | 2023 / 2024          | 14.9%          | 4.87%         | 1.0930          |
| 2022     | 2024 / 2025          | 14.8%          | 4.83%         | 1.0926          |
| 2022     | 2025 / 2026          | 14.7%          | 4.81%         | 1.0918          |
| 2022     | 2026 / 2027          | 14.7%          | 4.81%         | 1.0918          |

\* FPR = (1 + IRM)\*(1 - Average EFORD)





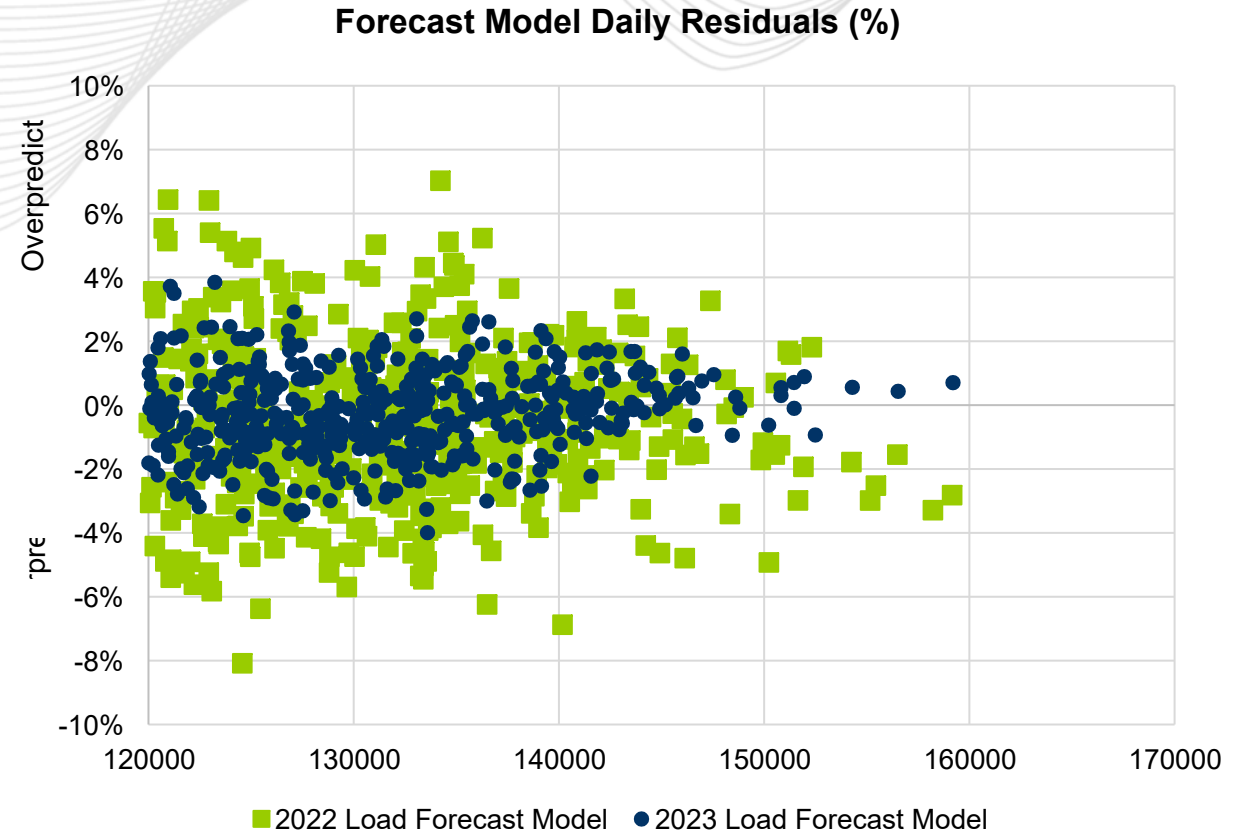
- The 2023 Load Model (LM), relative to the 2022 LM, puts upward pressure on both the FPR and the IRM





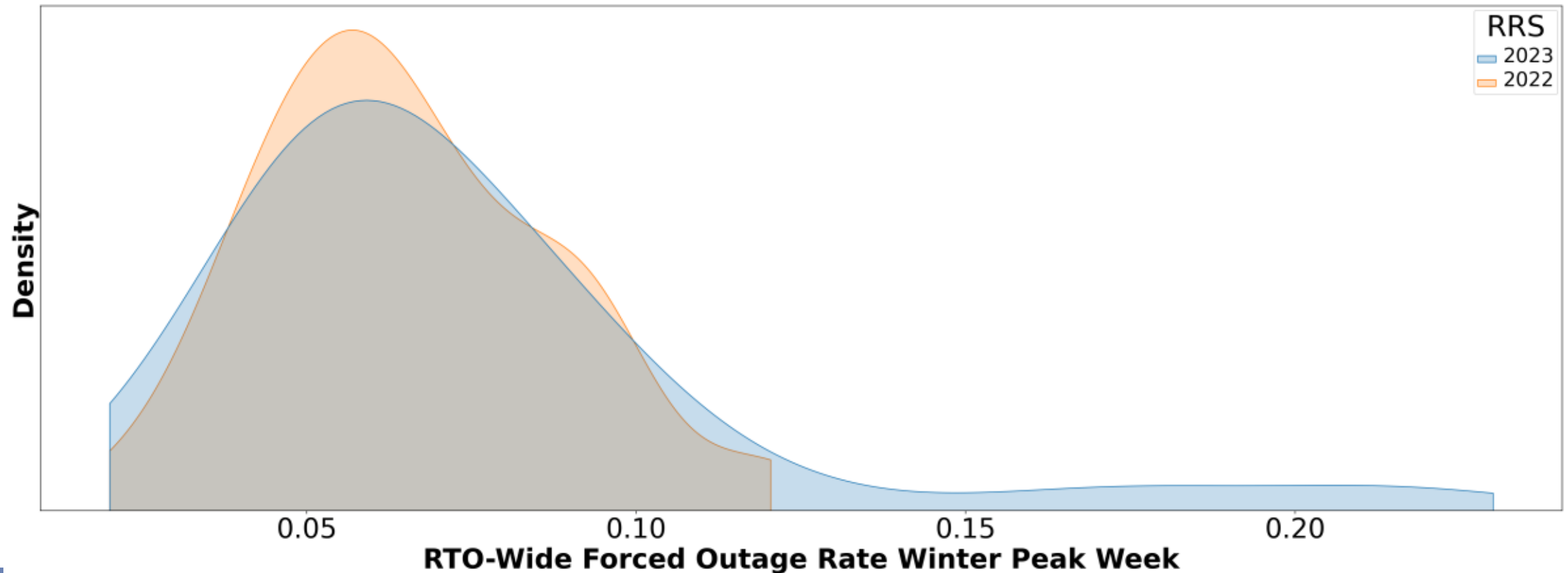
# Main Contributing Factors to Higher CP1 at Extremes

- New forecast model shows a demonstrable improvement in fit at higher load levels. This includes a prior tendency to underpredict at summer extremes.
- Hourly model allows for more granular treatment of solar. Prior daily model had assumed solar impact on load was from its HE17 contribution. Peaks are shifting to HE18 and later meaning smaller weight on load from solar, and consequently higher net loads.



*\*Residuals are all in-sample, full CP1 distribution includes weather outside of sample*

- The 2023 Winter Peak Week Capacity Model (WPWCM) relative to the 2022 WPWCM, puts upward pressure on both the FPR and the IRM.



- The 2023 Capacity Benefit of Ties (CBOT), relative to the 2022 CBOT, puts downward pressure on both the FPR and the IRM
  - The CBOT increased to 1.5% (2023 RRS) from 1.0% (2022 RRS).
- The 2023 Capacity Model (non Winter Peak Week), relative to the 2022 Capacity Model (non Winter Peak Week), puts upward pressure on the IRM.
  - The Average EEFORd in the 2023 RRS (for DY 2027) is 5.90% whereas in the 2022 RRS (for DY 2026) was 5.70 %

- **Background**

- WWRT is supplied to the PJM Operations Department so that it can be used to coordinate planned outages scheduling during the upcoming winter period

- **Objective**

- Cover against uncertainties associated with load and forced outages during the winter months so that the calculated winter LOLE is practically zero

- Procedure

- Step 1: Set up an IRM case with total LOLE = 0.1 days/year.
- Step 2: In addition to the required planned outage schedule, simulate additional planned outages during each week of the three winter months until the annual LOLE is worse than 0.1 days/year.
- Step 3: Calculate the available reserves in each of the winter weeks as a percentage of the corresponding monthly peak.
- Step 4: The WWRT for each month is the highest weekly reserve percentage (rounded up to the next integer value).



# 2023/24 Winter Weekly Reserve Targets

| Month    | % Available Reserves | WWRT (Max Monthly % Available Reserves) |
|----------|----------------------|---|
| December | 14.78%               | 28%                                     |
|          | 27.23%               |   |
|          | 8.97%                |   |
|          | 12.70%               |   |
| January  | 29.77%               | 30%                                     |
|          | 4.37%                |   |
|          | 21.08%               |   |
|          | 24.43%               |   |
| February | 19.39%               | 25%                                     |
|          | 24.50%               |   |
|          | 23.24%               |   |
|          | 17.62%               |   |

Last year's values were:

December: 21%  
 January: 27%  
 February: 23%

- The 2023 RRS Report has been posted alongside this presentation
- This year, PJM is providing a shorter version of the report given all the Resource Adequacy activities occurring simultaneously

- Endorsement of the Recommended FPR and IRM values in the table below

**2023 RRS results:**

| RRS Year | Delivery Year Period | Calculated IRM | Average EFORd | Calculated FPR* |
|----------|----------------------|----------------|---------------|-----------------|
| 2023     | 2024 / 2025          | 17.7%          | 5.10%         | 1.1170          |
| 2023     | 2025 / 2026          | 17.7%          | 5.09%         | 1.1171          |
| 2023     | 2026 / 2027          | 17.7%          | 5.08%         | 1.1172          |
| 2023     | 2027 / 2028          | 17.6%          | 5.06%         | 1.1165          |

- Endorsement of the WWRT values for 2023/24 as shown below

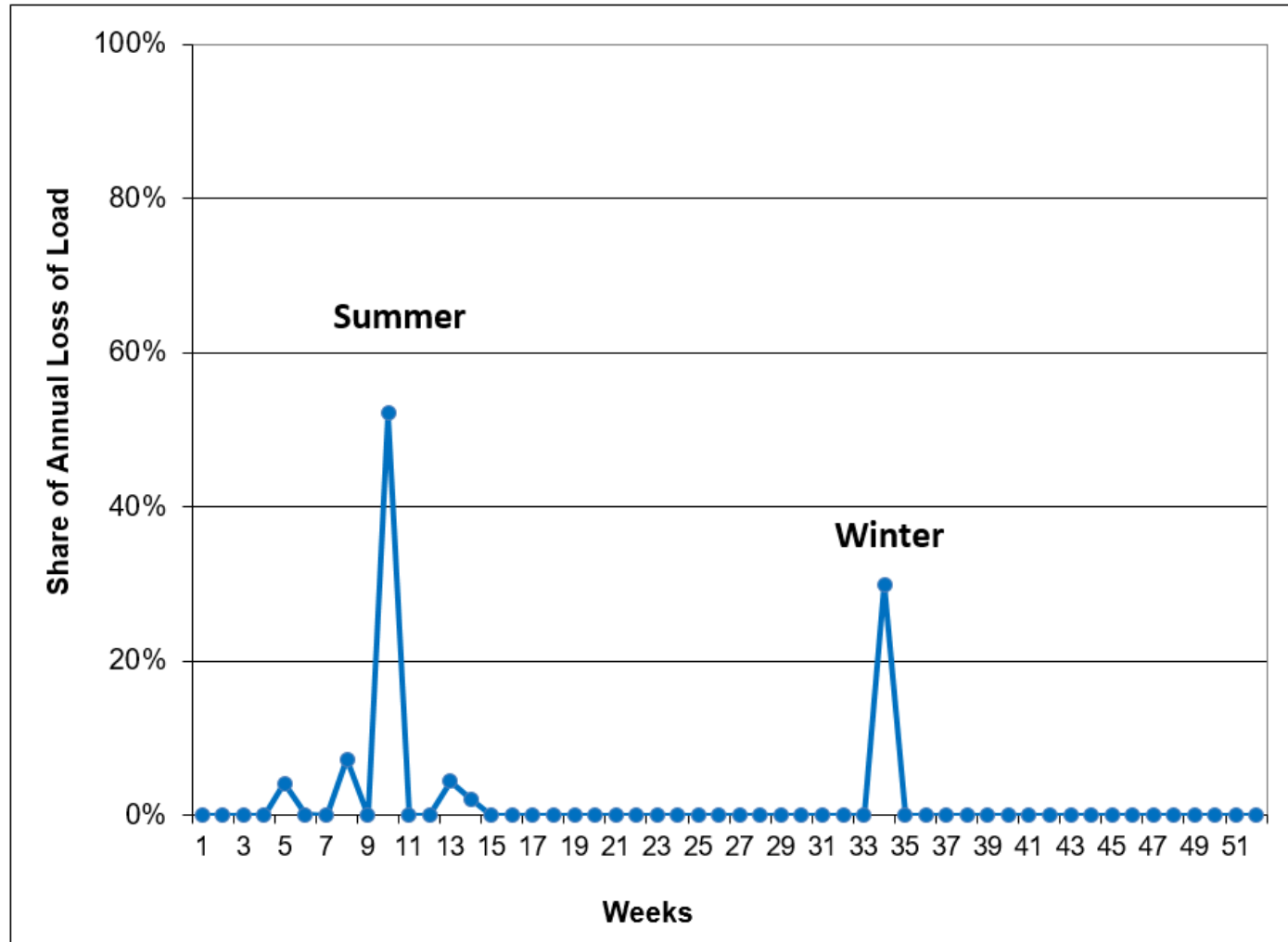
| Month         | WWRT |
|---------------|------|
| December 2023 | 28%  |
| January 2024  | 30%  |
| February 2024 | 25%  |



- For FPR and IRM
  - Sep, MRC: first read of FPR and IRM
  - Oct, PC: vote on FPR and IRM
  - Oct-Nov, MRC and MC: review and vote on FPR and IRM
  - Dec, PJM Board: final approval of FPR and IRM
- For WWRT
  - Oct, PC: first read of WWRT
  - Oct, OC: first read of WWRT
  - Nov, PC: vote on WWRT
  - Nov, OC: vote on WWRT

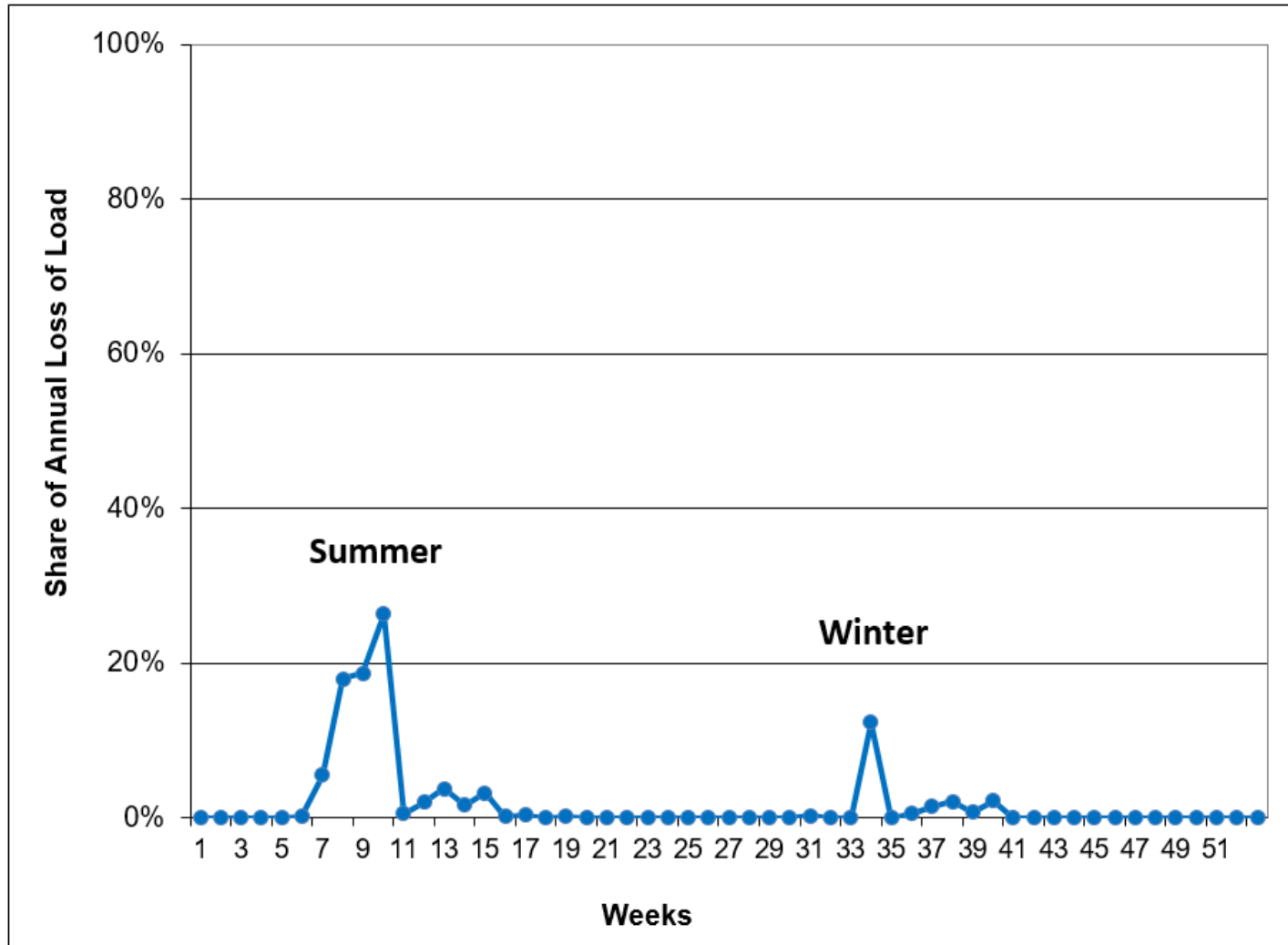
# Appendix

- PRISM
  - 70% Summer, 30% Winter
- Hourly Loss of Load Model
  - 80% Summer, 20% Winter





# Weekly/Daily (Top 40) LOLE Breakdown – Hourly Loss of Load Model



| Date      | LOLE     | Share  |
|-----------|----------|--------|
| 7/19/2027 | 0.016584 | 16.59% |
| 7/20/2027 | 0.015043 | 15.05% |
| 7/6/2027  | 0.010978 | 10.98% |
| 7/7/2027  | 0.006676 | 6.68%  |
| 7/21/2027 | 0.006045 | 6.05%  |
| 1/7/2028  | 0.005411 | 5.41%  |
| 7/1/2027  | 0.004467 | 4.47%  |
| 7/23/2027 | 0.004229 | 4.23%  |
| 1/10/2028 | 0.002852 | 2.85%  |
| 1/6/2028  | 0.001839 | 1.84%  |
| 8/27/2027 | 0.001799 | 1.80%  |
| 8/30/2027 | 0.00126  | 1.26%  |
| 8/11/2027 | 0.00117  | 1.17%  |
| 1/31/2028 | 0.001089 | 1.09%  |
| 8/12/2027 | 0.00099  | 0.99%  |
| 1/5/2028  | 0.00099  | 0.99%  |
| 8/18/2027 | 0.00099  | 0.99%  |
| 8/16/2027 | 0.0009   | 0.90%  |
| 6/29/2027 | 0.000742 | 0.74%  |
| 2/15/2028 | 0.000646 | 0.65%  |
| 2/16/2028 | 0.000646 | 0.65%  |
| 2/3/2028  | 0.00063  | 0.63%  |
| 2/2/2028  | 0.00063  | 0.63%  |
| 8/5/2027  | 0.00063  | 0.63%  |
| 1/4/2028  | 0.00063  | 0.63%  |
| 7/17/2027 | 0.000593 | 0.59%  |
| 7/16/2027 | 0.000582 | 0.58%  |
| 1/8/2028  | 0.000579 | 0.58%  |
| 7/26/2027 | 0.000524 | 0.52%  |
| 8/3/2027  | 0.000492 | 0.49%  |
| 7/15/2027 | 0.00045  | 0.45%  |
| 7/22/2027 | 0.00045  | 0.45%  |
| 2/1/2028  | 0.00045  | 0.45%  |
| 8/13/2027 | 0.00045  | 0.45%  |
| 2/19/2028 | 0.000387 | 0.39%  |
| 2/17/2028 | 0.000387 | 0.39%  |
| 2/11/2028 | 0.00036  | 0.36%  |
| 8/9/2027  | 0.00036  | 0.36%  |
| 2/4/2028  | 0.00036  | 0.36%  |

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## 2023 Reserve Requirement Study (RRS) Results



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