NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

October 1, 2025

North American Electric Reliability Corporation
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Ms. Debbie-Anne A. Reese
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: North American Electric Reliability Corporation, Docket No. RD23-1-002

Dear Secretary Reese:

Pursuant to paragraph 95 of the Order Approving Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1,[1] the North American Electric Reliability Corporation ("NERC") respectfully submits data collection and analysis regarding Generator Owner declared constraints and the performance of freeze protection measures during extreme cold weather events from Winter 2024-2025.

In the February 16 Order, the Commission approved two Reliability Standards (Cold Weather Preparedness Standards), directed further standards modifications, and directed NERC to submit a plan explaining how NERC will gather data and submit an analysis that will allow the Commission to understand the efficacy of, and monitor the ongoing risk posed by: (1) proposed technical, commercial, or operational constraint provisions in EOP-012-1, Requirements R1, R6, and R7;[2] and (2) actual performance of freeze protection measures during future extreme cold weather events. As part of the plan, NERC committed to submitting an informational filing on the data and analysis, the first of which is the submittal attached to this letter. NERC submitted its plan on February 16, 2024,[3] and the Commission accepted the plan on May 23, 2024.[4]

In the enclosed submittal, NERC staff evaluates the data and finds no indication that the Cold Weather Preparedness Standards are not meeting their objective to mitigate the reliability impacts of freezing issues caused by extreme cold weather on applicable generating units. Furthermore, NERC finds that the risk from extended Corrective Action Plans and Generator Cold Weather Constraints is limited. As such, NERC

[1] *N. Am. Elec. Reliability Corp.*, 182 FERC ¶ 61,094 (2023) (Order Approving Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1) [hereinafter February 16 Order], *reh'g denied*, 183 FERC ¶ 62,034, *order addressing arguments raised on reh'g*, 183 FERC ¶ 61,222.

[2] Since the Commission issued this directive, the Commission has approved EOP-012-2 and EOP-012-3, with the latter becoming effective on October 1, 2025 in the United States.

[3] *Compliance Filing of the North American Electric Reliability Corporation for Cold Weather Data Collection*, Docket No. RD23-1-002 (Feb. 16, 2024).

[4] *N. Am. Elec. Reliability Corp.*, Letter Order, 187 FERC ¶ 61,087 (2024).

observed strong industry implementation of the Cold Weather Preparedness Standards. Other key observations include the following:

- At the calculated Extreme Cold Weather Temperatures (ECWT), 99% of the total net winter capacity is operable.
- Ninety-six percent of the total net winter capacity reported ECWT at or below 32 degrees Fahrenheit, triggering winter preparedness measures under the Cold Weather Preparedness Standards.
- Approximately three percent of the total net winter capacity was under a Corrective Action Plan, indicating a low percentage of capacity reported as inoperable during the past winter.
- As NERC anticipated, the use of Generator Cold Weather Constraints are mostly wind and solar units citing no commercially viable solutions, which likely are due to blade icing for wind and snow accumulation on solar panels.
- In reviewing forced outage data from the Generating Availability Data System, NERC observed that performance in Winter 2024-2025 was consistent with historical performance.

As the Cold Weather Preparedness Standards are recently implemented, NERC observed opportunities for further monitoring, including review of the accuracy of ECWT calculations in some portions of the southern United States and review of discrepancies between ECWT and the reported Minimum Ambient Operating Temperature. Overall, however, NERC staff is encouraged by the level of preparedness and performance this past winter.

As this is the initial data collection and analysis, NERC considers the enclosed submittal as a benchmark against which future data collection can be analyzed. Accordingly, NERC anticipates that future submittals may provide trends in winter performance or changes in reported data.

NERC respectfully requests the Commission accept the attached analysis submitted in accordance with the Commission's directive in the February 16 Order.

Respectfully submitted,

/s/ Marisa Hecht
Marisa Hecht
Senior Counsel
North American Electric Reliability Corporation
1401 H Street NW, Suite 410
Washington, DC 20005
202-400-3000
marisa.hecht@nerc.net

Counsel for North American Electric Reliability Corporation

Enclosure:

Cold Weather Data Collection and Analysis (October 1, 2025)

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service list compiled by the Secretary in this proceeding.

Dated at Washington, D.C. this 1st day of October, 2025.

/s/ Marisa Hecht

Marisa Hecht
Senior Counsel
North American Electric Reliability Corporation
1401 H Street NW, Suite 410
Washington, DC 20005
202-400-3000
marisa.hecht@nerc.net

Counsel for North American Electric Reliability Corporation

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Cold Weather Data Collection and Analysis

Informational Filing

October 1, 2025

RELIABILITY | RESILIENCE | SECURITY




3353 Peachtree Road NE
Suite 600, North Tower
Atlanta, GA 30326
404-446-2560 | www.nerc.com

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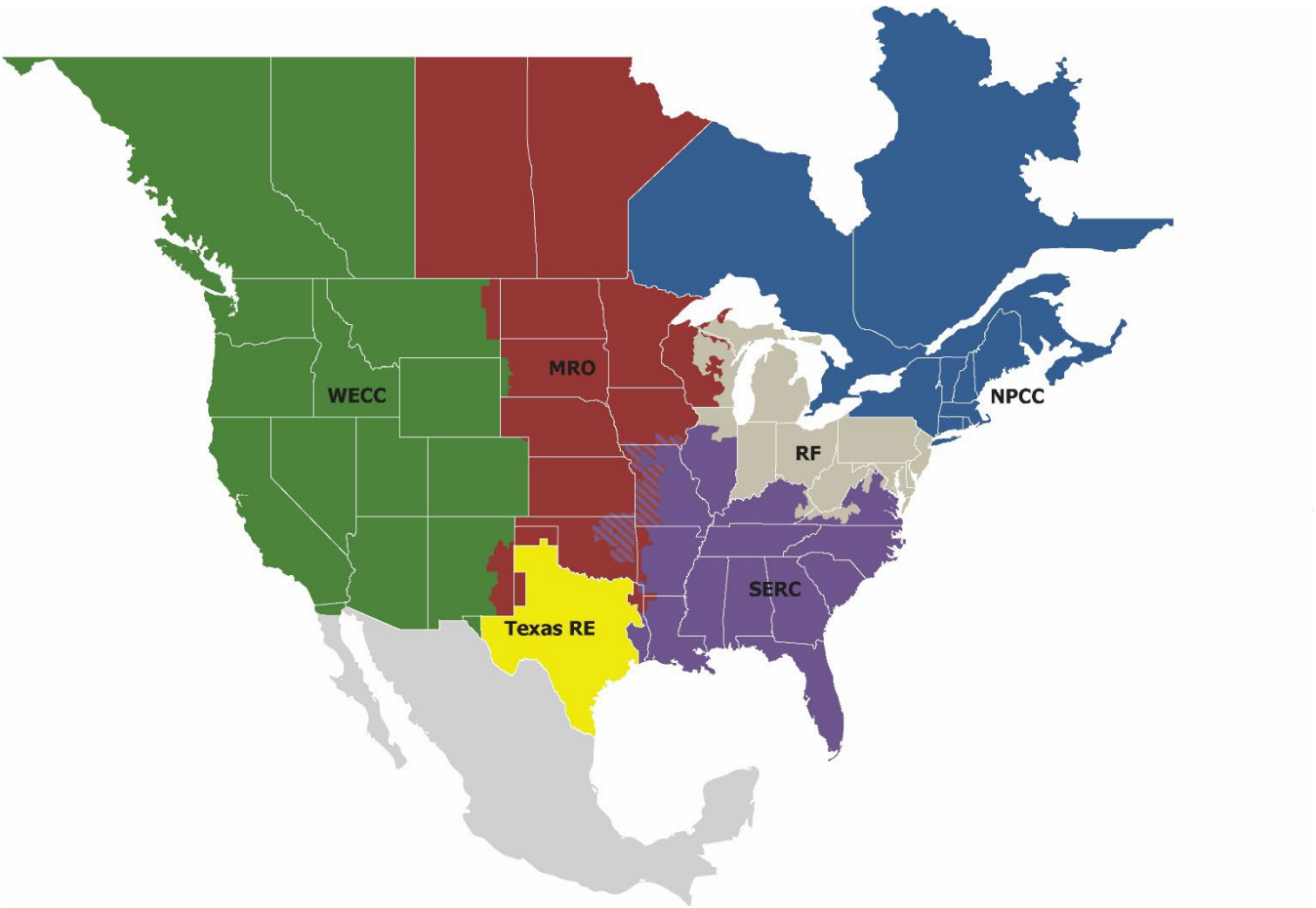
Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entities as shown on the map and in the corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Regional Entity while associated Transmission Owners/Operators participate in another.



MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

Executive Summary

This informational filing provides the North American Electric Reliability Corporation's ("NERC") evaluation of data collected on the winterization of generating units through the NERC Rules of Procedure Section 1600 Cold Weather Preparedness Data Request, consistent with the Federal Energy Regulatory Commission's ("FERC" or "Commission") February 16, 2023 order in Docket No. RD23-1-000 (February 16 Order).[1] In approving EOP-012-1, the Commission issued the February 16 Order directing NERC to develop a plan to collect data and analyze the efficacy of, and monitor the ongoing risk posed by: (1) proposed technical, commercial, or operational constraint provisions in EOP-012-1, Requirements R1, R6, and R7;[2] and (2) actual performance of freeze protection measures during future extreme cold weather events. The Commission directed NERC to include the aggregated data and analysis in an annual filing to the Commission to determine whether further modifications are needed to the Standard. NERC filed its plan on February 16, 2024, and the Commission approved the plan on May 23, 2024.

As noted in NERC's FERC-approved plan, the initial annual cold weather informational filing on October 1, 2025 establishes a starting point for informing future performance analysis comparison. This filing includes data collected and analyzed covering the winter 2024-2025 time-period. Based on its analysis, NERC sees no indication that the Cold Weather Preparedness Standards are not meeting their objective to mitigate the reliability impacts of freezing issues caused by extreme cold weather on applicable generating units. Furthermore, NERC finds that the risk from extended Corrective Action Plans (CAPs) and Generator Cold Weather Constraints (Constraints) is limited. Based on the data reported this year, 99% of the total net winter capacity in the continental US responded that they were able to operate at the calculated Extreme Cold Weather Temperature (ECWT). Additionally, 96% of the total net winter capacity reported an ECWT at or below 32 degrees Fahrenheit and would be required to apply freeze protection measures to operate during the winter.

NERC also found that based on the projected CAP completion dates, 1% of the total net winter capacity in the continental US would be under a CAP at the start of winter 2025-2026. This is consistent with and further supports the data indicating a very high percentage of the total net winter capacity in every region being reported as operable at the ECWT.

The reported use of constraints was also limited with approximately 4% of the total net winter capacity in the continental US, declaring a constraint. Additionally, 71% of the capacity that declared a constraint are wind and solar units citing no commercially viable solutions available, most likely due to blade icing and snow accumulation on solar panels based on the provided rationale and descriptions. On a regional basis, Constraints comprise from a high of 11% in MRO down to a low of 1% in NPCC and SERC of the total net winter capacity within each region. In relation to economically driven constraints (e.g., significant expense on equipment with minimal remaining life or cost is prohibitively expensive), 42 units comprising 4,095 MWs, or 0.4% of the total net winter capacity in the continental US, spread out across five regions, identified an economically related rationale for the declared constraint. Therefore, the use of Constraints is primarily indicating known limitations with winterizing wind and solar generation with limited use of economically based Constraints that did not significantly impact the total capacity of generation units winterized to ECWT.

A review of forced outage data from the Generating Availability Data System (GADS) for the winter 2024-2025 period indicated performance consistent with historical performance as reported in NERC's annual State of Reliability Report. The joint FERC, NERC, Regional Entity 2025 System Performance Review[3] found a reduction in peak coincident unplanned generator outages for the four 2025 winter storms reviewed compared to past winter storms but also

[1] N. Am. Elec. Reliability Corp., 182 FERC ¶ 61,094 (2023) (Order Approving Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1)([hereinafter February 16 Order], reh'g. denied, 183 FERC ¶ 62,034, order addressing arguments raised on reh'g, 183 FERC ¶ 61,222

[2] EOP-012-1 was replaced by EOP-012-2 when approved by the Commission on 6/27/2024. EOP-012-2 became effective on 10/1/2024.

[3] FERC, NERC to Review Bulk Power System Performance During Recent Cold Snap

noted that it was not an exact comparison due to prior winter storms having different characteristics. NERC and the Regional Entities will continue to monitor system performance during cold weather events using this initial evaluation as a benchmark to determine whether the implementation of the cold weather Reliability Standards is resulting in improved performance during cold weather events.

NERC also identified several possible risk areas that warrant additional follow-up outside of the Section 1600 Cold Weather Data Request process including the accuracy of ECWT calculations in areas where the ECWT appears to fall just above or below 32 degrees Fahrenheit and instances where the reported Minimum Ambient Operating Temperatures were higher than the calculated ECWTs possibly resulting in the RCs, BAs, and TOPs using incorrect data in their short term planning, assessments, and monitoring. NERC and the Regional Entities will follow up on these through outreach and by using the general trend information as a risk input into its compliance monitoring activities.

Background

Over the past thirteen years, NERC and FERC staff have initiated inquiries into five events where cold weather has caused effects to the Bulk Electric System ("BES") generation, with four of those events resulting in the need for firm load shed.[4] Based on the recommendations resulting from the NERC, FERC, Regional Entity staff inquiries into those events, the ERO Enterprise and FERC have initiated several types of activities, such as Reliability Standards development, NERC Alerts issuances, a review of generator performance during cold weather in February 2024 and January 2025, and entity assist visits, among others, to support industry in extreme cold weather preparedness. In addition, the ERO Enterprise is implementing a broad and comprehensive strategy for coordinating its cold weather activities, including assessing the implementation of Reliability Standards addressing cold weather over the next several years as part of robust compliance monitoring.

As part of these activities, Project 2021-07 developed, among others, Reliability Standard, EOP-012-1, Extreme Cold Weather Preparedness and Operations. Reliability Standard EOP-012-1 includes requirements for freeze protection measures for both new and existing generation, the development of enhanced cold weather preparedness plans with annual training on those plans, and the development and implementation of Corrective Action Plans to address freezing issues.

On February 16, 2023, FERC issued an Order Approving Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1.[5] In the February 16 Order, the Commission directed NERC to work with Commission staff to develop a plan, to be submitted by February 16, 2024, to collect data on the winterization of generating units and to submit an annual informational filing on the analysis of the data starting on October 1, 2025. Specifically, the Commission directed NERC to collect data and submit analysis that will allow the Commission to understand the efficacy of, and monitor the ongoing risk posed by: (1) technical, commercial, or operational constraint provisions in EOP-012-1, Requirements R1, R6, and R7;[6] and (2) actual performance of freeze protection measures during future extreme cold weather events.[7] On February 16, 2024, NERC submitted a compliance filing outlining the ERO Enterprise plan[8] to accomplish the directive in the February 16 Order which was accepted by the Commission via letter Order on May 23, 2024.[9]

As outlined in the compliance filing, NERC issued a data request to registered Generator Owners (GOs) pursuant to NERC's authority in NERC Rules of Procedure Section 1600. The Generator Owners were able to upload their cold weather generator data starting on April 1, 2025, and were able to amend and finalize that data until June 15, 2025. The data collected allowed NERC and Regional Entity staff to analyze the seven categories of data outlined in the February 16 Order that were aggregated at the Regional Entity level,[10] and analyze generating unit performance during cold weather events as follows:

- Generating units that have declared constraints under EOP-012-2;
- The capacity of the generation for each type of constraint;
- The rationale for the constraints;
- Capacity of generation that is currently able to operate at its calculated ECWT;

[4] FERC, NERC, and Regional Entity Staff Report, Inquiry into Bulk-Power System Operations During December 2022 Winter Storm Elliott, FERCNERC and Regional Entity Staff Report (Oct. 2023), at pp. 12-14, available at https://www.ferc.gov/media/winter-storm-elliott-report-inquirybulk-power-system-operations-duringdecember-2022.

[5] February 16 Order.

[6] EOP-012-1 was replaced by EOP-012-2 when approved by the Commission on 6/27/2024. EOP-012-2 became effective on 10/1/2024.

[7] February 16 Order at P94.

[8] https://www.nerc.com/FilingsOrders/us/NERC%20Filings%20to%20FERC%20DL/Cold_Weather_Data_Collection_Plan_signed.pdf

[9] N. Am. Elec. Reliability Corp., 187 FERC ¶ 61,087 (2024)

[10] February 16 Order at P95.

- Capacity of generation that was under a Corrective Action Plan (CAP) during the reporting period and expected CAP completion timeline;
- Capacity of generation under a CAP due to being identified as “similar equipment”;
- Performance during recent cold weather events;
- Recent forced outage rates for each area assessed during the winter months; and
- Other on-going risk(s) related to cold weather preparedness.

In addition to noting the categories of data collection, the plan in the compliance filing stated that the initial dataset would serve as a starting point to inform future analysis, particularly as EOP-012 was in early stages of implementation and effectiveness during winter 2024-2025 when the data was collected. Accordingly, the plan indicates that each annual informational filing will build on the prior years’ to inform on the efficacy of the Reliability Standard.

Chapter 1: Data Request

Section 1600 Data Request

The Section 1600 Cold Weather Data Request[11] (Cold Weather Data Request) defines the data that Generator Owners (GOs) with Bulk Electric System units in the United States are required to report. NERC developed the Cold Weather Data Request pursuant to Section 1600 of the NERC Rules of Procedure throughout 2024, with approval by the NERC Board of Trustees in December 2024.

Upon approval of the Cold Weather Data Request, NERC staff developed the reporting template and prepared NERC's ERO Portal for data collection. As anticipated, for the initial 2025 reporting period, the Cold Weather Data Request submissions were processed through a series of automated and manual processes to validate the submissions and notify submitters of validation errors. As NERC expects to continue the use of the Section 1600 Cold Weather Data Request to support the annual filing, beginning with the 2026 reporting period, NERC anticipates that GOs will be able to use a more user-friendly and automated process through NERC's ERO Portal.

Outreach

NERC staff sent training announcements to all Primary Compliance Contacts and Entity Administrators of Generator Owners with a registration effective date on or before January 31, 2025. NERC conducted four training sessions in April 2025 on different days and times over two weeks to accommodate participation by entities in different time zones. Training materials, reporting instructions, and the reporting template were posted on NERC.com.[12,13,14] A frequently asked questions document was also posted to address questions from the initial training sessions.[15]

The Cold Weather Data Request specified the initial reporting deadline of May 15, 2025, with a provision to allow for amended reports through June 15, 2025. Reminders were sent one week before the initial reporting due date and 10 days before the final deadline. Weekly reports monitored the submission status of the GOs. As of June 25, 2025, 91% of required GOs had responded to the Cold Weather Data Request, with 5.5% still in the process of making corrections, and 3.5% had not responded.

Between June 25, 2025, and September 3, 2025, entities with outstanding reports were contacted directly to submit or to make the required corrections. Ultimately, the number of non-responders was reduced to 2% (24 entities) and no further requests were made to those entities as the remaining non-responders are widely dispersed[16] and do not have a material impact on the results of the initial data collection and analysis. NERC will continue to work with the Regional Entities to engage with non-responders ahead of the next data collection period to further reduce or eliminate them.

Data Validation and Data Quality

In NERC's experience, new data collection initiatives are more prone to reporting errors as users build processes to meet the new reporting requirements. Standard data validations for format and completeness of required fields were automated and occurred after the reporting templates were submitted, not as part of the import process. This was necessary because the data collection could not be fully automated before data collection began in April 2025.[17] When validation errors were identified, NERC sent emails with a request for resubmission and a text file containing

[11] https://www.nerc.com/pa/comp/ColdWeatherGenDataDL/Cold_Weather_Section_1600_Data_Request.pdf
[12] https://www.nerc.com/pa/comp/ColdWeatherGenDataDL/Cold%20Weather%20Data%20Request%20Reporting%20Worksheet.xlsx
[13] https://www.nerc.com/pa/comp/ColdWeatherGenDataDL/Cold_Weather_Section_1600_DRI.pdf
[14] https://www.nerc.com/pa/comp/ColdWeatherGenDataDL/ECWT_Training.pdf
[15] https://www.nerc.com/pa/comp/ColdWeatherGenDataDL/NERC_Cold_Weather_1600_DR_FAQ.pdf
[16] Number of non-responders per region: MRO – 3, NPCC – 1, RF – 0, SERC – 3, Texas RE – 7, and WECC – 11.
[17] The Cold Weather Data Section 1600 Data Request was approved by NERC's Board of Trustees on December 10, 2024 and the first data collection period began on April 1, 2025.

details of the validation errors. NERC manually performed continuous monitoring of submissions, resubmissions, and outstanding responses.

Following standard validation, submissions were verified against Energy Information Administration (EIA) Form 860 reports and NERC's Generating Availability Data System (GADS) databases. Subsequent requests were made to submitters when conflicts arose, and several rounds of data cleansing and email correspondence were necessary to resolve errors. Outliers of reported temperatures were confirmed or corrected via email.

The automation of the Cold Weather Data Request planned for deployment in Q1 2026 will include automated notifications and reminders, validation at the time of import, allow for unit definition and management using EIA data as a starting point to ensure consistency with a public source of generator information, and allow registered entities and Regional Entities visibility and status updates on reporting completion.

Population of Generator Owners

Cold Weather Data Respondents

A total of 1,258 GOs met the reporting criteria for the Cold Weather Data Request, with 97% completing the reporting requirements. One percent of entities made initial submissions that failed validation and did not respond to subsequent requests to make the necessary corrections. The capacity of those ten entities with unresolved validation errors was less than 2,400 MW and was evenly distributed across four regions. Due to the incomplete status of the information from those ten entities, their submissions were excluded from the analysis in this report.

Table 1.1: Reporting Generator Owners

	GO Count	%
Reported Successfully	1,224	97%
Reported with Unresolved Validation Errors	10	1%
No Response	24	2%
Total	1,258	100%

Capacity and Fuel Type

The Cold Weather Data Request collected information on 6,806 distinct units with a total winter capacity of 1,079,237 MW across the continental United States. **Table 1.2** details the winter capacity reported and fuel type by NERC region; these capacity values are the basis for all analysis results provided in this report.[18]

Table 1.2: Cold Weather Data Request
Winter Capacity (MW) and Fuel Type by NERC Region

Fuel Type	MRO	NPCC	RF	SERC	Texas RE	WECC	Total
Coal	28,894	818	46,952	57,974	13,867	21,106	169,611
Energy Storage	12	0	265	1,304	4,381	14,769	20,731

[18] Only the winter capacity of the units responding to the Cold Weather Data Request is included in the table. The amounts shown are not total installed capacity in the region, sourced from any planning studies, or public data sources. A step in the validation process compared the reported winter capacity to EIA winter capacity values; while many were not exact, the differences were not material and outliers were resolved.

Table 1.2: Cold Weather Data Request Winter Capacity (MW) and Fuel Type by NERC Region							
Fuel Type	**MRO**	**NPCC**	**RF**	**SERC**	**Texas RE**	**WECC**	**Total**
Gas	38,207	31,959	85,885	166,540	47,567	63,119	433,277
Hydro	4,426	7,317	4,836	21,660	425	52,281	90,945
Nuclear	5,012	5,475	31,059	40,216	5,093	8,128	94,983
Other[19]	5,385	14,573	14,249	18,929	8,351	15,890	77,377
Solar	2,165	469	6,457	21,990	18,037	27,362	76,480
Wind	47,214	2,619	9,691	3,141	28,959	24,209	115,833
Total	131,315	63,230	199,394	331,754	126,680	226,864	1,079,237

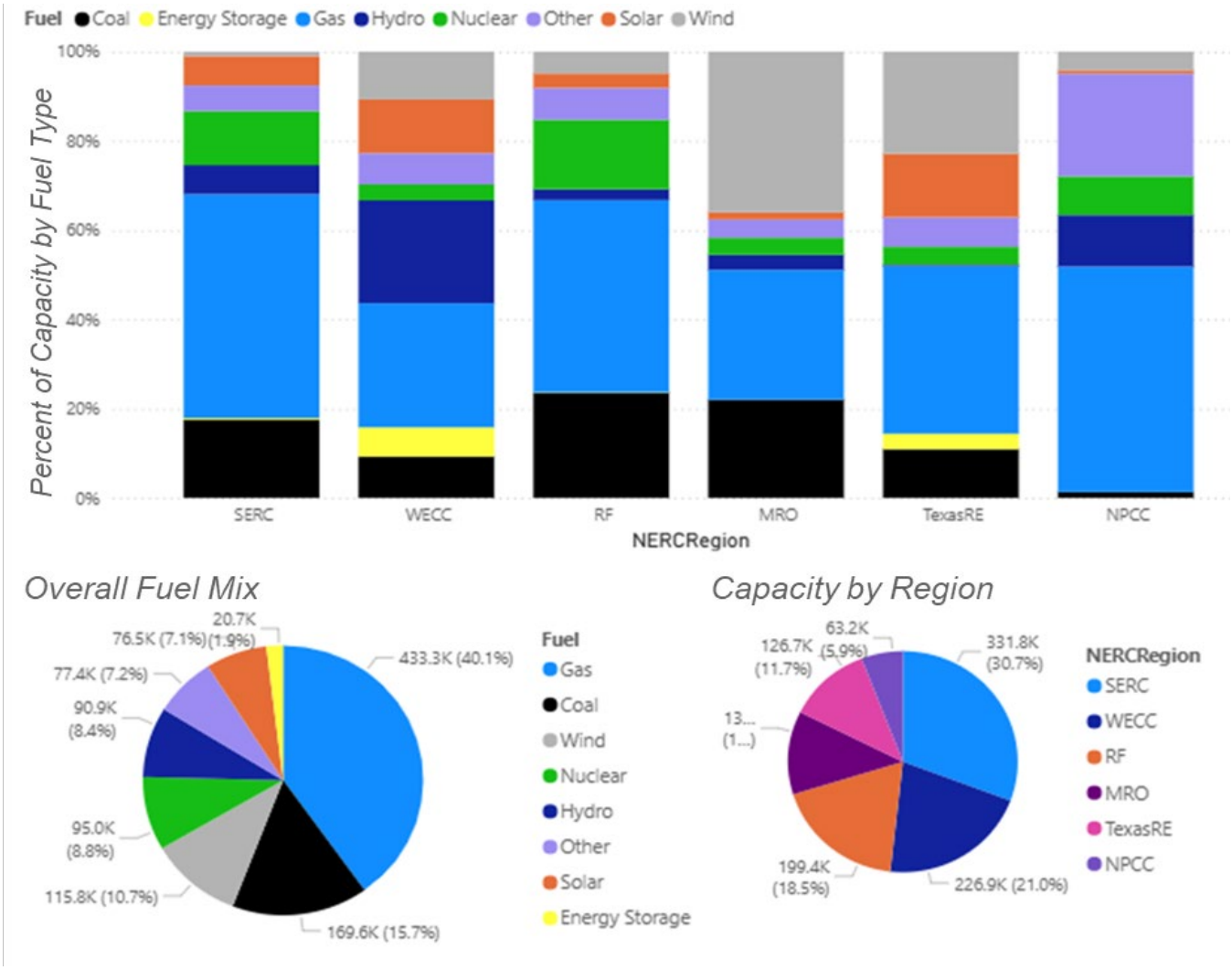


Figure 1.1: Responding Unit Fuel Mix by Region

[19] The fuel type of other combines the capacity of units for biomass, geothermal, kerosene, oil, waste heat, and other small categories of capacity.

GOs were required to provide the Net Winter Capacity for each unit reported. Units that reported a Net Winter Capacity of zero are summarized below by region and fuel type. The capacity used for this analysis was the EIA winter capacity. The total capacity of units reporting a Net Winter Capacity of zero was less than one-tenth of 1% of total winter capacity reporting.

Table 1.3: Cold Weather Data Request
Capacity (MW)of Units Reporting Winter Capacity of Zero (0)
by Fuel Type and NERC Region[20]

Fuel Type	MRO	NPCC	RF	SERC	Texas RE	WECC	Total
Coal	0	0	0	0	0	0	0
Energy Storage	0	0	0	0	0	0	0
Gas	27	165	0	124	122	75	513
Hydro	0	0	0	0	0	0	0
Nuclear	0	0	0	0	0	0	0
Other[21]	0	16	0	0	0	0	16
Solar	250	0	200	0	0	0	450
Wind	0	0	0	0	0	0	0
Total	277	181	200	124	122	75	979

The Cold Weather Data Request included a single field with a question about whether a unit self-commits or is required to operate at or below 32° F. The question was asked due to the inclusion of a footnote within EOP-012-2 Requirements R2, R3, and R6 stating, "Generating unit(s) that do not self-commit or are not required to operate at or below a temperature of 32 degrees Fahrenheit (zero degrees Celsius), but may be called upon to operate in order to assist in the mitigation of BES Emergencies, Capacity Emergencies, or Energy Emergencies during periods at or below a temperature of 32 degrees Fahrenheit (zero degrees Celsius), are exempt from this requirement." 86% of units responded yes to this question which may signify that entities did not fully understand the question. Clarification of this question may be necessary in 2026 to ensure entities understand the intent of the question, which is simply if an entity must comply with all requirements of EOP-012-2 or not.

[20] EIA winter capacity was used for this table

[21] The fuel type of other combines the capacity of units for biomass, geothermal, kerosene, oil, waste heat, and other small categories of capacity.

Chapter 2: ERO Wide Analysis

Temperature Analysis

The Cold Weather Data Request collected two temperatures related to the operation of the units: Extreme Cold Weather Temperature (ECWT), and the Minimum Ambient Operating Temperature. Generator Owners were directed to use the ECWT Calculation Instructions available on NERC.com.[22] The Minimum Ambient Operating Temperature options were design or nameplate temperature, historical operating temperature for at least one hour, or performance temperature determined by engineering analysis.

ECWT

Figure 2.1 shows the reported ECWT values for all responding plants by location. Figures of the discrete temperature bands shown in the legend are provided in **Appendix B**. While there are a few plants that have an ECWT that differs from surrounding plants, the ECWTs of the plants by location are generally as expected.

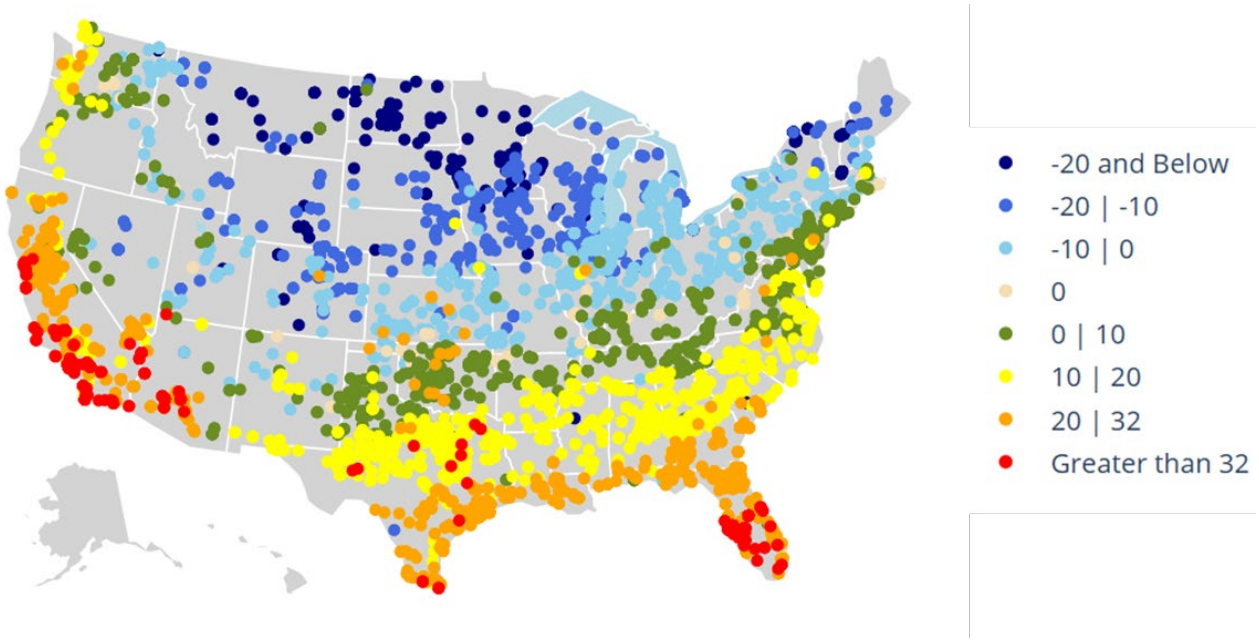


Figure 2.1: ECWT by Plant and Temperature Range

Reviewing the location of plants that reported an ECWT above 32° Fahrenheit does not show any significant pockets of units outside the expected areas as discussed in this section (see **Figure 2.2**). **Table 2.1** shows the winter capacity by region and fuel type for units with an ECWT greater than 32° Fahrenheit. The gas fuel type comprises 52% of the capacity reporting an ECWT greater than 32° F, and only 2%[23] of the total reported winter capacity.

Understanding the number of units with an ECWT greater than 32° is paramount to understanding those units that have minimal responsibilities associated with EOP-012-2. The responsibilities of units with an ECWT greater than 32° are limited to calculating their ECWT (Requirement R1), developing a cold weather preparedness plan (Requirement R4) and training for the implementation of their cold weather preparedness plan (Requirement R5). Requirements around freeze protection measures, Corrective Action Plans, Generator Cold Weather Reliability Events, and Generator Cold Weather Constraints would not apply. As seen in **Figure 2.2** below, most of the units with a stated ECWT greater than 32° are clustered in reasonably expected areas such as southern Florida and the southern coastal

[22] https://www.nerc.com/pa/Stand/Project202403RevisionstoEOP0122DL/2024-03_Calculating%20Extreme%20Cold%20Weather%20Temperature_120324.pdf

[23] A total of 23,597 MW of generation with a fuel type of gas reported an ECWT above 32° F of the 1,079,237 MW total reported winter capacity.

area of California. Areas with a small number of units in northern Texas and southwest Utah have been identified as possible risk areas as analysis showed that other units geographically located near those units reported an ECWT less than 32 degrees Fahrenheit. This risk will be addressed outside of the Cold Weather Data Request process.

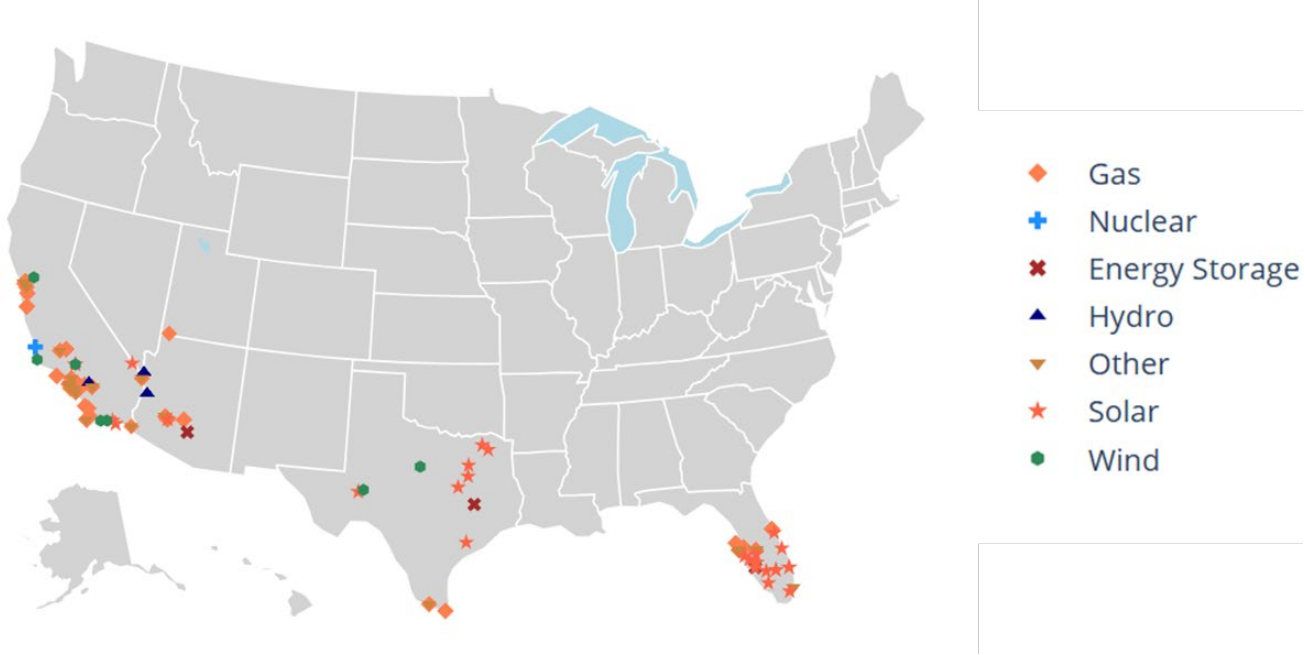


Figure 2.2: Plant locations with ECWT Greater Than 32° Fahrenheit

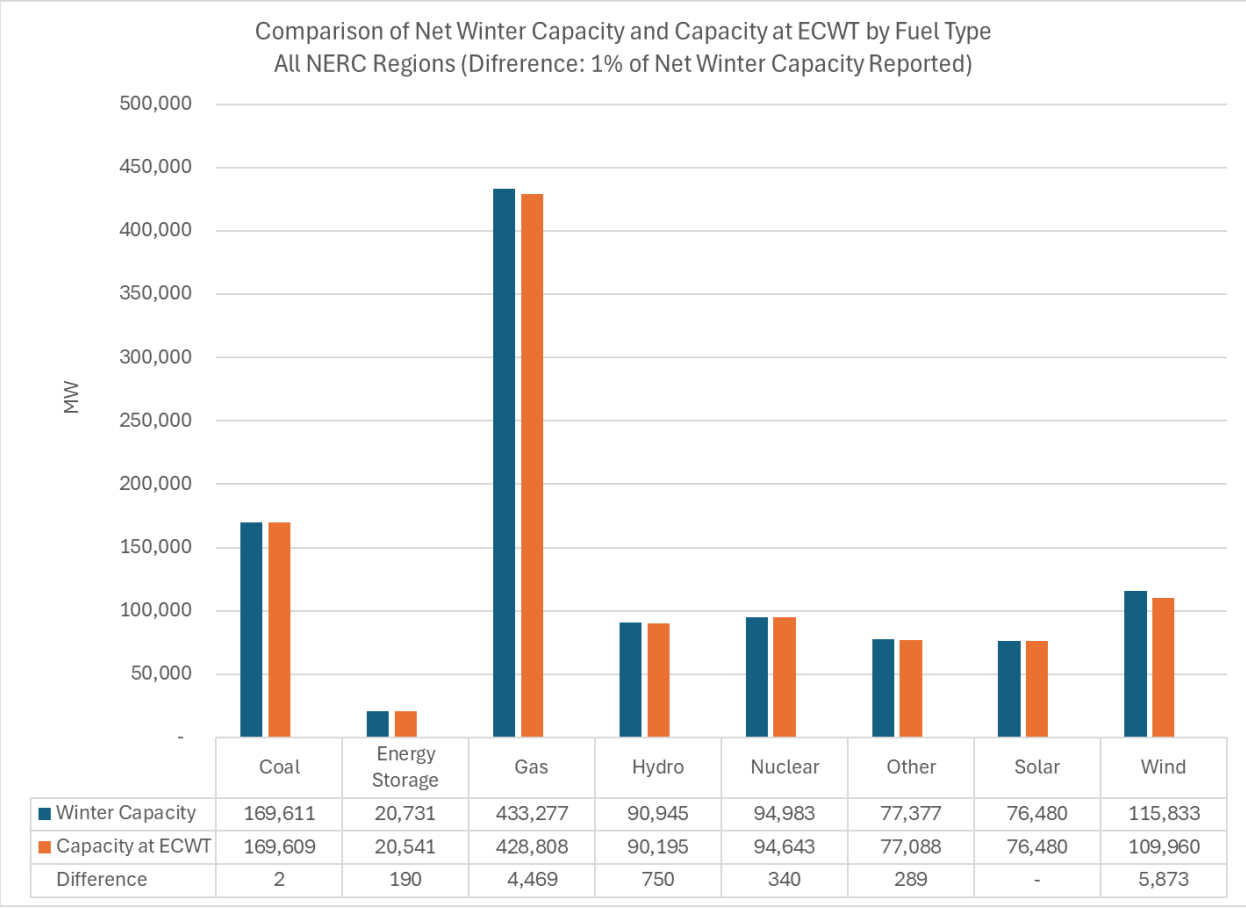
Table 2.1: ECWT Greater Than 32° F
Winter Capacity (MW) and Fuel Type by NERC Region

Fuel Type	MRO	NPCC	RF	SERC	Texas RE	WECC	Total	% Capacity by Fuel Type with ECWT >32° F
Coal	0	0	0	0	0	0	0	0%
Energy Storage	0	0	0	920	262	2,744	3,926	19%
Gas	0	0	0	5,840	456	17,301	23,597	5%
Hydro	0	0	0	0	0	638	638	1%
Nuclear	0	0	0	0	0	2,279	2,279	2%
Other	0	0	0	3,887	185	3,551	7,623	10%
Solar	0	0	0	1,635	2,502	1,278	5,415	7%
Wind	0	0	0	0	1,278	693	1,971	2%
Total	0	0	0	12,282	4,683	28,484	45,449	4%
% Regional Winter Capacity	0%	0%	0%	4%	4%	13%	4%	4%

Table 2.1: ECWT Greater Than 32° F Winter Capacity (MW) and Fuel Type by NERC Region								
Fuel Type	**MRO**	**NPCC**	**RF**	**SERC**	**Texas RE**	**WECC**	**Total**	**% Capacity by Fuel Type with ECWT >32° F**
% Total Reporting Capacity	0%	0%	0%	1%	0.4%	3%	4%	n/a

Comparison of Net Winter Capacity and Capacity at ECWT

Figure 2.3 shows a comparison of reported Net Winter Capacity to the amount of capacity operable at ECWT by fuel type for all NERC regions. Capacity operable at ECWT is 11,913 MW lower than Net Winter Capacity, reflecting 1% of total reported Net Winter Capacity. Region-specific figures are available in **Appendix B**.



	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	169,611	20,731	433,277	90,945	94,983	77,377	76,480	115,833
Capacity at ECWT	169,609	20,541	428,808	90,195	94,643	77,088	76,480	109,960
Difference	2	190	4,469	750	340	289	-	5,873

Figure 2.3: Comparison of Reported Winter Capacity and Capacity at ECWT by Fuel Type – All NERC Regions

Minimum Ambient Operating Temperature

Minimum Ambient Operating Temperature was collected to analyze the operating temperature range of by fuel type and identify the capacity where the ECWT was greater than the Minimum Ambient Operating Temperature.

Figure 2.4 shows the range of Minimum Ambient Operating Temperature by fuel type for all units that responded. Region-specific figures are available in **Appendix B**. Given the varied locations of generating units, it is not surprising to see the wide range of Minimum Ambient Operating Temperatures.

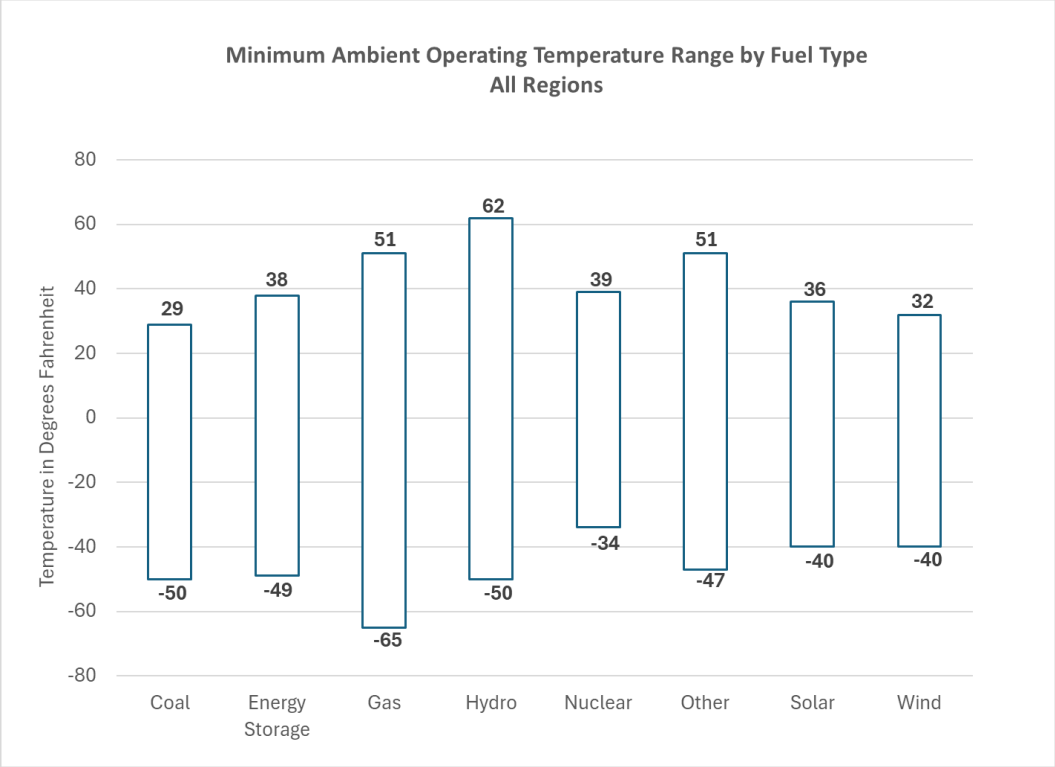


Figure 2.4: Range of Minimum Ambient Operating Temperatures by Fuel Type

Figure 2.5 illustrates the incremental amount of capacity by fuel type at various five-degree temperature ranges based on the ECWT reported for each unit. For example, energy storage across all regions reported no capacity with an ECWT below -10° F. However, the winter capacity that can operate between 25° F and 32° F is nearly double that of the next lowest temperature band, with approximately 20% of winter capacity for energy storage reporting an ECWT of 32° F or more.

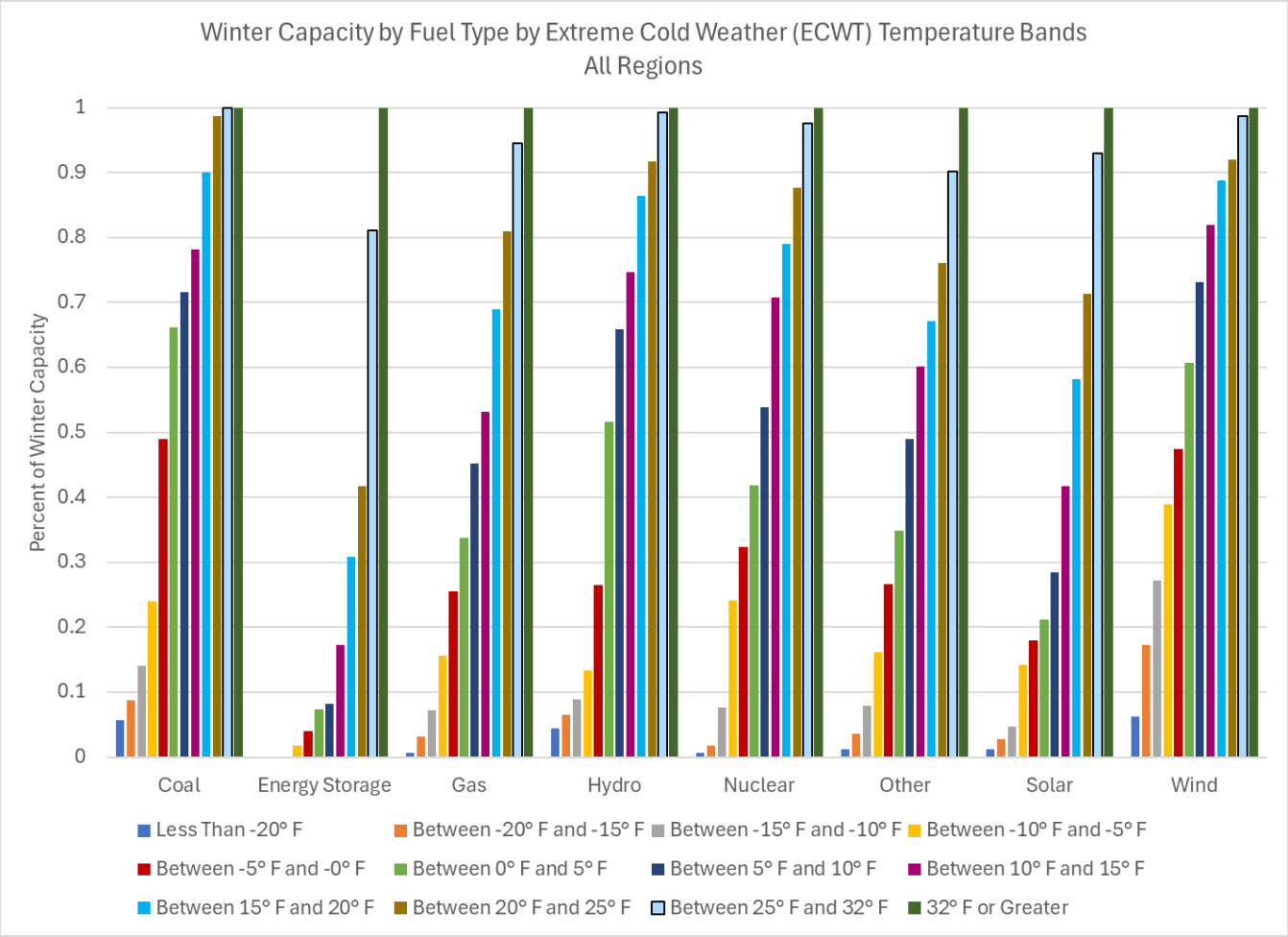


Figure 2.5: Reported Winter Capacity – ECWT bands by Fuel Type

Relationships Between ECWT and Minimum Ambient Operating Temperatures

The availability of environmental and operational temperatures allows for additional analysis to understand where temperature may impact a unit's ability to operate.

This section includes analysis showing a comparison of ECWT and Minimum Ambient Operating Temperature by region and by fuel type, the spread between the ECWT and Minimum Ambient Temperature, and units where the ECWT is lower than the unit's Minimum Ambient Operating Temperature.

Figure 2.6 shows a scatter plot of the coordinates of the ECWT and Minimum Ambient Operating Temperature of each unit, by region. The alignment of many units into vertical series of dots occurs because of the commonality of fuel type and type of equipment; the majority of the units that make up the vertical series are inverter-based resources, primarily solar and wind. WECC's large amount of inverter-based resources are easily visible in this figure.

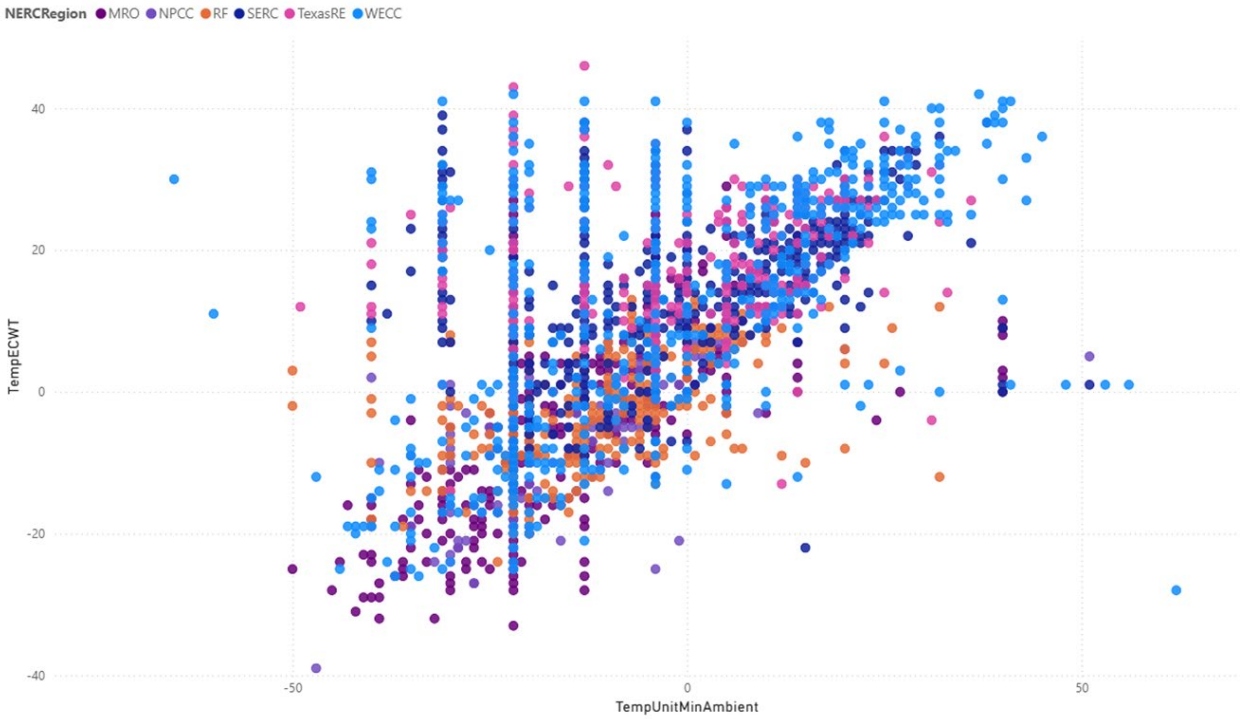


Figure 2.6: Intersection of ECWT and Minimum Ambient Operating Temperature by NERC Region

Figure 2.7 shows the same scatter plot of the ECWT and Minimum Ambient Operating Temperature of each unit, by fuel type. In this view, other fuel types also exhibit vertical alignment as inverter-based resources because similar equipment may have the same Minimum Ambient Operating Temperature. Detailed charts by region and fuel type are included in **Appendix B**.

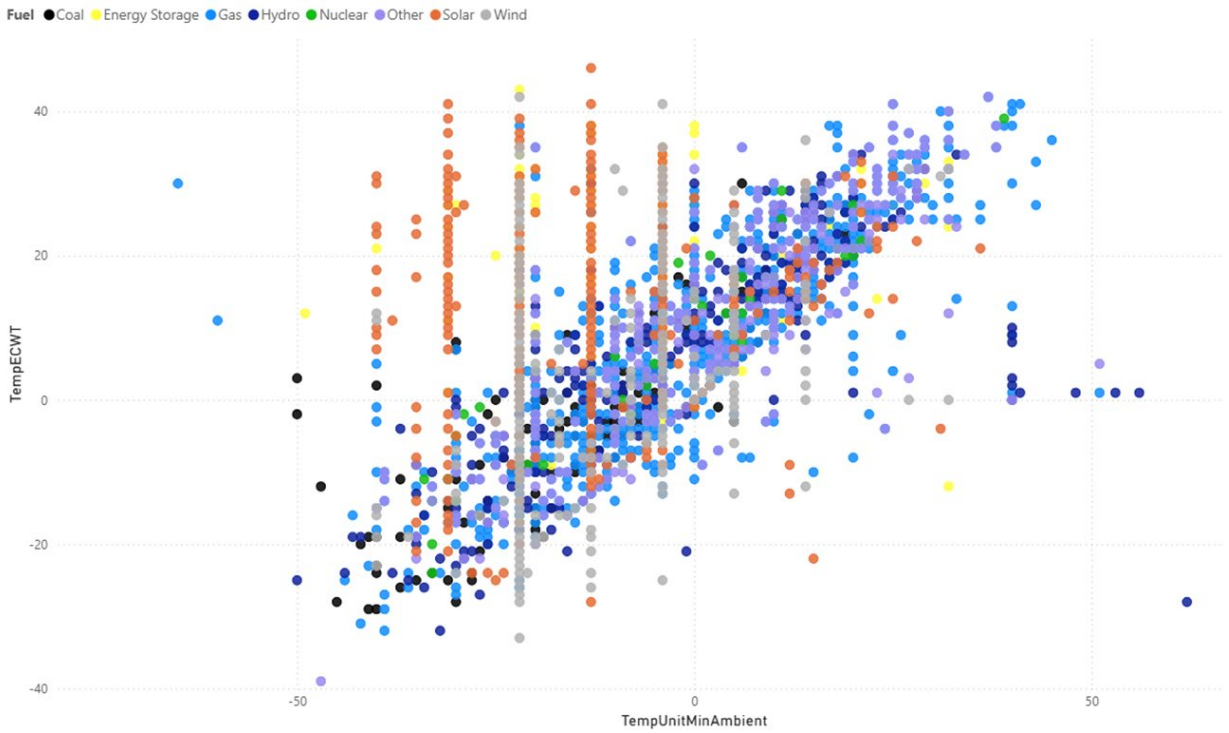


Figure 2.7: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

Figure 2.8 illustrates the locations of units that reported an ECWT lower than Minimum Ambient Operating Temperature. **Table 2.2** lists capacity of those units by region fuel type. Several additional factors beyond temperature will affect whether the unit may operate when the external temperature is below the Minimum Ambient Operating Temperature. If a unit is indoors, the unit may continue to operate when the outside temperature is below the Minimum Ambient Operating Temperature where a unit that is outside may experience outages or derates due to the cold. Another factor that can impact a unit's ability to operate when the external temperature is below the Minimum Ambient Operating Temperature is whether the unit was online. Units that are already online may be able to run due to the heat produced by the operating unit.[24] However, a unit may have difficulty starting or have its capacity derated during operations below its Minimum Ambient Operating Temperature. The declaration of a GCWC may also be necessary if the implementation of a specific freeze protection measure would exceed a manufacturer's design limitation.

Information about whether a unit was located inside a permanent building with a heating source that regularly maintains the space at a temperature above 32 degrees Fahrenheit was outside the scope of the initial Cold Weather Data Request.

[24] See Recommendation 8 from the Inquiry into Bulk-Power System Operations During December 2022 Winter Storm Elliott: FERC, NERC and Regional Entity Staff Report, October 2023, https://www.ferc.gov/media/winter-storm-elliott-report-inquiry-bulk-power-system-operations-during-december-2022

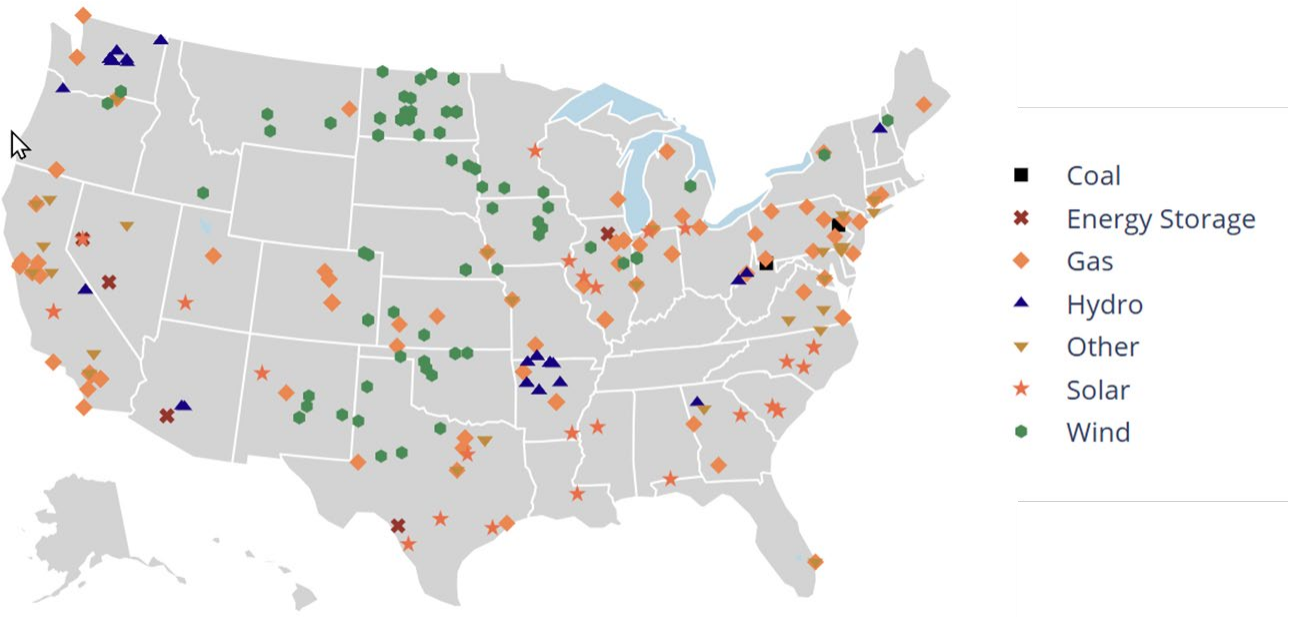


Figure 2.8: Units with an ECWT Lower Than the Minimum Ambient Operating Temperature of the Unit

Table 2.2: Units with ECWT lower than Minimum Ambient Operating Temperature Unit Count and Winter Capacity (MW) by NERC Region and Fuel Type

Fuel Type	MRO	NPCC	RF	SERC	Texas RE	WECC	Total Capacity	% Total Fuel Type Capacity with ECWT Lower than Min. Ambient Operating Temp.
Coal	0	0	1362	0	0	0	1,362	1%
Energy Storage	0	0	20	233	160	434	847	4%
Gas	291	1,607	9,127	2,067	1,642	6,382	21,116	5%
Hydro	1,079	53	88	42	0	2,026	3,288	4%
Nuclear	0	0	0	0	0	0	0	0%
Other	4	283	1,384	317	191	1,364	3,543	5%
Solar	288	0	257	1,888	846	505	3,784	5%
Wind	8,182	208	627	150	385	2,521	12,073	10%
Total	9,844	2,151	12,865	4,697	3,224	13,232	46,013	4%
% Regional Winter Capacity	7%	3%	6%	1%	3%	6%	4%	4%

Table 2.2: Units with ECWT lower than Minimum Ambient Operating Temperature Unit Count and Winter Capacity (MW) by NERC Region and Fuel Type								
Fuel Type	**MRO**	**NPCC**	**RF**	**SERC**	**Texas RE**	**WECC**	**Total Capacity**	**% Total Fuel Type Capacity with ECWT Lower than Min. Ambient Operating Temp.**
% Total Reporting Capacity	0.9%	0.2%	1.2%	0.4%	0.3%	1.2%	4%	n/a

Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

The difference between a unit's Minimum Ambient Operating Temperature and its ECWT ("spread") provides information about the potential range of operation that could be affected by cold weather. Box-whisker plots were used to illustrate the difference between the ECWT and Minimum Ambient Temperatures reported for each unit. Figure 2.9 shows the spread of temperatures by fuel type for all units reporting. Figure 2.10 shows the range of temperatures by region. Detailed charts by region and fuel type are included in **Appendix B**.

A box-whisker plot describes data visually by showing the minimum and maximum values (upper and lower boundary lines), the box itself is the interquartile range (the middle 50% of the values) and the large white dot represents the mean (arithmetic average). 25% of the values fall both above and below the box, and each differently shaded portion within the box represents 25%. The median is at the point where the two sub boxes meet, which represents the value where 50% of values are both above and below.

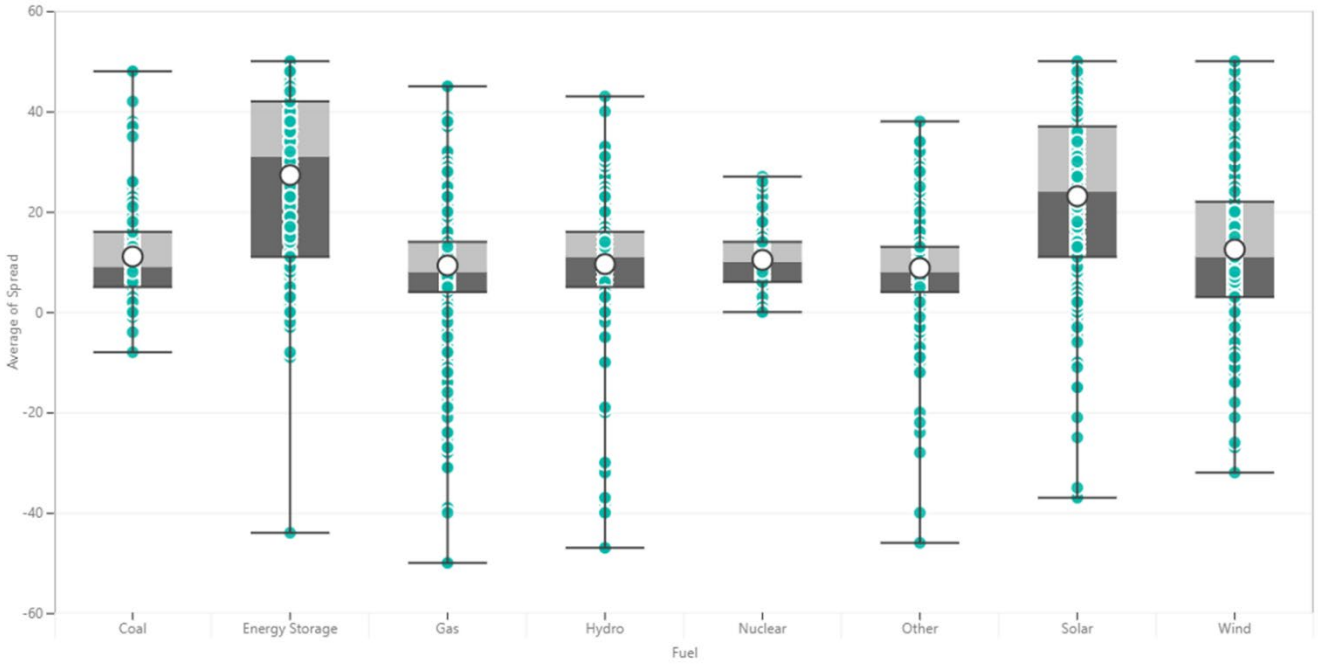


Figure 2.9: Temperature Spread between ECWT and Minimum Ambient Operating Temperature by Fuel Type

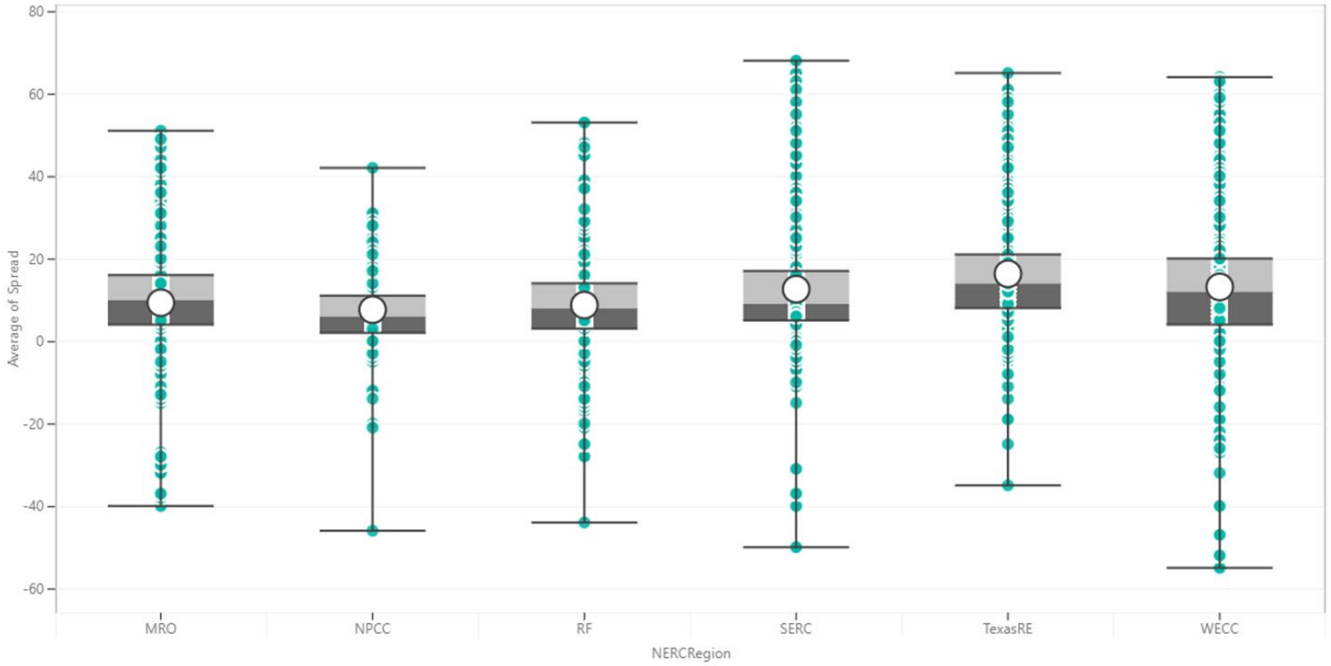


Figure 2.10: Temperature Spread between ECWT and Minimum Ambient Operating Temperature by Region

Corrective Action Plan (CAP) Analysis

Entities were required to report the amount of capacity under a Corrective Action Plan, the date the CAP was developed and the Projected Completion Date of the CAP. Responses to CAP information were analyzed using four distinct periods:

1. CAPs that were completed during the winter 2024 – 2025 (December 1, 2024 – March 31, 2025);
2. CAPs projected to be complete before the winter 2025 – 2026 season (April 1, 2025 – November 30, 2025);
3. CAPs projected to be complete during the winter 2025 – 2026 period (December 1, 2025 – March 31, 2026); and
4. CAPs projected to be complete after the winter 2025 – 2026 period (on or after April 1, 2026)

The total capacity reported under Corrective Action Plans was 27,300 MW, 3% of total reported capacity. Detailed information about the CAPs was not collected as part of the Cold Weather Data Request. **Figure 2.11** presents the capacity associated with these four CAP periods, by fuel type. Detailed charts by region and fuel type are included in **Appendix B**.

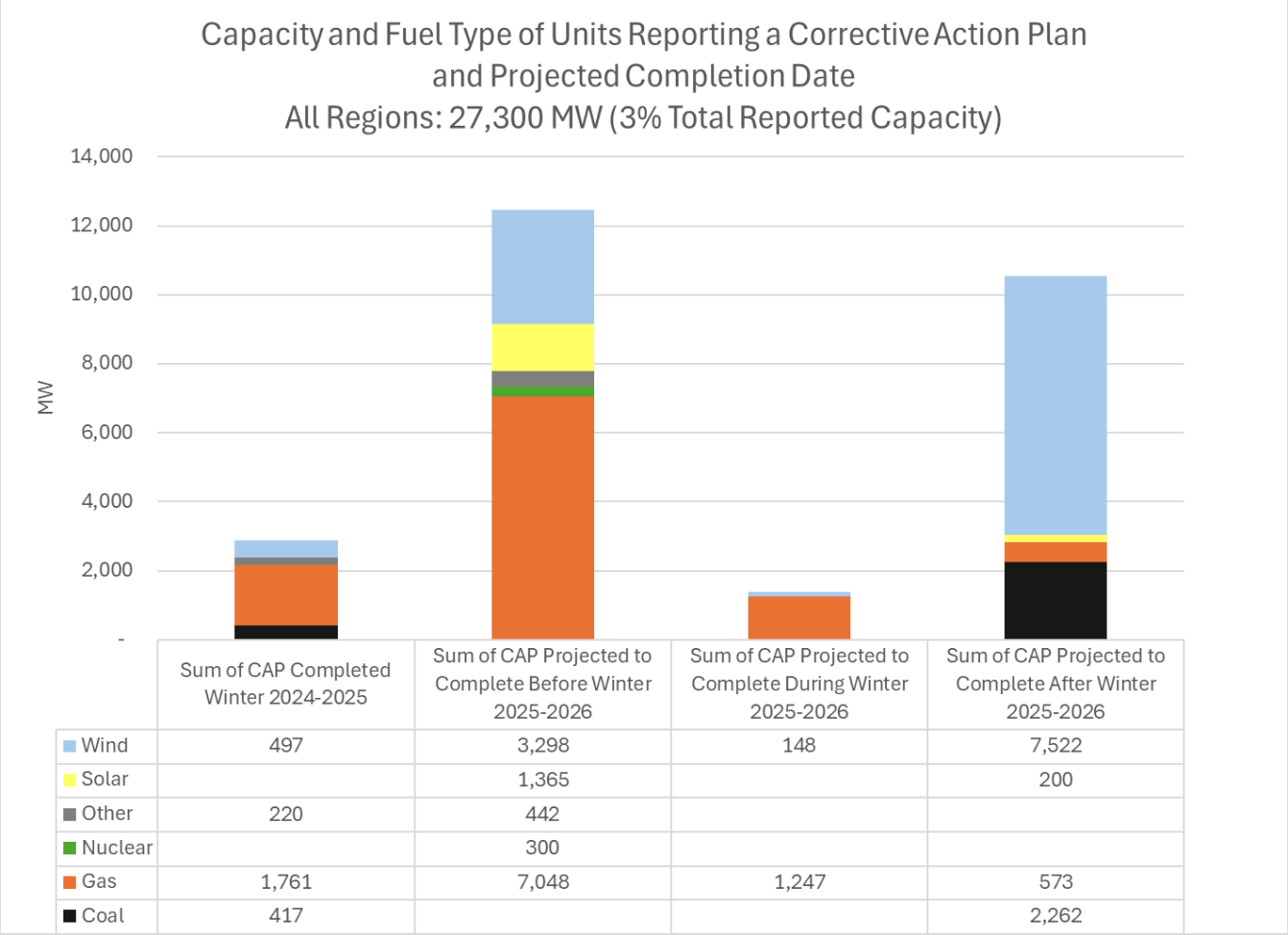


Figure 2.11: Capacity under a Corrective Action Plan by Fuel Type and Projected Completion Period

Table 2.3 shows the capacity by fuel type and region for units under a Corrective Action Plan because they were identified as "similar equipment."

Table 2.3: Units under a Corrective Action Plan Identified as "Similar Equipment" Winter Capacity (MW) by NERC Region and Fuel Type

Fuel Type	MRO	NPCC	RF	SERC	Texas RE	WECC	Total Capacity	% Total Fuel Type Capacity
Coal	5,577						5,577	3%
Energy Storage						293	293	1%
Gas	50	905	2,425	5,406	42	362	9,190	2%
Hydro							0	0%
Nuclear							0	0%
Other		272					272	0.4%

Table 2.3: Units under a Corrective Action Plan Identified as "Similar Equipment" Winter Capacity (MW) by NERC Region and Fuel Type								
Fuel Type	**MRO**	**NPCC**	**RF**	**SERC**	**Texas RE**	**WECC**	**Total Capacity**	**% Total Fuel Type Capacity**
Solar						700	700	1%
Wind	1,292	154	868	208	1,483	2,811	6,816	6%
Total	6,919	1,331	3,293	5,614	1,525	4,166	22,848	2%
% Regional Winter Capacity	5%	2%	2%	2%	1%	2%	2%	2%
% Total Reporting Capacity	1%	0.1%	0.3%	1%	0.1%	0.4%	2%	n/a

Constraint Analysis

The Cold Weather Data Request template provided a list of constraints consistent with the EOP-12-2 standard. Any Constraint that included "Other" required a free text description to provide further explanation of the selected constraint; 216 entries selected a Constraint that included "Other." NERC's Compliance staff reviewed the free text descriptions for these entries and determined that 180 of the Constraints reported were characterized as preventative maintenance items or pre-winter activities in the free text field, which would not be considered Constraints under EOP-012-2. The remaining Constraints are shown in **Figure 2.12** below by Generator Cold Weather Constraints and fuel type. The number of distinct units reporting Generator Cold Weather Constraints is 274, representing 4% of Total Net Winter Capacity reported. Detailed tables by region and fuel type are included in **Appendix B**. For the remaining 36 units that reported a Constraint that included "Other"[25], 16 units have a fuel type of wind, solar, or energy storage and the Constraint relates to impacts from accumulations of snow and ice, six units have an impending retirement, and 14 units have a gas, hydro or other fuel type with a variety of rationales including fuel supply limits, water intake issues, manufacturer design limits, and operational limits based on the provided descriptions.[26]

[25] Includes 'OTHER', 'Commercial - other', 'Environmental - other', and 'Operational - other'.

[26] In NERC's plan in the compliance filing, NERC provided an example of determining outliers (e.g., the use of a certain category of constraint) by reviewing whether an Assessment Area has a relatively large number of Constraints. Given the relatively low number of Corrective Action Plans not implemented or completed and reported Constraints, NERC declined to pursue further analysis. NERC may elect to perform this analysis in future cold weather reports, depending on the data received and the need for such an analysis.

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Coal	**2**	**233**	**-17**	**-29**
OTHER	2	233	-17	-29
Energy Storage	**3**	**810**	**20**	**-25**
Environmental - other	3	810	20	-25
Gas	**39**	**4,607**	**8**	**10**
Commercial – cost is prohibitively expensive	13	1,050	31	40
Commercial - other	2	0	14	33
Commercial – significant expense on equipment with minimal remaining life	14	985	-27	-37
Operational - other	1	36	0	0
OTHER	7	910	6	7
Technical – no commercially viable solutions	2	1,626	24	17
Hydro	**5**	**316**	**22**	**-5**
Environmental - other	5	316	22	-5
Other	**3**	**24**	**12**	**17**
Operational - other	3	24	12	17
Solar	**19**	**4,305**	**15**	**3**
Commercial – cost is prohibitively expensive	2	430	13	5
Environmental - other	3	1,140	25	22
OTHER	1	120	15	14
Technical – no commercially viable solutions	13	2,615	10	-10
Wind	**203**	**31,399**	**-4**	**-13**
Commercial – cost is prohibitively expensive	6	1,095	-4	-4
Commercial – significant expense on equipment with minimal remaining life	5	535	-17	-22
Environmental - other	4	852	7	-5
Operational – introduces increased personnel or safety risk	3	439	-7	-20
Operational - other	3	639	-5	-10
OTHER	2	669	-9	-22
Technical – no commercially viable solutions	180	27,170	-3	-14
Total	**274**	**41,694**	**4**	**-5**

Figure 2.12: Generator Cold Weather Constraints by Fuel Type

Chapter 3: Winter 2024 – 2025 Performance/Trends

Analysis of Forced Outage Rates

The GADS database was referenced to evaluate forced outage rates during the winter 2024 – 2025 period (December 2025 – March 2025) covered by the Cold Weather Data Request. Although forced outage events are reported for the date/time they occur, information used in the denominator for calculating the forced outage rate is only reported on a monthly basis. The forced outage rates below include all GADS units for seven of the eight fuel types included in this analysis, regardless of whether they responded to the Cold Weather Data Request. At the time of this informational filing, energy storage performance is not reported to GADS.

Conventional Generating Types: Coal, Gas, Hydro, Nuclear, Other

The Weighted Equivalent Forced Outage Rate (WEFOR) is a metric that measures the probability of a group of generating units failing to meet demand due to forced outages or deratings, with a crucial distinction: larger units are given more weight in the calculation, reflecting their greater impact on the power system's overall reliability. It builds upon the Equivalent Forced Outage Rate by incorporating a weighting factor, typically the unit's capacity, to account for the varying sizes of generating units evaluated. The outage rates shown for this period are consistent with historical performance as reported in NERC's annual State of Reliability Report.[27]

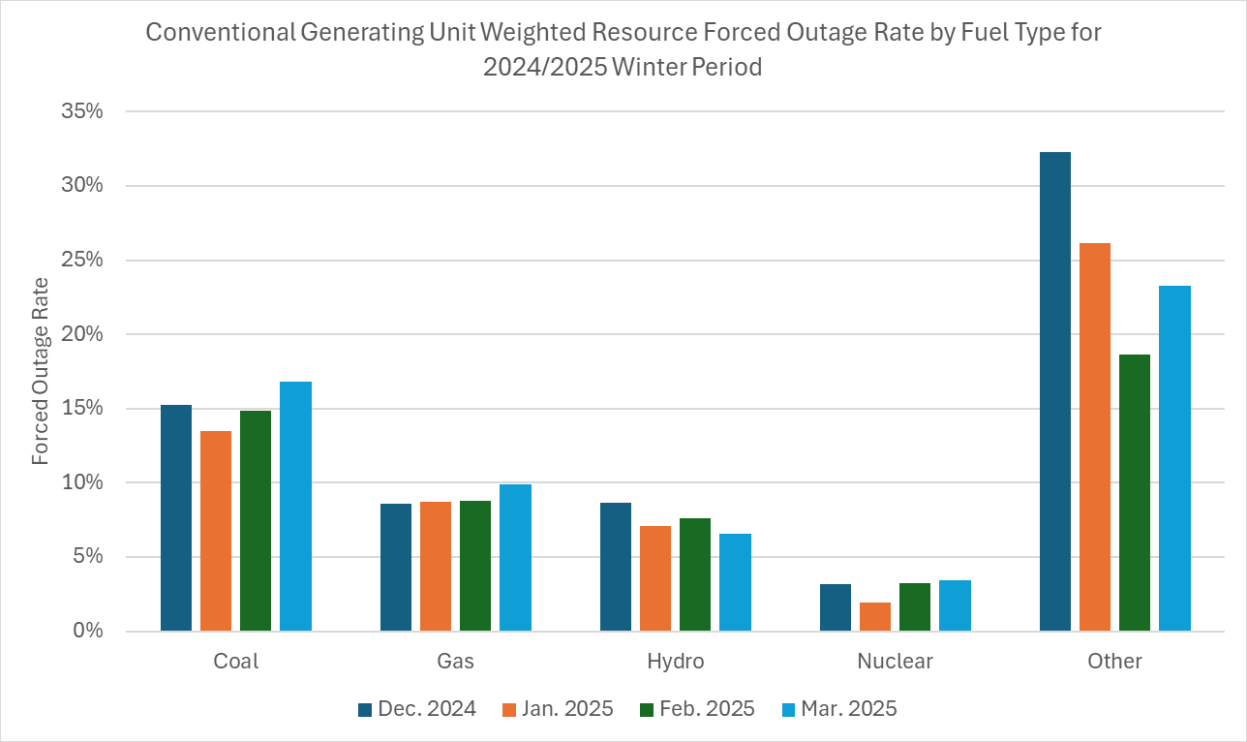


Figure 3.1: Conventional Generating Unit Forced Outage Rates by Fuel Type and Month, December 2024 – March 2025

[27] https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2025_technical_assessment.pdf

Inverter-Based Generating Resources: Solar and Wind

The resource forced outage rate (RFOR) for solar and wind generating units can be separated into resource forced outage rate (representing forced equipment outages) and resource unavailable outage rate (representing forced outages due to a lack of generating resource). For this analysis, the resource forced outage rate is shown.

Figure 3.2 displays two versions of the resource forced outage rate for solar plants. The RFOR Day Only rate includes forced outage hours during daylight hours for the plant.[28] The RFOR 24h rate includes all hours in which the solar plant experienced a forced outage condition. The outage rates shown for this period are consistent with historical performance as reported in NERC's annual State of Reliability Report.[29]

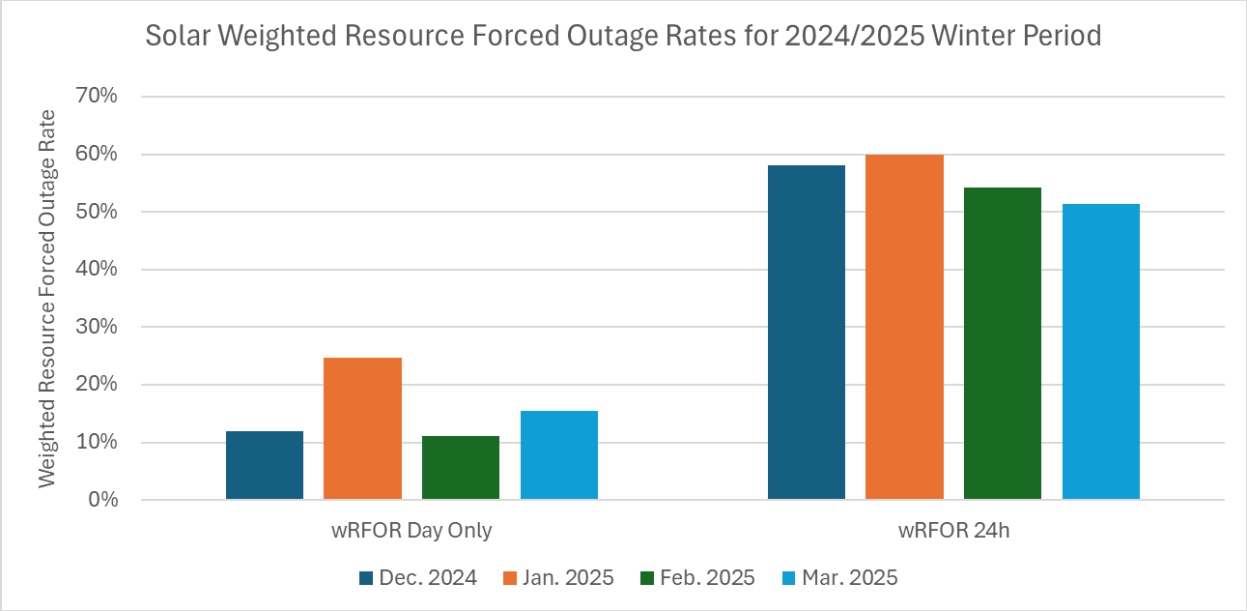


Figure 3.2: Solar Resource Forced Outage Rate by Month, December 2024 – March 2025

Figure 3.3 shows the Weighted Resource Forced Outage Rate for three sizes of wind plants. NERC's collection of wind performance data began in 2018 with a phased-in reporting cycle based on the size of the plant. Analysis by size grouping allows for evaluation of performance of the different size plants with varying amounts of historical performance data. The outage rates shown for this period for wind plants are consistent with historical performance as reported in NERC's annual State of Reliability Report.[30]

[28] Daylight hours are defined in the GADS Solar Data Reporting Instructions as being the times between sunrise and sunset that produce energy in the inverter.

[29] https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2025_technical_assessment.pdf

[30] https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2025_technical_assessment.pdf

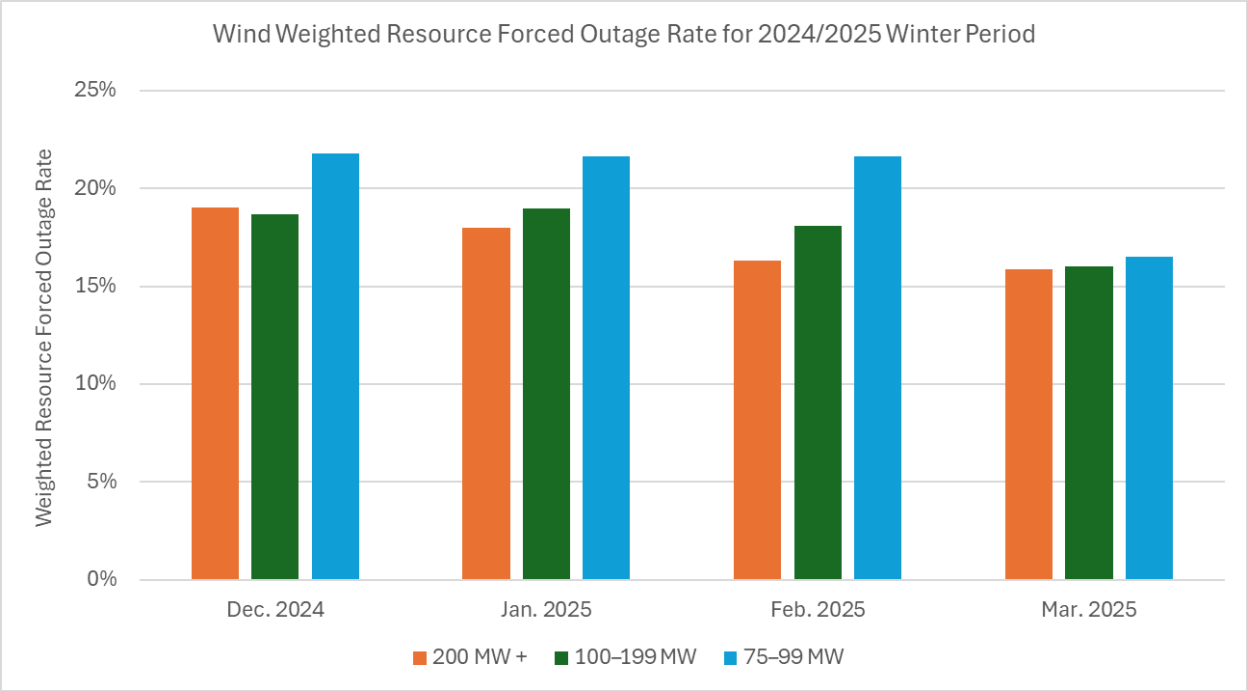


Figure 3.3: Wind Resource Forced Outage Rate by Month, December 2024 – March 2025

Time Series of Daily Forced Outage Capacity

Figure 3.4 shows the daily changes in cumulative capacity in a forced outage state as a time series for all conventional units reported to the GADS database during the winter 2024 – 2025 period (December 2025 – March 2025) covered by the Cold Weather Data Request. Due to the intermittent availability of resource supply for solar and wind plants, a comparable time series is not available.

The daily conventional unit capacity reporting a forced outage or restoration of a forced outage is presented using a stock chart format to illustrate the changes over the course of each day during the winter 2024 – 2025. The chart shows the minimum and maximum amount of capacity reporting forced outages during the day as bars extending from the rectangle. The length of the rectangle reflects the opening value of capacity for the day at the bottom, and the final value for the day at the top of the rectangle. The change in capacity for the day is represented by a rectangle that shows a white box with black outline when there is an increase in capacity with a forced outage or a solid black rectangle to show a net reduction in capacity experiencing a forced outage. Detailed daily forced outage charts by region are included in **Appendix B**.

During the winter 2024 – 2025 period, the highest amount of capacity in a forced outage state for all reasons occurred on January 20, 2025, with 68,519 MW across all regions. This is within the normal range of capacity that occurs across the fleet. The outages occurring over January 20, 2025 were analyzed as part of the joint FERC, NERC, Regional Entity 2025 System Performance Review discussed further below.

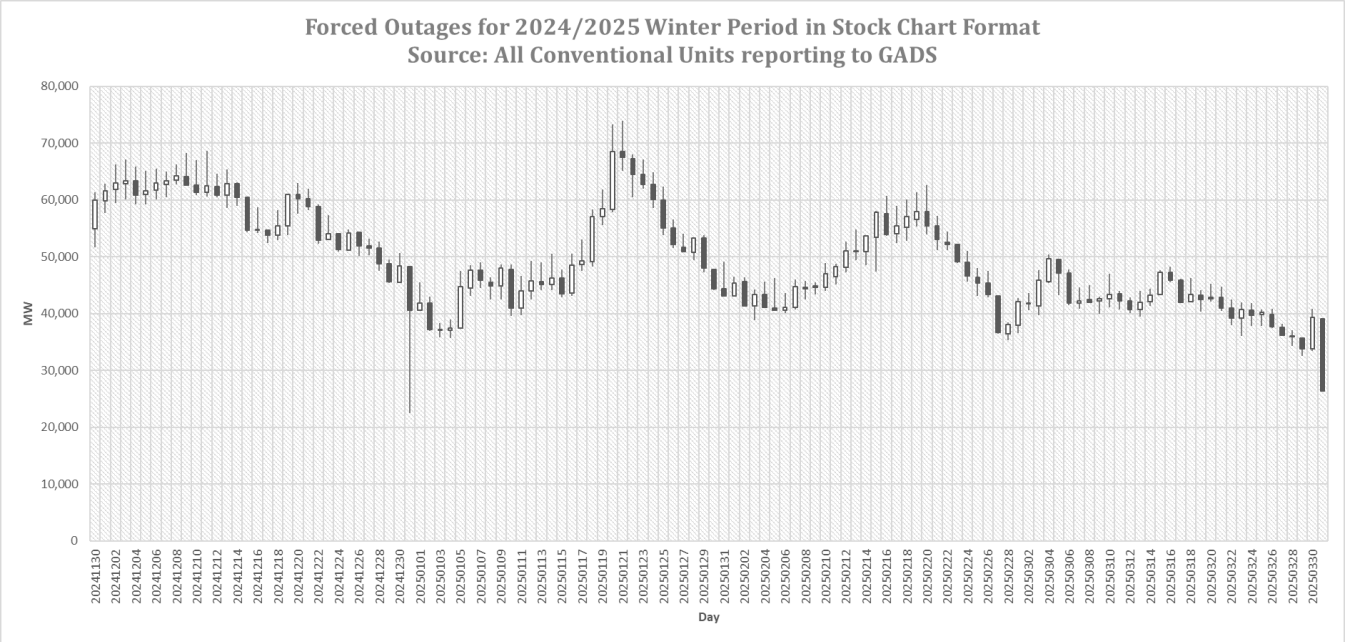


Figure 3.4: Time Series of Daily Conventional Unit Capacity Reporting Forced Outages, December 2024 – March 2025

Winter 2025 System Performance Review[31]

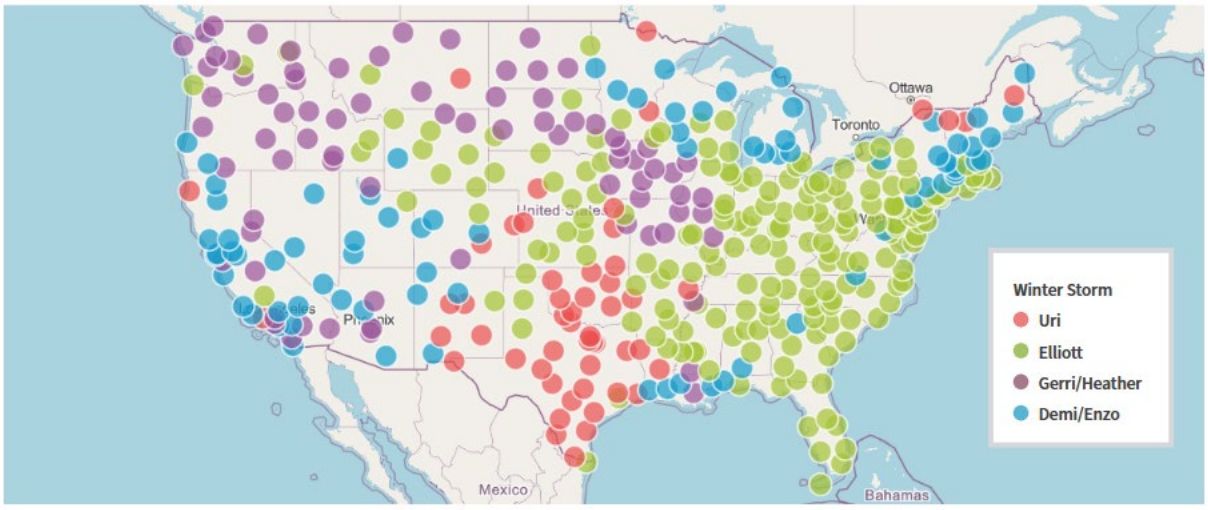
NERC, FERC, and the Regional Entities performed a review of the bulk power system's performance during four artic events that took place from January 3 to January 24, 2025. For the purposes of the review, Winter Storm Blair took place from January 3 to January 9, 2025; Winter Storm Cora took place from January 9 to January 12, 2025; and Winter Storms Demi/Enzo took place from January 19 to January 24, 2025. The week of January 19-25, 2025 was the third coldest winter week (spanning Sunday through Saturday) across the United States since 2000.

The January 2025 arctic events had lower observed hourly wind chill temperatures in pockets of the Northeast, the Louisiana Gulf, California, and the Southwest compared to Winter Storms Uri, Elliott, Gerri, and Heather as shown in **Figure 3.5**.[32] Neither Winter Storm Blair nor Cora are identified in the chart because no weather station experienced its coldest hourly windchill temperature during those storms. As discussed in the report, although much of the country faced freezing temperatures and some amount of snowfall, freezing temperatures did not last as long on average as compared to Winter Storm Uri within each Region and temperatures did not drop as rapidly as they did during Winter Storm Elliott.

As shown in **Figure 3.6**, during the coldest week of the January 2025 arctic events, the number of coincident incremental unplanned outages (not including outages that started before January 3, 2025) peaked at 71,022 MW on January 22, 2025 across the areas review. As identified in the report this is a reduction in peak coincident unplanned generator outages compared to past winter storms but the report also notes that this is not an exact comparison due to prior winter storms having different characteristics, geographic locations, duration, and resources. The review also concluded that despite the unplanned generation outages, manual load shed was not required during any of the four 2025 Winter Storms.

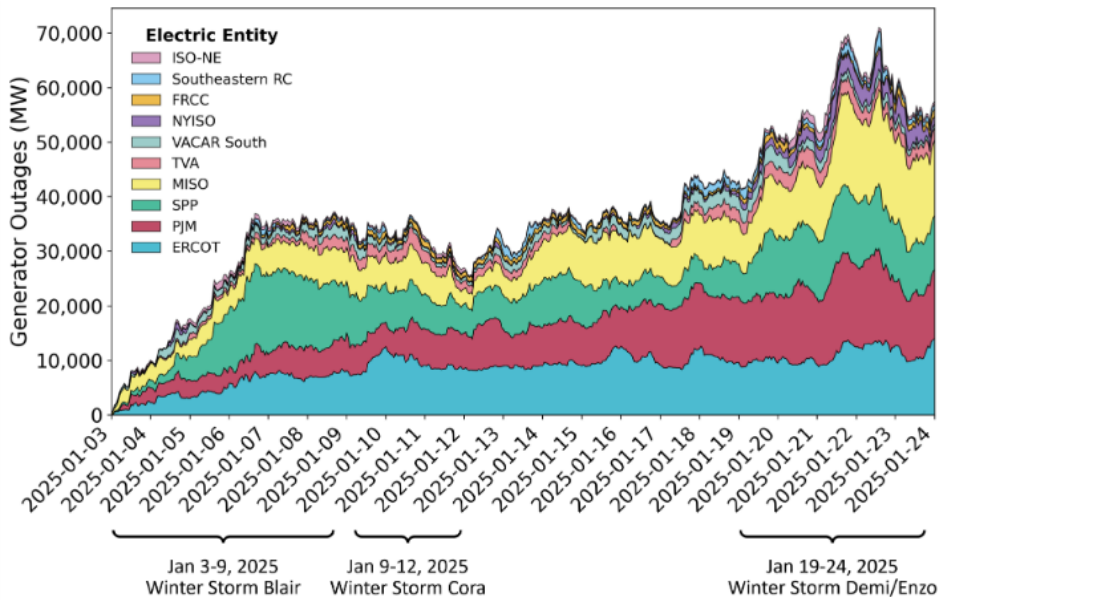
[31] The information contained in this section is quoted and/or paraphrased from the "January 2025 Arctic Events, A System Performance Review, FERC, NERC and its Regional Entities: A Joint Staff Report", April 17, 2025, (January 2025 Arctic Events Report) https://www.ferc.gov/media/report-january-2025-arctic-events-system-performance-review-ferc-nerc-and-its-regional

[32] Figure 3.4 is color coded to show the winter storms—Uri, Elliott, Gerri/Heather, and Demi/Enzo—with the coldest observed hourly wind chill temperature at that weather station.



Source: NOAA (via Velocity Suite, © 2025 Hitachi Energy, The Velocity Suite

Figure 3.5: Winter Storm with the Lowest Observed Wind Chill Temperature at each Weather Station



Source: 2025 January Arctic Events Data Requests

Figure 3.6: Cumulative Incremental Unplanned Generator Outages in the Eastern and Texas Interconnections from January 3-24, 2025

Additionally, the report identified that when considering only the Eastern Interconnection during the January 2025 arctic events, coincident incremental unplanned outages peaked at 57,396 MW, which is lower than the 90,500 MW of coincident incremental unplanned outages during the worst point of Winter Storm Elliott in the Eastern Interconnection study area. Further, the coincident peak of incremental unplanned generation outages in the Texas Interconnection during the January 2025 arctic events was 13,990 MW , which was less than half of the 34,290 MW of incremental unplanned generator outages in the Texas Interconnection during Winter Storm Uri. In discussing generator cold weather performance during the 2025 Winter Storms the report states,

"Weatherization: Improvements to generator weatherization supported reliable operations during the January 2025 arctic events. Since the 2014 polar vortex, entities within the Southeastern RC have placed a greater emphasis on heat trace monitoring and plant readiness in advance of extreme cold weather. The team believes that by putting more time and effort into ensuring that equipment has the proper winterization measures, generating units will be less likely to freeze and fail to perform during extreme cold weather. ERCOT stated that the Texas state rules for generator winterization align closely with Reliability Standard EOP-012 (Extreme Cold Weather Preparedness and Operations) on generator winterization; as such, ERCOT believes that its generators should be able to comply with certain requirements of the Reliability Standard earlier than its mandatory and effective date. Several participants also reported that they already implemented Reliability Standard EOP-012, which they believe led to better performance during the January 2025 arctic events."[33]

[33] January 2025 Arctic Events Report at pg. 22.

Chapter 4: Regional Entity Analysis

Overview

The following analysis for each Regional Entity is based on the BES units required to report through the Cold Weather Data Request and does not represent the entire capacity of a region. Charts and tables supporting the data and analysis in this section can be found in **Appendix B**. Registered entities were, in some cases, not required to identify whether a Corrective Action Plan (CAP) was needed or declare a Constraint until at least October 1, 2025. As the initial data request occurred prior to that date it is possible that the full population of CAPs and Constraints may not be accurately reflected in this data set.

The information presented below represents the data submitted by the entities. As we processed the data, we identified instances where it is unclear what entities intended the data they entered in several columns to represent which limits the depth of analysis that is possible. For example, in the excerpt of constraint data in **Table 4.1** below, in some cases an entity would indicate the total MW capacity of a unit was not operable at ECWT and under a CAP if they had a constraint, while others indicated that the full capacity of a unit was both operable at ECWT and under a CAP while declaring a constraint, while yet others indicated full capacity was operable at ECWT but not under a CAP when declaring a constraint. For a wind facility, the entity may have considered that the total capacity is normally operable at ECWT, however, if freezing precipitation is present the unit may trip within the ECWT necessitating a constraint. Others may have the understanding that the capacity operable at ECWT should be zero because there is a constraint that prevents them from operating within the ECWT in all circumstances. Overall, given the number of CAPs and Constraints reported, at 3% of total net winter capacity and 4% of total net winter capacity respectively, the impact of the analysis limitations are not significant; however, in subsequent years, NERC will evaluate the questions, instructions, and training for enhancement opportunities to reduce or eliminate these issues.

Table 4.1: Sample Constraint Data Submittal

Fuel	Total Net Winter Capacity (MW)	Capacity Operable at ECWT (MW)	Capacity Under a CAP (MW)	Constraint Category
Wind	100	0	100	Technical – no commercially viable solutions
Wind	400	400	400	Technical – no commercially viable solutions
Wind	132	132	0	Technical – no commercially viable solutions

Midwest Reliability Organization (MRO)

Units in the MRO region reported a total net winter capacity of 131,315 MWs. Currently, 126,849 MWs reported as operable at their calculated ECWT; this represents 97% of the total net winter capacity. 100% of the units reporting in the MRO region indicated they had an ECWT below 32 degrees Fahrenheit.

8,153 MWs in the MRO footprint reported being under a CAP during the reporting period. CAPs representing 2,666 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 5,487 MWs or 4% of the MRO total net winter capacity remaining under a CAP going into this winter.

101 units comprising 14,254 MWs, or 11% of the total net winter capacity in the MRO region, reported a Constraint. Of that total, 82 units comprising 12,651 MWs, are wind with over 80% citing no commercially viable solutions available, most likely due to blade icing based on the provided descriptions. Further, the remaining 19 units were gas-

fired units, with 14 of those citing significant expense on equipment with minimal remaining life, most likely meaning those units are close to or are currently being retired. The total winter capacity of those 14 units totals 985 MWs.

Northeast Power Coordinating Council (NPCC)

Units in the NPCC region reported a total net winter capacity of 63,230 MWs. Currently, 63,063 MWs reported as operable at their calculated ECWT; this represents 99% of the total net winter capacity. 100% of the units reporting in the NPCC region indicated they had an ECWT below 32 degrees Fahrenheit.

1,717 MWs in the NPCC footprint reported being under a CAP during the reporting period. CAPs representing 1,326 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 391 MWs or 0.6% of the NPCC total net winter capacity remaining under a CAP going into this winter.

Seven units comprising 696 MWs, or 1% of the total net winter capacity in the NPCC region, reported a Constraint. Of that total, all were wind generation citing no commercially viable solutions available, most likely due to blade icing based on the provided descriptions.

ReliabilityFirst (RF)

Units in the RF region reported a total net winter capacity of 199,364 MWs. Currently, 197,152 MWs reported as operable at their calculated ECWT; this represents 99% of the total net winter capacity. 100% of the units reporting in the RF region indicated they had an ECWT below 32 degrees Fahrenheit.

7,526 MWs in the RF footprint reported being under a CAP during the reporting period. CAPs representing 6,138 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 1,387 MWs or 0.7% of the RF total net winter capacity remaining under a CAP going into this winter.

33 units comprising 4,165 MWs, or 2% of the total net winter capacity in the RF region reported a Constraint. Of that total, 30 units comprising 3,412 MWs are wind with 87% citing no commercially viable solutions available, most likely due to blade icing based on the provided descriptions.

SERC Reliability Corporation (SERC)

Units in the SERC region reported a total net winter capacity of 331,754 MWs. Currently, 329,670 MWs reported as operable at their calculated ECWT; this represents 99% of the total net winter capacity. 96% of the units reporting in the SERC region indicated they had an ECWT below 32 degrees Fahrenheit. All units that reported an ECWT above 32 degrees Fahrenheit are in southern Florida.

3,624 MWs in the SERC footprint reported being under a CAP during the reporting period. CAPs representing 2,372 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 1,252 MWs or 0.4% of the SERC total net winter capacity remaining under a CAP going into this winter.

16 units comprising 4,573 MWs, or 1% of the total net winter capacity in the SERC region, reported a Constraint. Of that total, 7 wind units and 7 solar units, comprising 2,974 MWs, cited no commercially viable solutions available, most likely due to blade icing and snow accumulation on solar panels based on the provided descriptions.

Texas Reliability Entity (Texas RE)

Units in the Texas RE region reported a total net winter capacity of 126,680 MWs. Currently, 126,371 MWs reported as operable at their calculated ECWT; this represents 99% of the total net winter capacity. 97% of the units reporting in the Texas RE region indicated they had an ECWT below 32 degrees Fahrenheit. A number of the units that reported an ECWT greater than 32 degrees Fahrenheit were in northern Texas while most units geographically located near those units reported an ECWT less than 32 degrees Fahrenheit.

2,369 MWs in the Texas RE footprint reported being under a CAP during the reporting period. CAPs representing 475 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 1,894 MWs or 1% of the Texas RE total net winter capacity remaining under a CAP going into this winter.

44 units comprising 7,735 MWs, or 6% of the total net winter capacity in the Texas RE region, have reported a Constraint. Of that total, 33 units comprising 6,625 MWs are wind with 94% citing no commercially viable solutions available, most likely due to blade icing based on the descriptions provided.

Western Electricity Coordinating Council (WECC)

Units in the WECC region reported a total net winter capacity of 226,864 MWs. Currently, 224,081 MWs reported as operable at their calculated ECWT; this represents 99% of the total net winter capacity. 87% of the units reporting in the WECC region indicated they had an ECWT below 32 degrees Fahrenheit. The majority of units that reported an ECWT above 32 degrees Fahrenheit are located on the west coast of California as well as southern California and Arizona. However, a few were reported in southern Utah and Nevada where most units geographically located near those units reported an ECWT less than 32 degrees Fahrenheit.

3,912 MWs in the WECC footprint reported being under a CAP during the reporting period. CAPs representing 2,371 MWs were completed during winter 2024-2025 or are scheduled to be completed prior to winter 2025-2026. This would leave 1,541 MWs or 0.7% of the WECC total net winter capacity remaining under a CAP going into this winter.

73 units comprising 10,271 MWs, or 5% of the total net winter capacity in the WECC region, have reported a Constraint. Of that total, 44 units comprising 6,444 MWs are wind with 89% citing no commercially viable solutions available, most likely due to blade icing based on the provided descriptions.

Chapter 5: Conclusions

Based on the initial data reported and analysis completed, NERC sees no indication that the Cold Weather Preparedness Standards are not meeting their objective to mitigate the reliability impacts of freezing issues caused by extreme cold weather on applicable generating units. Furthermore, NERC sees no indication that entities are overusing or misusing the requirements on Corrective Action Plans or Constraints in a manner that would lead to less reliable generation during extreme cold weather. Accordingly, NERC observed strong industry implementation of the Cold Weather Standards while also identifying several possible risk areas for additional follow-up.

The following areas were determined to indicate industry was moving towards implementation of the Cold Weather Standards. NERC and the Regional Entities will continue to monitor these areas, but no additional follow-up was identified at this time:

1. **Generators Operable at ECWT** - GOs reported a total net winter capacity of 1,079,237 MWs in the continental United States and reported that 1,067,324 MWs are operable at the calculated ECWT. This represents 99% of the total net winter capacity. Further, the analysis showed that every region had 97% or higher of its total net winter capacity that was operable at ECWT. This indicates a high level of winter preparedness, that if effectively implemented, should mitigate the reliability impacts of cold weather events.
2. **Calculated ECWTs Support Winterization** - 1,034,232 MWs of the 1,079,237 MWs, or 96%, of the total net winter capacity reported an ECWT at or below 32 degrees Fahrenheit. This means that, to operate during the winter, the vast majority of generating units in the continental US are required to apply freeze protection measures to be able to operate at the calculated ECWT in accordance with EOP-012.
3. **Limited Capacity Under a Corrective Action Plan** - GOs reported 27,300 MWs were under a Corrective Action Plan (CAP) during the reporting period. This represents about 3% of the total net winter capacity. Of the 27,300 MWs under a CAP during the reporting period, 15,348 MWs have already completed the CAP or are projected to have the CAP complete before Winter 2025-2026. This would result in 11,952 MWs or 1% of the total net winter capacity in the continental US being under a CAP at the start of Winter 2025-2026. When looked at on a regional basis, no more than 4% of the total net winter capacity in any region is projected to be under a CAP by the start of Winter 2025-2026, with five of the six regions being at 1% or less. This is consistent with and further supports the data indicating a very high percentage of the total net winter capacity in every region being reported as operable at the ECWT.
4. **Known Limitations of Wind and Solar Driving Use of Constraints** - GOs reported 274 units comprising 41,694 MWs, or 4% of the total net winter capacity in the continental US, had a Constraint. 193 units comprising 29,785 MWs or 71% of the MWs with a Constraint, are wind and solar units citing no commercially viable solutions available, most likely due to blade icing and snow accumulation on solar panels based on the provided descriptions. On a regional basis, Constraints comprise from a high of 11% in MRO down to a low of 1% in NPCC and SERC (of the total net winter capacity within a region). From 60-100% of the Constraints in each region are from wind and solar generation, with the majority of those citing no commercially viable solutions available, most likely due to blade icing and snow accumulation on solar panels based on the provided descriptions. Additionally, across all fuel types, 42 units comprising 4,095 MWs, or 0.4% of the total net winter capacity in the continental US, spread out across five regions, identified economics (e.g., significant expense on equipment with minimal remaining life or cost is prohibitively expensive) as the rationale for a Constraint. The use of Constraints, while occurring in every region, are primarily indicating known limitations with winterizing wind and solar generation. There was limited use of economically based Constraints that did not significantly impact the total capacity of generation units winterized to ECWT.
5. **No Performance Outliers Identified** – A review of forced outage data from GADS for the winter period 2024-2025 indicated performance consistent with historical performance as reported in NERC's annual State of Reliability Report. The GADS data also highlighted that during the winter 2024 – 2025 period, the highest

amount of capacity in a forced outage state for all reasons occurred on January 20, 2025, with 68,519 MW across all regions. The outages occurring over the January 20, 2025 time period were analyzed as part of the 2025 System Performance Review which found a reduction in peak coincident unplanned generator outages for the four 2025 winter storms reviewed compared to past winter storms but also notes that it is not an exact comparison due to prior winter storms having different characteristics. NERC and the Regional Entities will continue to monitor system performance during cold weather events using this initial evaluation as a benchmark to determine whether the implementation of the cold weather Reliability Standards is resulting in improved performance during cold weather events.

Several possible risk areas that warrant additional follow-up outside of this data collection and analysis process were also identified:

1. **Accuracy of ECWT Calculations -** The 4% of total net winter capacity that reported an ECWT above 32 degrees Fahrenheit in the SERC (12,282 MWs), Texas RE (4,239 MWs) and WECC (28,484 MWs) regions are generally located in three pockets falling in the southern portion of the continental US. In the Texas RE and WECC pockets in particular, a review of some of the units with ECWTs above 32 degrees showed that other units geographically located near those units reported an ECWT less than 32 degrees Fahrenheit. Given the importance of accurate ECWT calculations in driving cold weather preparedness, SERC, Texas RE and WECC will ensure that the areas identified where the ECWT appears to fall just above or below 32 degrees Fahrenheit is a risk input into its compliance monitoring activities with a focus on accuracy of registered entities ECWT calculations.
2. **Accuracy of Minimum Ambient Operating Temperature** - Units dispersed all throughout the continental US comprising 46,013 MWs, or 4% of the total net winter capacity, reported Minimum Ambient Operating Temperatures that were higher than the calculated ECWTs. While this is not impactful to adequate winterization as EOP-012 uses the ECWT to determine what freeze protection measures are necessary, the Minimum Ambient Operating Temperature is one of the data points that should be communicated to the RCs, BAs, and TOPs for use in their short-term planning, assessments, and monitoring. If inaccurate information is being provided to these entities around the operating limitations of the units it could negatively impact decision making during cold weather events. NERC and the Regional Entities will utilize outreach to educate entities on the importance of updating the Minimum Ambient Operating Temperature for the units as improved winterization is undertaken to meet the expectations of EOP-012.

NERC plans to continue collecting this data under the Section 1600 request for the 2026 informational filing. Automation of the data collection process and clarified fields and descriptions are necessary to provide the required information to reduce the data cleansing effort in future years. These efforts are already under way and anticipated to be in place for the winter 2025-2026 reporting period in the early part of 2026.

NERC asserts that the level of analysis that this data provides is sufficient for monitoring the on-going risk related to cold weather preparedness, when considered in conjunction with other related products such as the NERC Winter Assessment and State of Reliability Report. NERC and the Regional Entities will also look for opportunities for this data to be used to strengthen the cold weather-related inputs into those products as well. While no such trends were identified in this analysis, if future trends in actual performance of freeze protection measures or the use of constraints indicate unacceptable levels of risk, then additional activities under Section 800 or under the Compliance Monitoring and Enforcement Program (“CMEP”) would be necessary to determine the specific root cause and mitigation (if appropriate).

Appendix A: Data Request

1. **GO-NCR #:** For the Generator Owner (GO) functional registration, enter the company's NERC Compliance Registry Number. (Format: NCRxxxxx)
2. **GO Name:** Enter the name of the GO as found on the NERC Compliance Registry.
3. **Company GADS Identifier:** For thermal/conventional generators, enter the 3-digit GADS company identifier: GADS Utility Code. Only applies to conventional/thermal units.
    a. If a unit is inverter-based, leave blank.
    b. If the Generator Owner has units that do not report to GADS, use 000 as the GADS company identifier.
4. **GADS Unit identifier:** For thermal/conventional generators, enter the 3-digit GADS unit identifier: GADS Unit Code. Only applies to conventional/thermal units.
    c. If a unit is inverter-based, leave blank.
    d. If the Generator Owner has units that do not report to GADS, use 000 as the GADS company identifier.
5. **Plant GADS Wind/Solar Identifier:** Enter the 7-digit GADS Wind/Solar plant identifier. Leave blank for conventional/thermal generating units.
6. **EIA Plant ID:** Enter the unit's EIA Plant ID. Plant file (part of annual zip file) is available at: https://www.eia.gov/electricity/data/eia860/
7. **EIA Unit ID:** Enter the unit's EIA Generator ID. Generator file (part of annual zip file) available at: https://www.eia.gov/electricity/data/eia860/
8. **Gen Unit Name:** Enter the name of the unit - as reported to EIA.
9. **Unit Postal Zip Code:** Enter the unit's postal/zip code.
10. **NERC Region:** Select the NERC Region the unit is located in from the list.
11. **Balancing Authority (BA) Area:** Select the Balancing Authority Area in which the unit is located.
12. **Unit Self-Commits or is Required to Run at or Below 32 deg F (Y/N)**: If the unit self-commits or is required to run at or below 32 deg F during the winter, select Y or N
13. **Unit ECWT:** Enter the unit's current Extreme Cold Weather Temperature in use in degrees Fahrenheit.
    a. Instructions for calculating the Extreme Cold Weather Temperature are available at: https://www.nerc.com/pa/Stand/Project202403RevisionstoEOP0122DL/2024-03_Calculating%20Extreme%20Cold%20Weather%20Temperature_120324.pdf
14. **Date ECWT Calculated:** Enter the date (MM/DD/YYYY) the ECWT was calculated.
15. **Generating Unit Minimum Ambient Temperature (deg F):** Any of the following three options may be used:
    a. Design or nameplate temperature,
    b. Historical operating temperature for at least one hour in duration, or
    c. Current cold weather performance temperature determined by an engineering analysis.
16. **Generating Unit Maximum Ambient Operating Temp (deg F)**: Any of the following three options may be used:
    a. Design or nameplate temperature,
    b. Historical operating temperature for at least one hour in duration, or

c. Current cold weather performance temperature determined by an engineering analysis.

NOTE: For 2025, this field is only required for generating units with a declared Generator Cold Weather Constraint(s) due to the impacts on performance during warmer time periods.

17. **Net Winter Capacity (MW):** Enter the net winter capacity of the unit in Megawatts (MWs). (999999.9)
18. **Capacity Operable at ECWT (MW):** Enter the portion of the unit's total net winter capacity that is currently able to operate at ECWT in Megawatts (MWs). (999999.9)
19. **Capacity Under Corrective Action Plans (CAPs) developed (MW):** If applicable, enter the portion of the unit's net winter capacity that currently cannot operate at ECWT and has a Corrective Action Plan (CAP) developed.
20. **CAP Development Date:** If applicable, enter the date (MM/DD/YYYY) the CAP was developed. Required when Capacity is under a Corrective Action Plan is reported.
21. **Projected CAP Completion Date:** If applicable, enter the date (MM/DD/YYYY) the CAP is projected to be completed. Required when Capacity is under a Corrective Action Plan is reported.
22. **Did the unit experience a Generator Cold Weather Reliability Event in the most recent winter?:** Select 'Y' or 'N' from the list.
23. **Is the unit under a CAP because it was identified as "similar equipment"?**: Select 'Y' or 'N' from the list.
24. **Description of the "similar equipment" identified:** Required when the response to the similar equipment question is 'Y'. Enter a brief description of the "Similar Equipment' that was identified.
25. **Unit has a Generator Cold Weather Constraint identified?:** Select 'Y' or 'N' from the list.
26. **Date the Generator Cold Weather Constraint identified**: Enter the date (MM/DD/YYYY) the Generator Cold Weather Constraint was identified.
27. **Generator Cold Weather Constraint Rationale**: If applicable, select a category from the list that best represents the entity's rationale for declaring the Generator Cold Weather Constraint. Single units with multiple constraints should select the 'Other' category and enter the date identified and a category for each constraint.
    a. Commercial
        i. Commercial – warranties would be voided by application of freeze protection measure
        ii. Commercial – cost is prohibitively expensive
        iii. Commercial – significant expense on equipment with minimal remaining life
        iv. Commercial – other (free text narrative, one sentence)
    b. Technical
        i. Technical – technology not used by a significant portion of electric industry for similar units
        ii. Technical – no commercially viable solutions
        iii. Environmental – introduces unacceptable risk of noncompliance with environmental regulations on unit
        iv. Environmental – other (free text narrative; one sentence)
    c. Operational
        i. Operational – accelerates retirement of existing unit
        ii. Operational – cancellation of new generating unit

iii. Operational – reduces reliability of unit in warm weather or normal conditions

iv. Operational – introduces increased personnel or safety risk

v. Operational – compromised ability to provide ancillary services

vi. Operational – other (free text narrative; one sentence)

d. OTHER : requires the date identified and a category for each constraint.

Appendix B: Supplemental Figures and Tables

ECWT Temperature Maps

The following maps show units by location within each of the temperature bands shown in Figure 2.1.

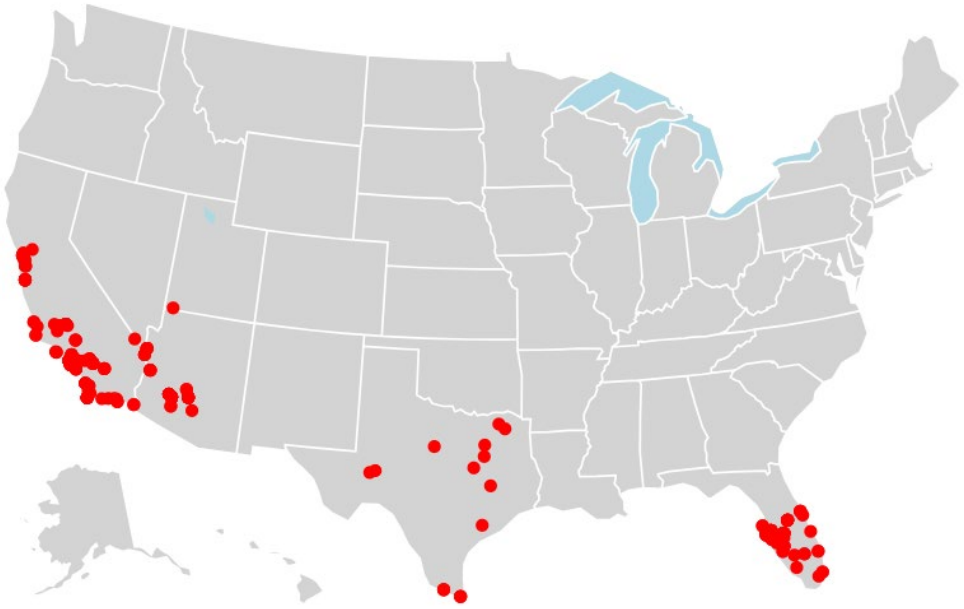


Figure B.1: ECWT Greater than 32° F

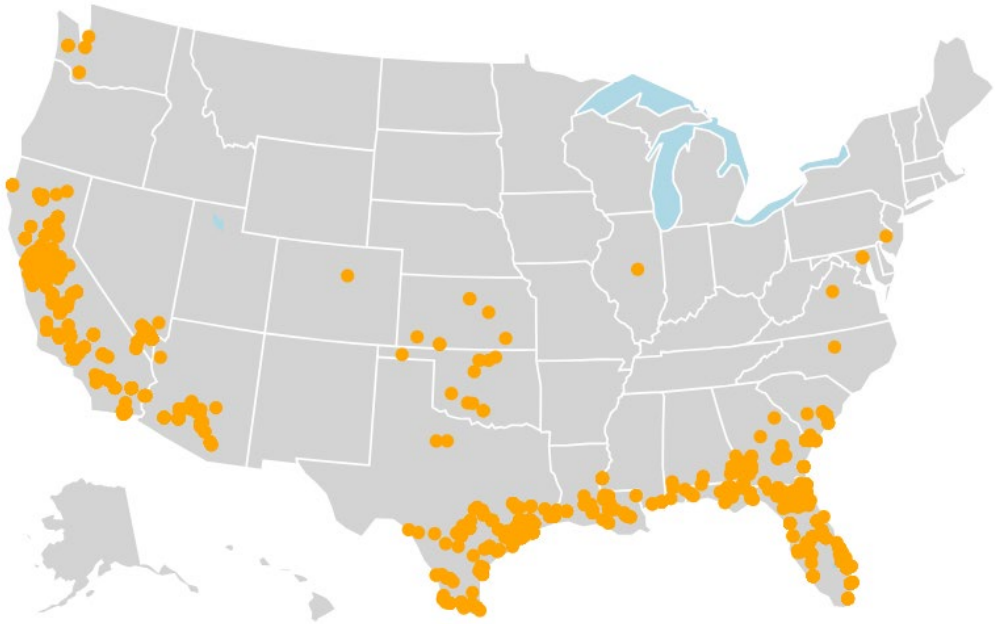


Figure B.2: ECWT between 20° F and 32° F

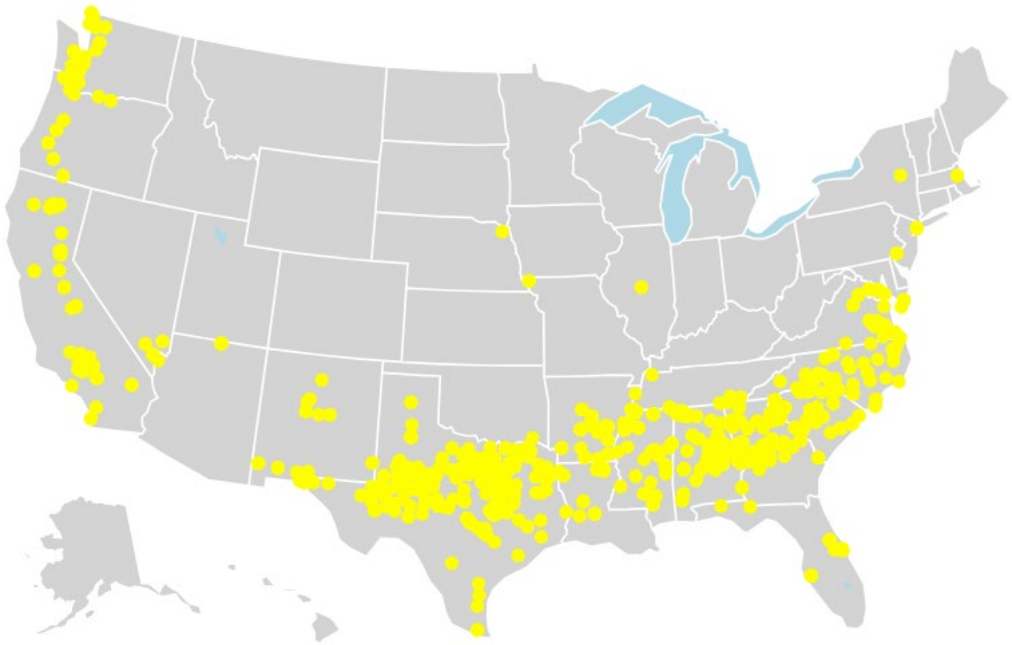


Figure B.3: ECWT between 10° F and 20° F

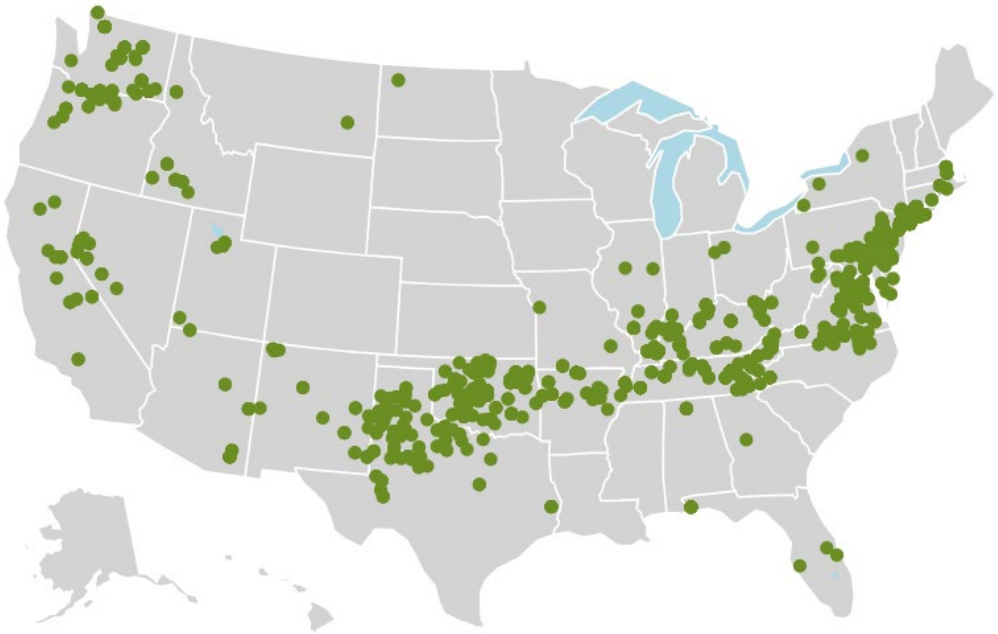


Figure B.4: ECWT between 0° F and 10° F

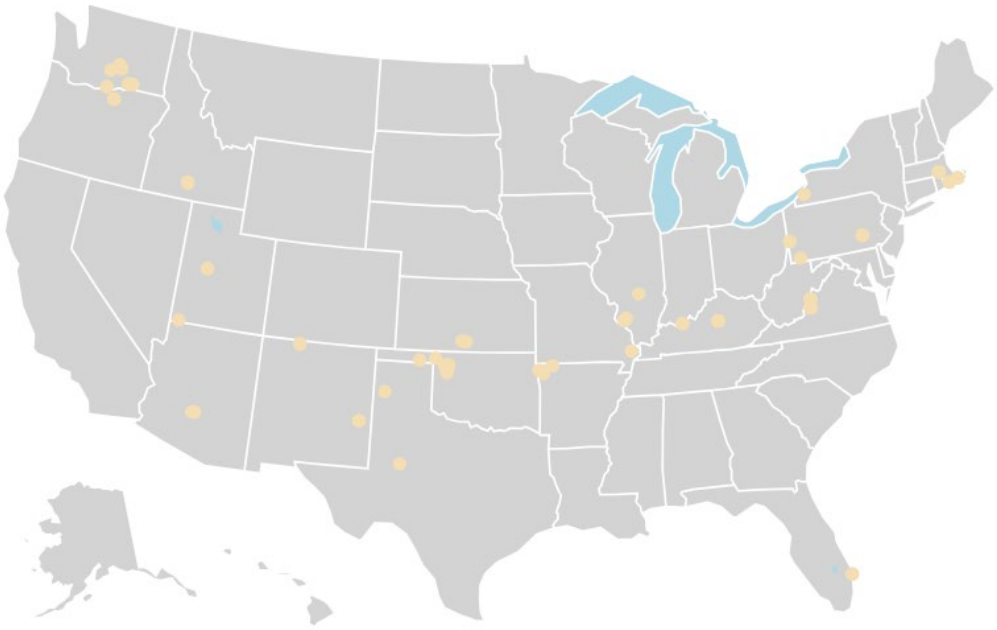


Figure B.5: ECWT of 0° F

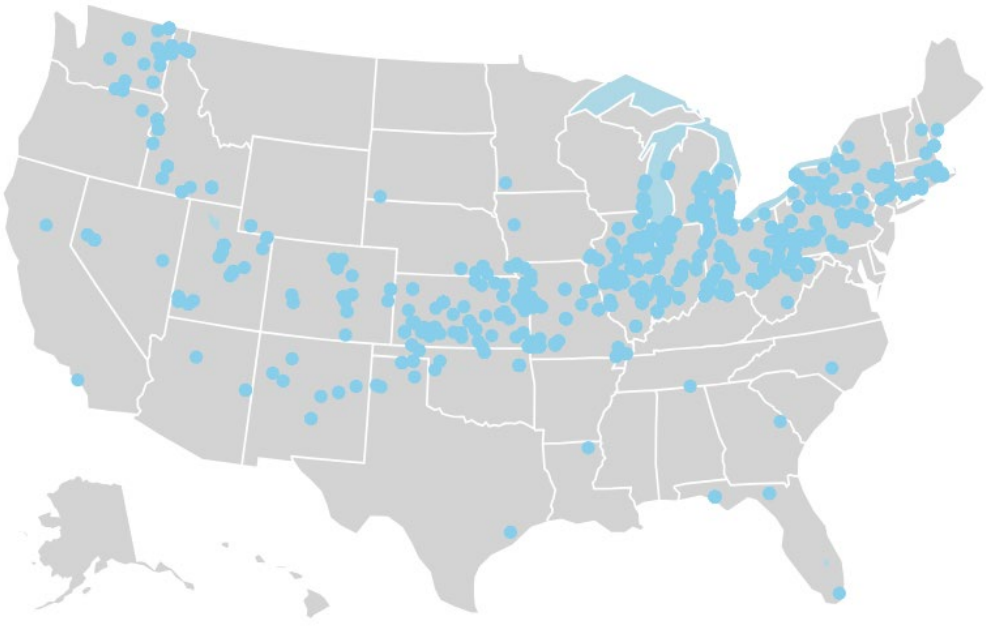


Figure B.6: ECWT between 0° F and -10° F

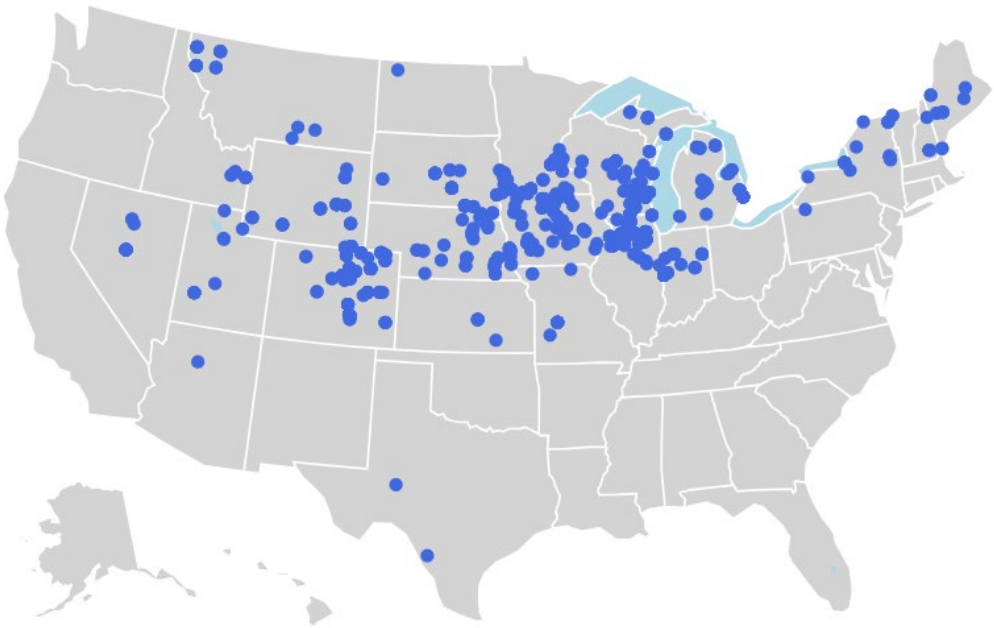
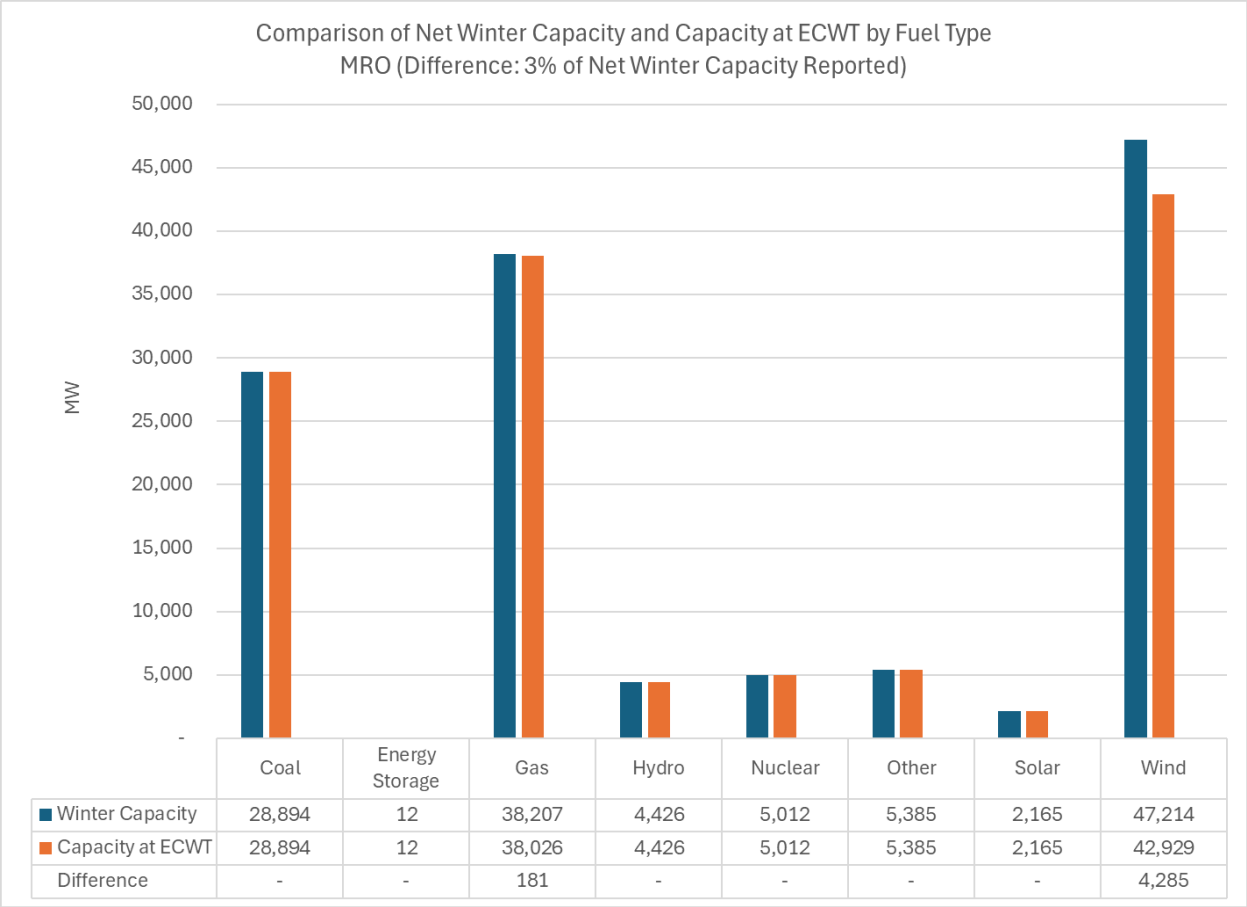


Figure B.7: ECWT between -20° F and -10° F

Figure B.8: ECWT below -20° F

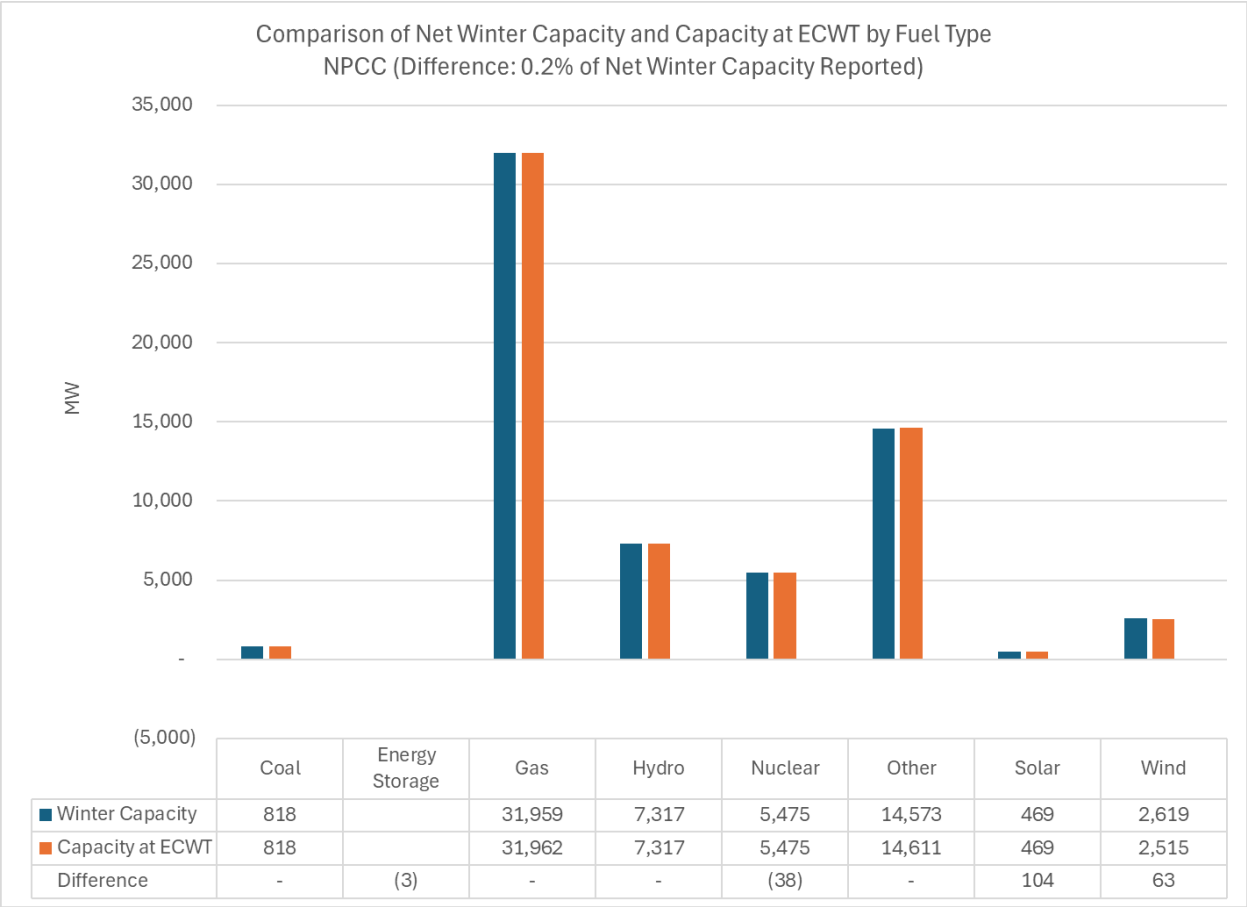
Comparison of Net Winter Capacity and Capacity at ECWT

The figures below compare the Net Winter Capacity and ECWT by fuel type for each region.



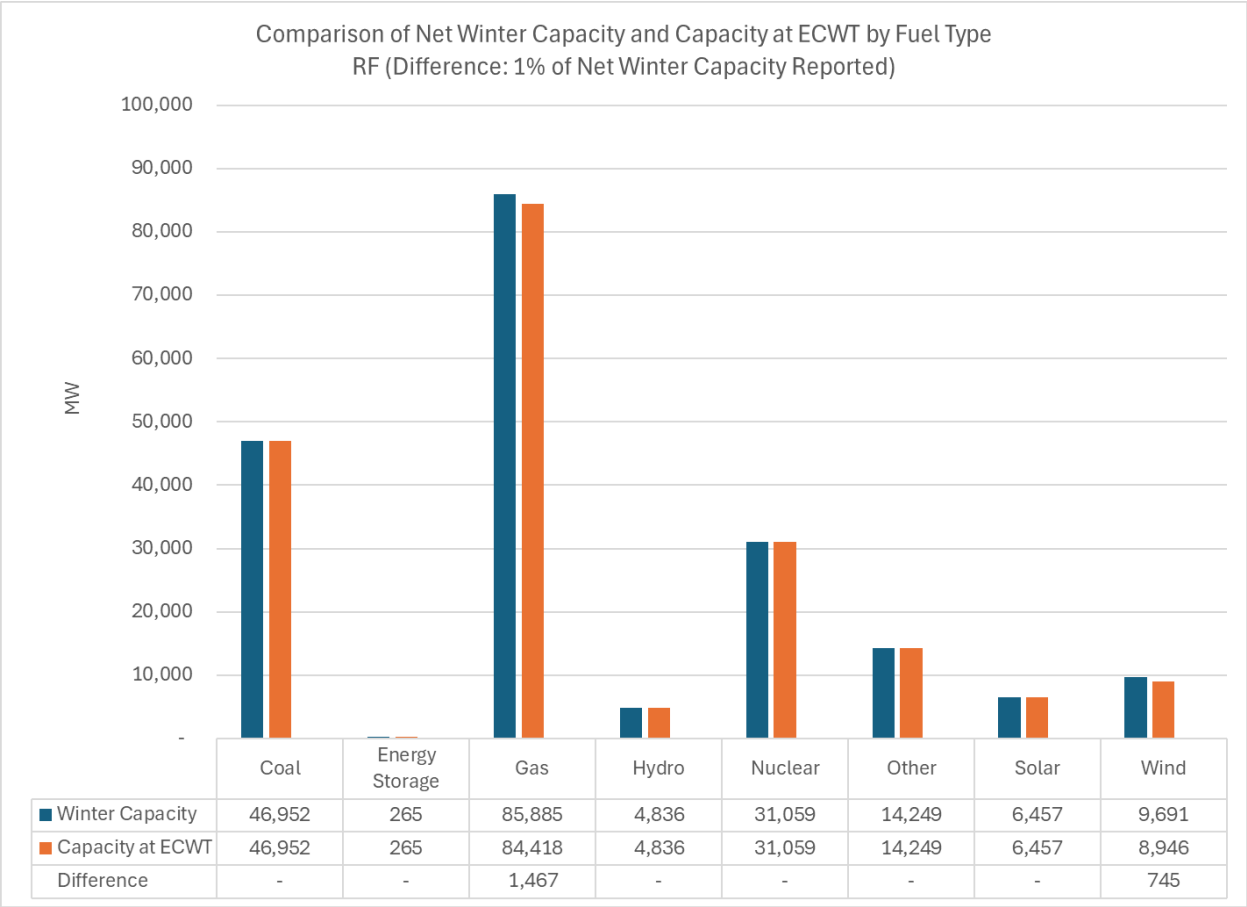
	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	28,894	12	38,207	4,426	5,012	5,385	2,165	47,214
Capacity at ECWT	28,894	12	38,026	4,426	5,012	5,385	2,165	42,929
Difference	-	-	181	-	-	-	-	4,285

Figure B.9: MRO Region: Comparison of Net Winter Capacity and ECWT by Fuel Type



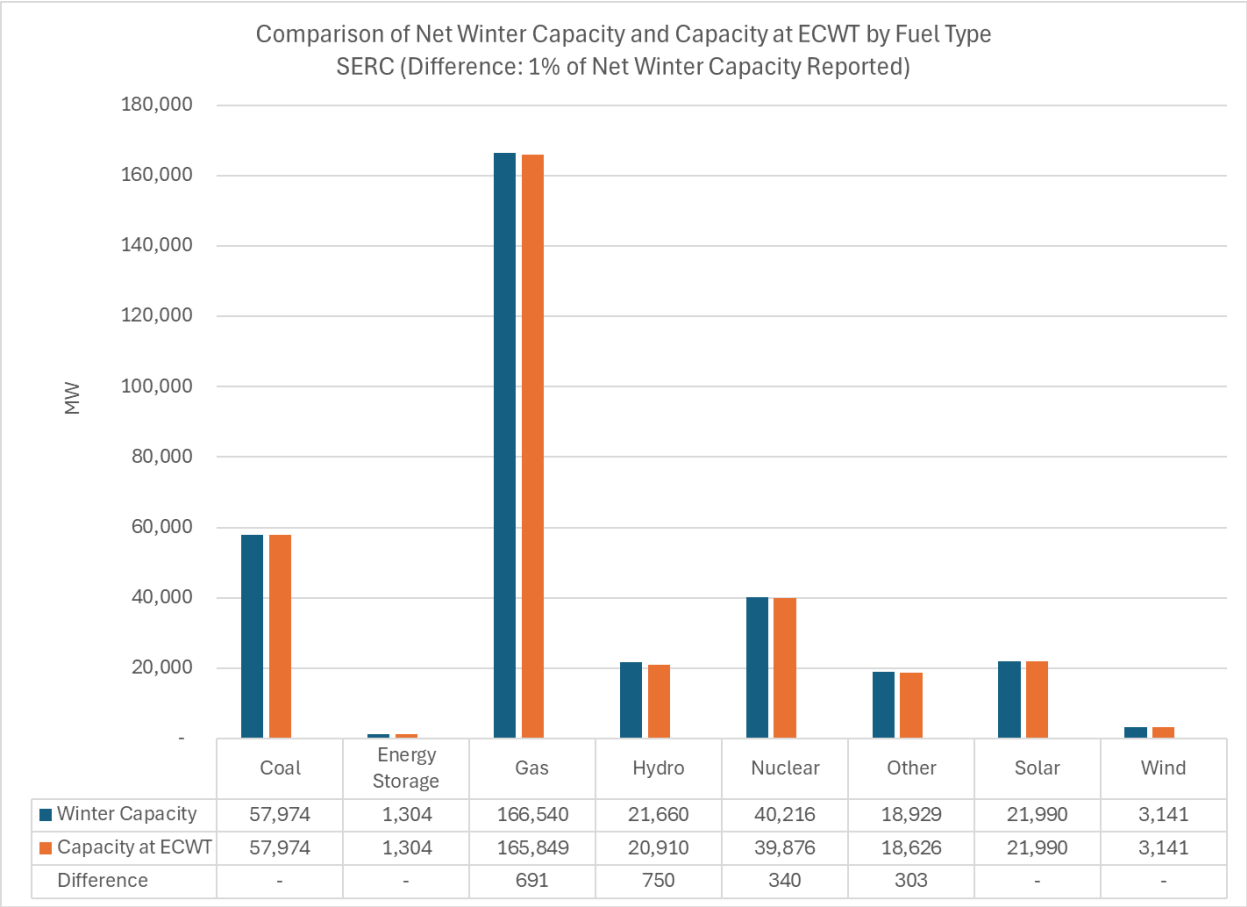
	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	818		31,959	7,317	5,475	14,573	469	2,619
Capacity at ECWT	818		31,962	7,317	5,475	14,611	469	2,515
Difference	-	(3)	-	-	(38)	-	104	63

Figure B.10: NPCC Region: Comparison of Net Winter Capacity and ECWT by Fuel Type



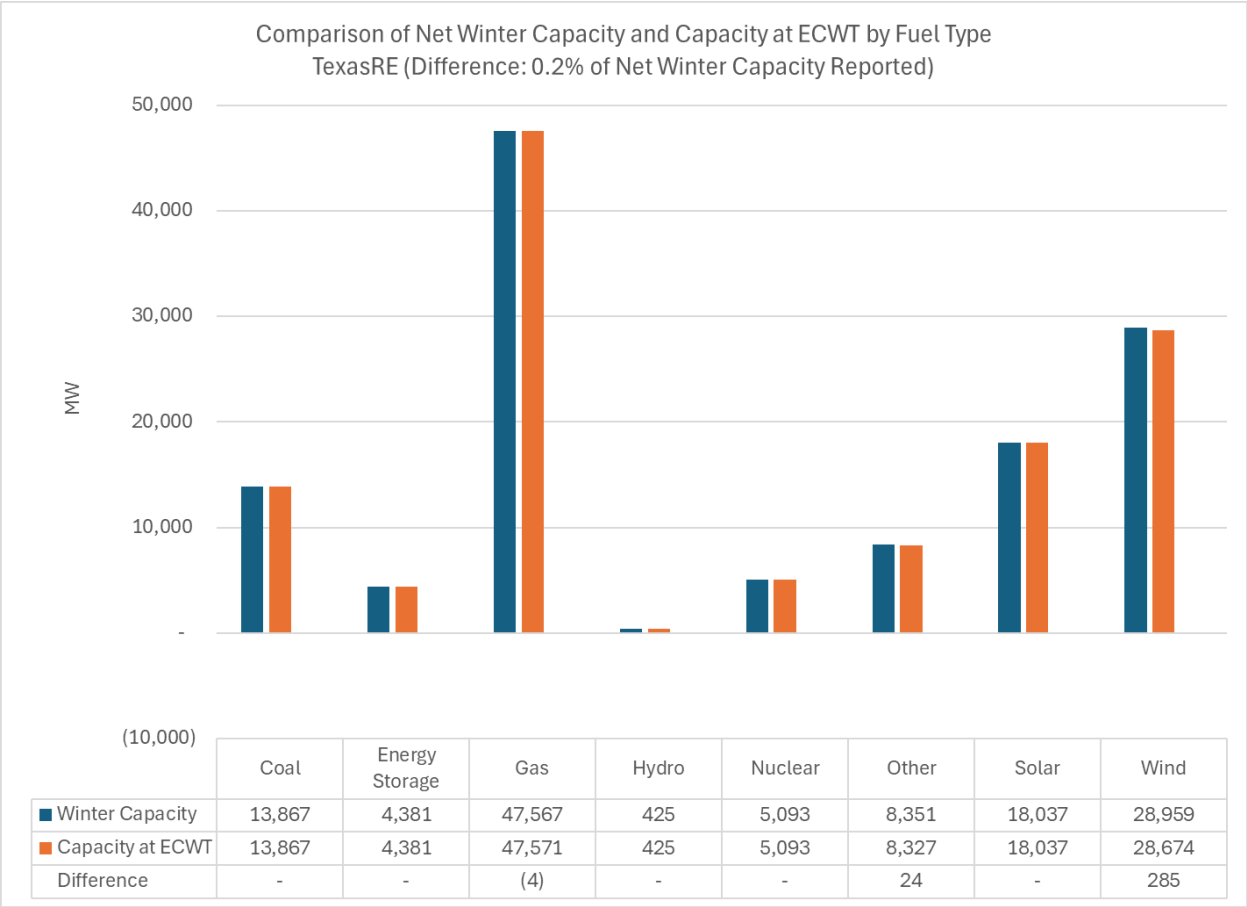
	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	46,952	265	85,885	4,836	31,059	14,249	6,457	9,691
Capacity at ECWT	46,952	265	84,418	4,836	31,059	14,249	6,457	8,946
Difference	-	-	1,467	-	-	-	-	745

Figure B.11: RF Region: Comparison of Net Winter Capacity and ECWT by Fuel Type



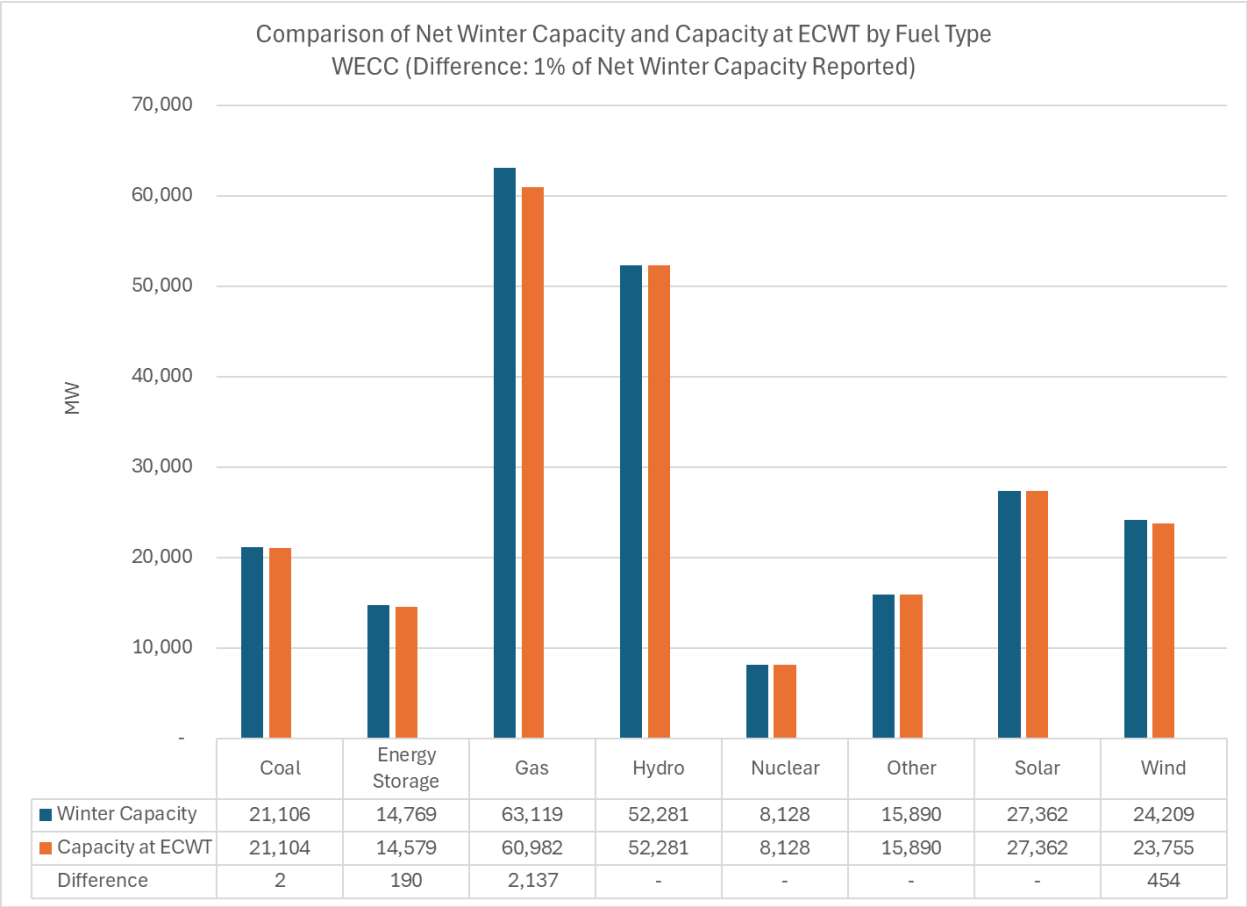
	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	57,974	1,304	166,540	21,660	40,216	18,929	21,990	3,141
Capacity at ECWT	57,974	1,304	165,849	20,910	39,876	18,626	21,990	3,141
Difference	-	-	691	750	340	303	-	-

Figure B.12: SERC Region: Comparison of Net Winter Capacity and ECWT by Fuel Type



	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	13,867	4,381	47,567	425	5,093	8,351	18,037	28,959
Capacity at ECWT	13,867	4,381	47,571	425	5,093	8,327	18,037	28,674
Difference	-	-	(4)	-	-	24	-	285

Figure B.13: Texas RE Region: Comparison of Net Winter Capacity and ECWT by Fuel Type

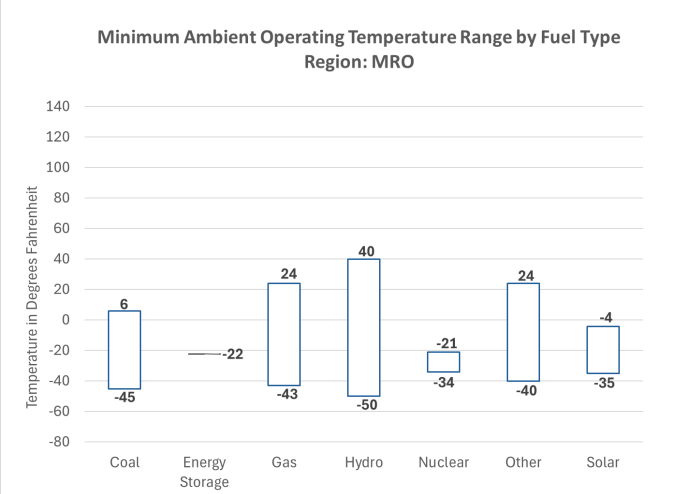


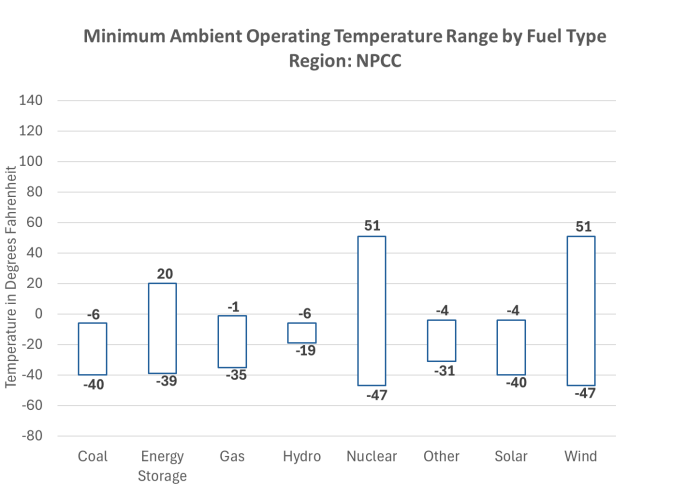
	Coal	Energy Storage	Gas	Hydro	Nuclear	Other	Solar	Wind
Winter Capacity	21,106	14,769	63,119	52,281	8,128	15,890	27,362	24,209
Capacity at ECWT	21,104	14,579	60,982	52,281	8,128	15,890	27,362	23,755
Difference	2	190	2,137	-	-	-	-	454

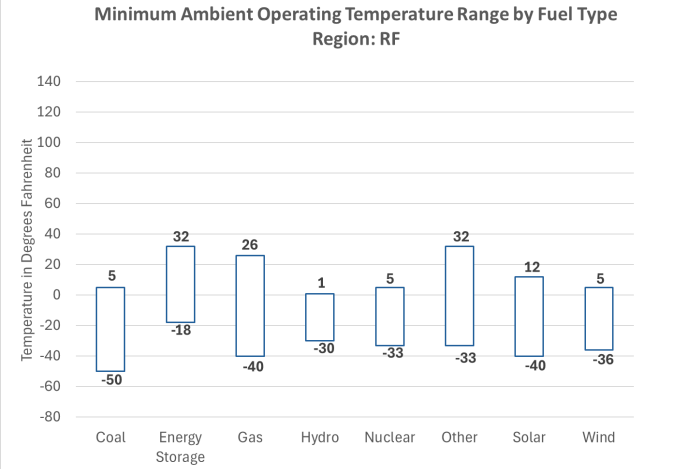
Figure B.14: WECC Region: Comparison of Net Winter Capacity and ECWT by Fuel Type

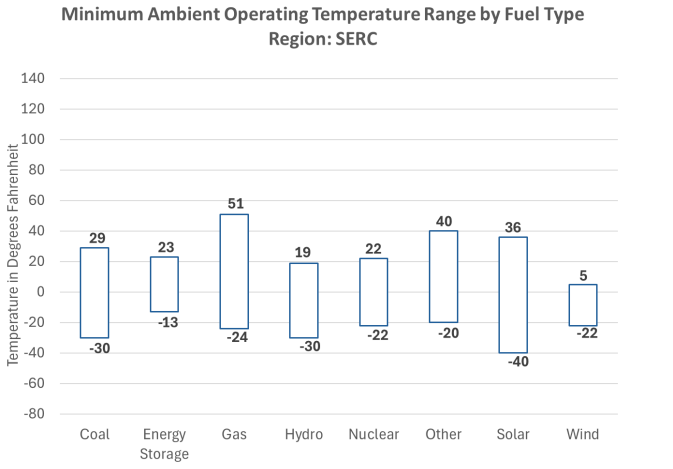
Minimum Ambient Operating Temperatures By Region and Fuel Type

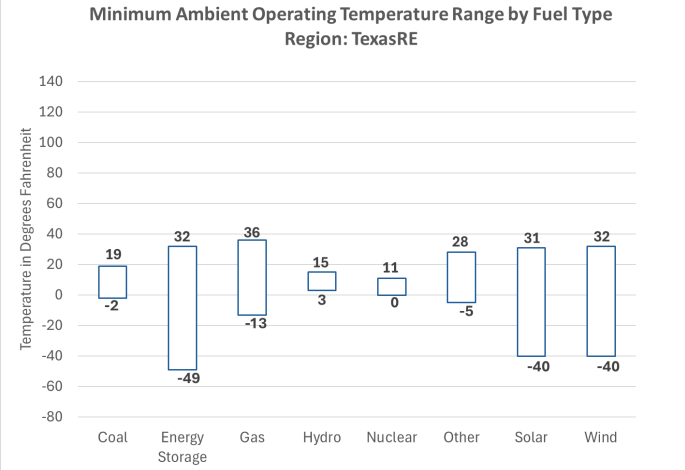
The figures below show the range of Minimum Ambient Operating Temperatures by region and fuel type for units responding to the Cold Weather Data Request.

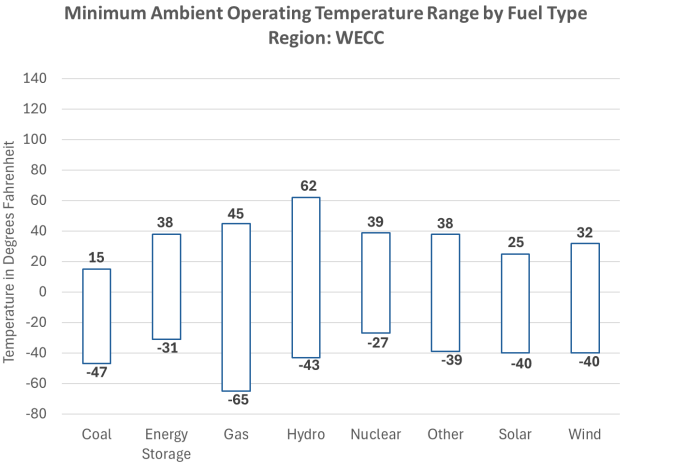












Relationship Between ECWT and Minimum Ambient Operating Temperatures

The figures below show scatter plots of the coordinates of the ECWT and Minimum Ambient Operating Temperature of reporting units by fuel type for each region.

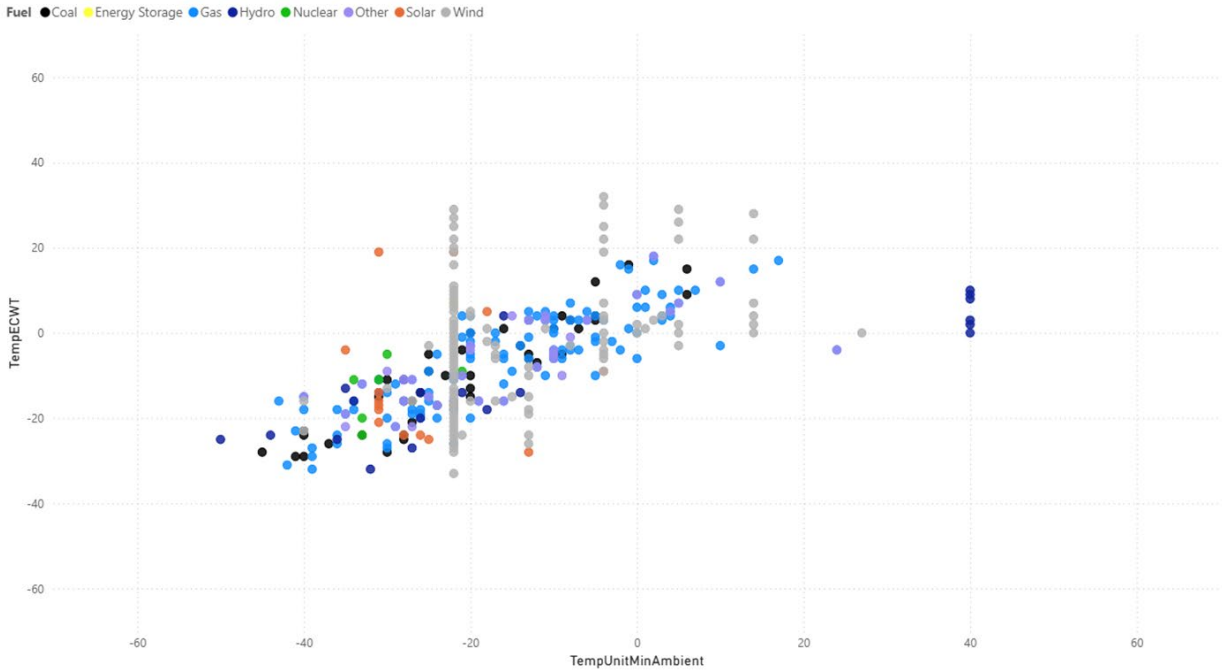


Figure B.15: MRO Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

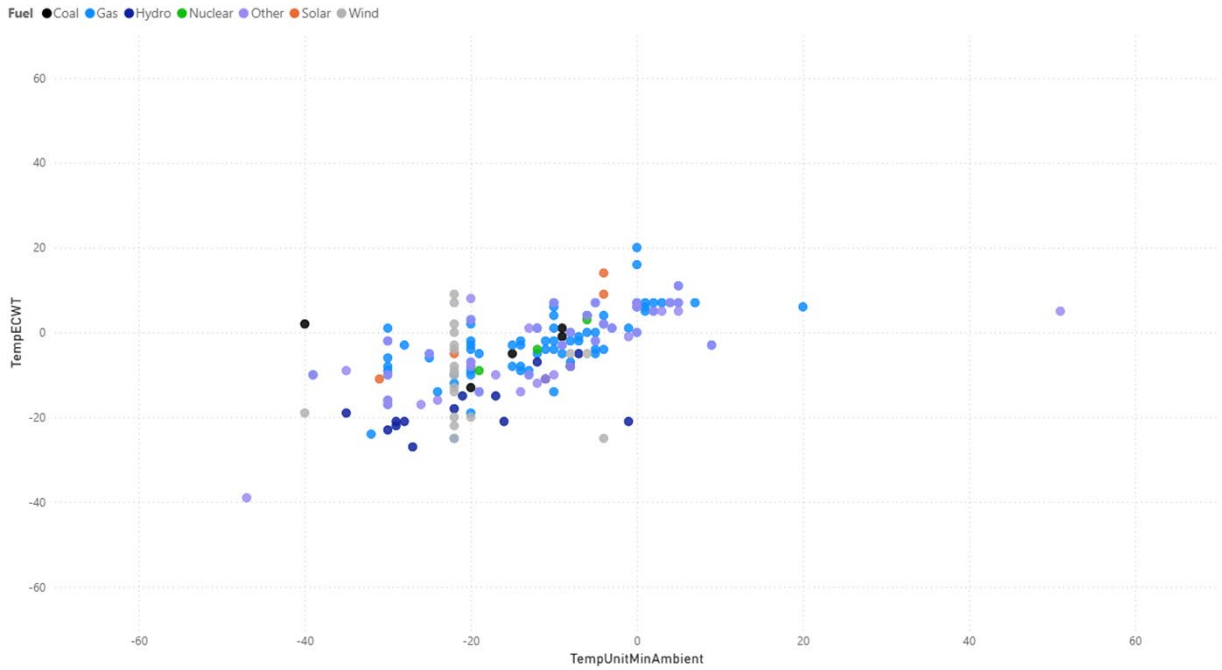


Figure B.16: NPCC Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

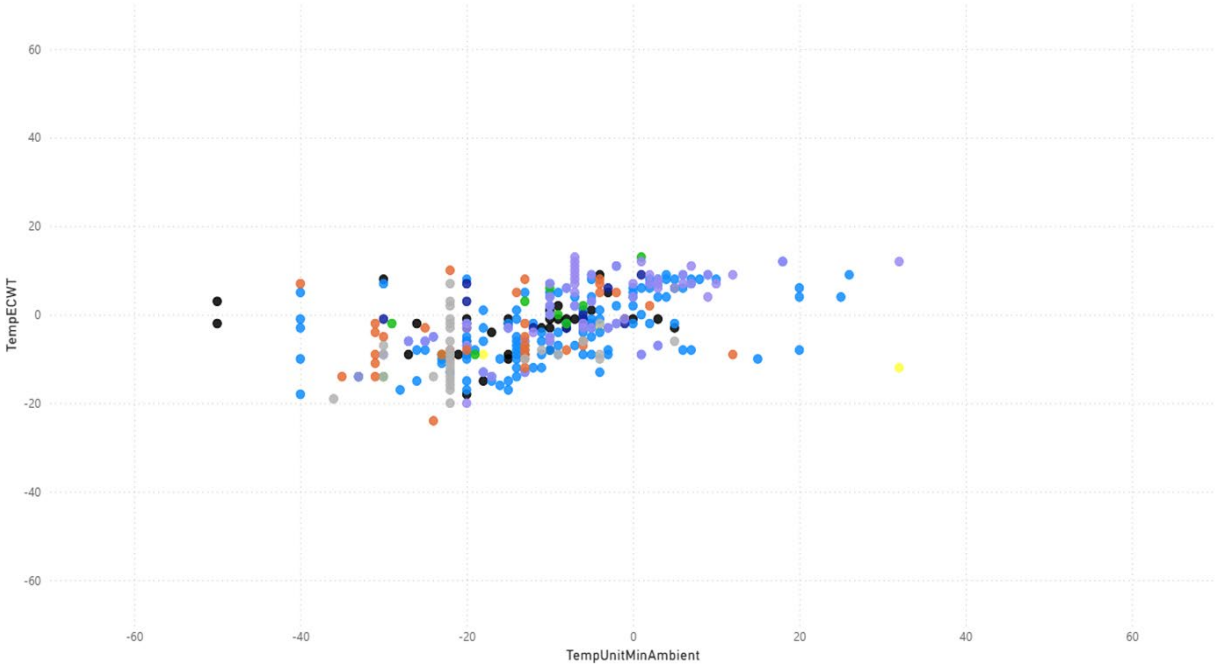


Figure B.17: RF Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

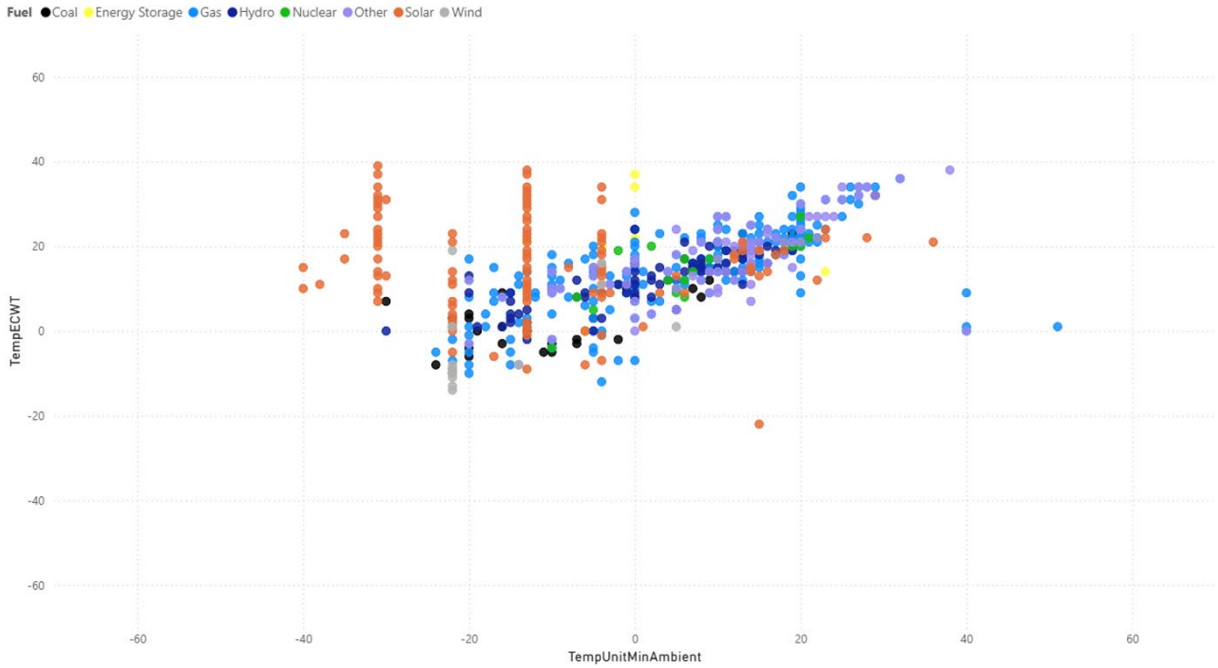


Figure B.18: SERC Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

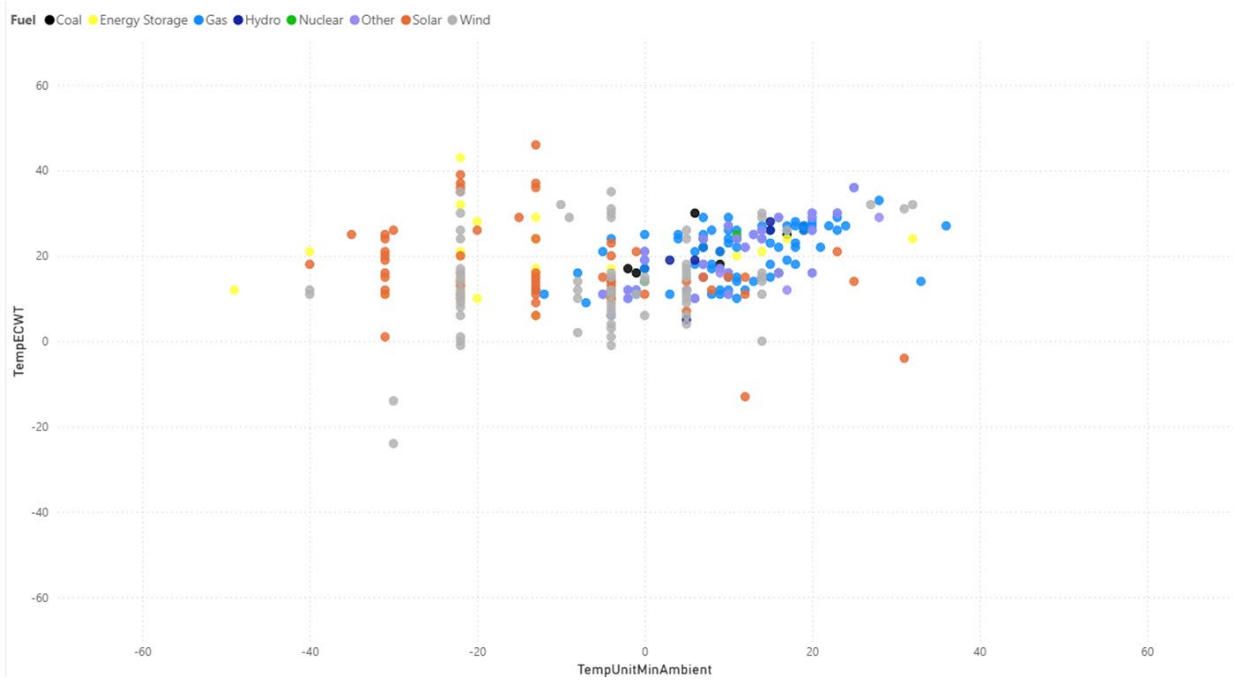


Figure B.19: Texas RE Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

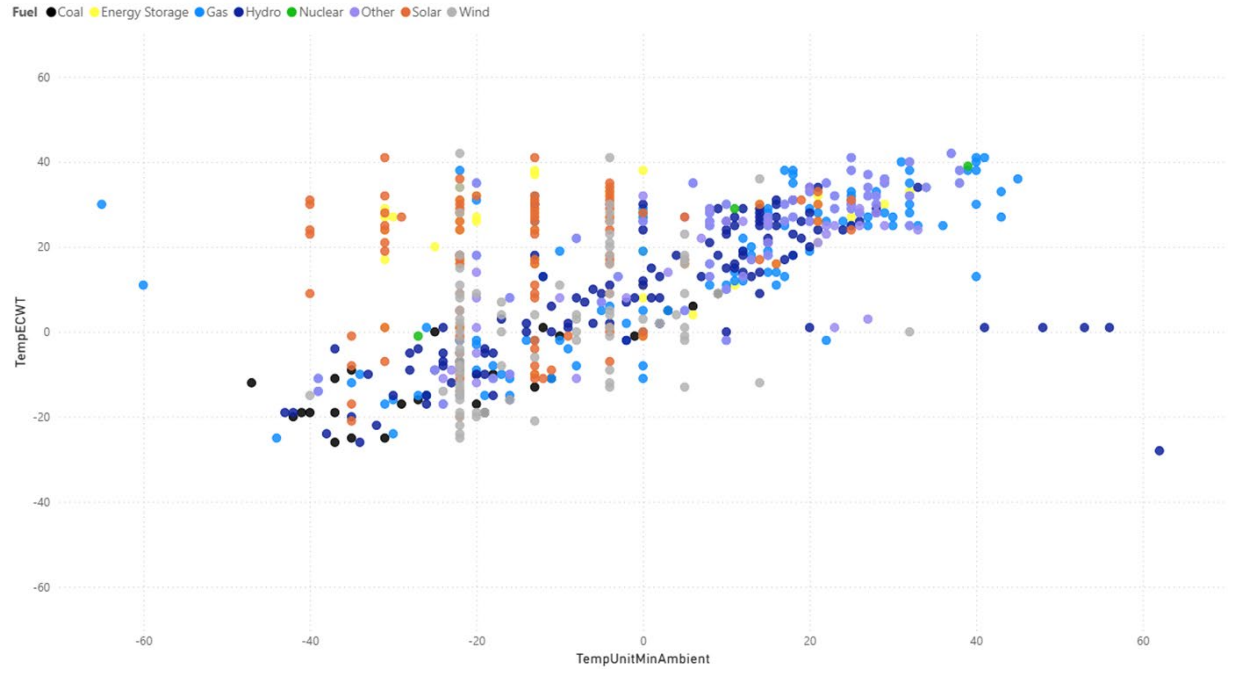


Figure B.20: WECC Region: Intersection of ECWT and Minimum Ambient Operating Temperature by Fuel Type

Temperature Spread between ECWT and Minimum Ambient Operating Temperature by Fuel Type

The figures below illustrate the temperature spread between ECWT and Minimum Ambient Operating Temperature by fuel type for each NERC region. A detailed explanation of the box-whisker format is provided in the main body of the informational filing.

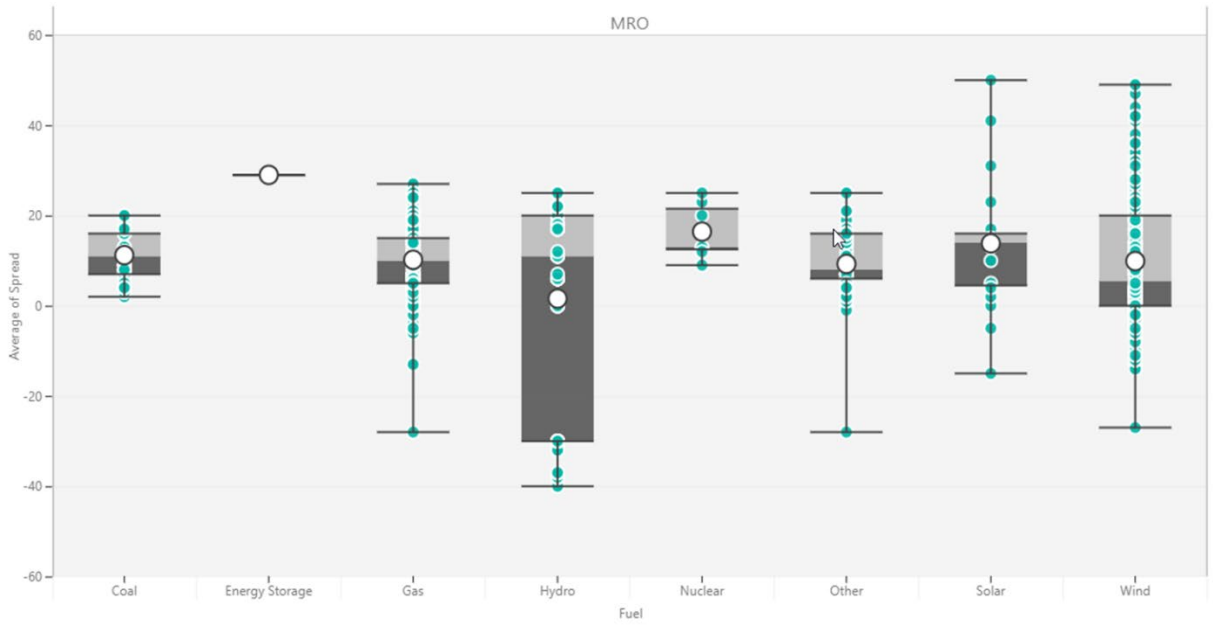


Figure B.21: MRO Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

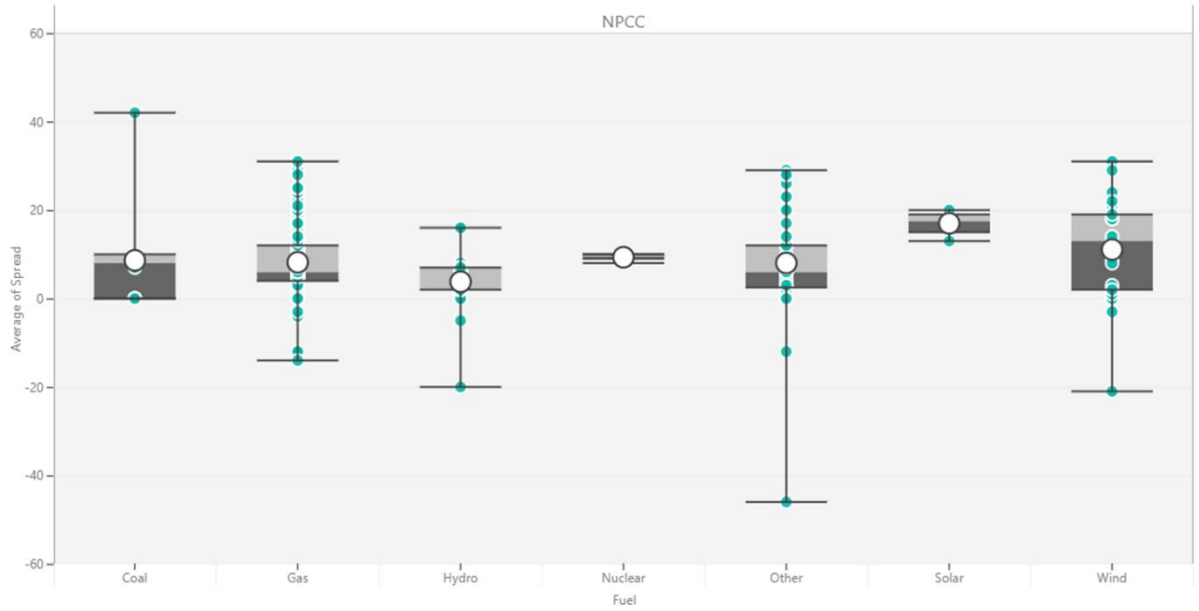


Figure B.22: NPCC Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

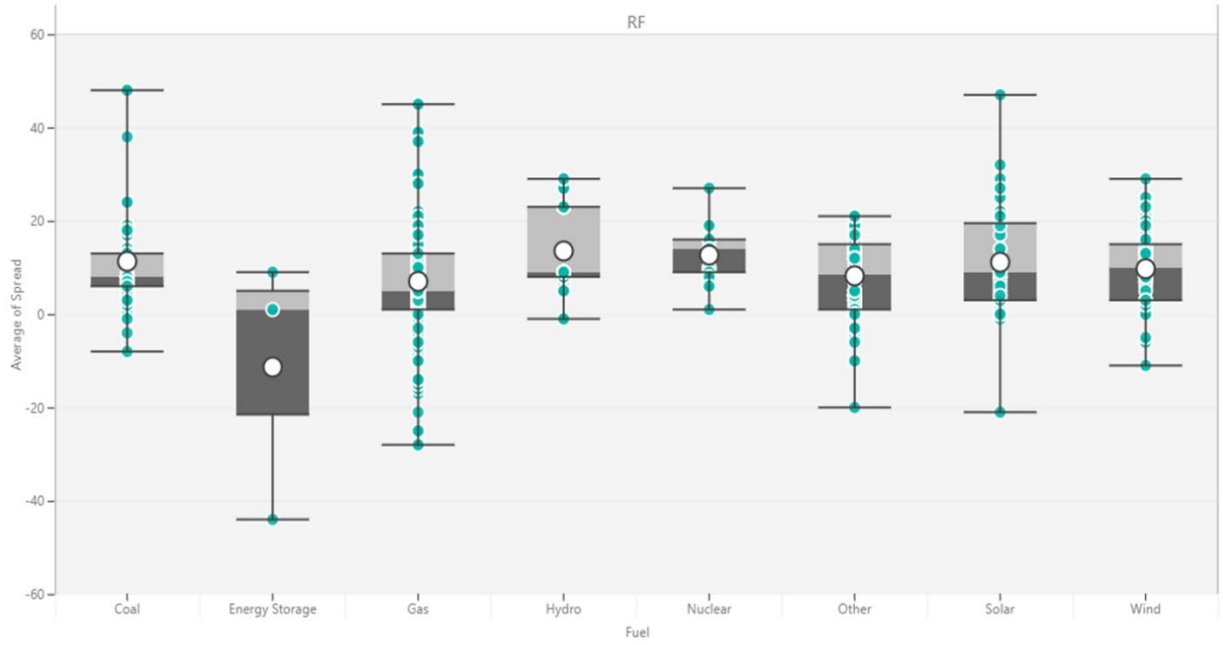


Figure B.23: RF Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

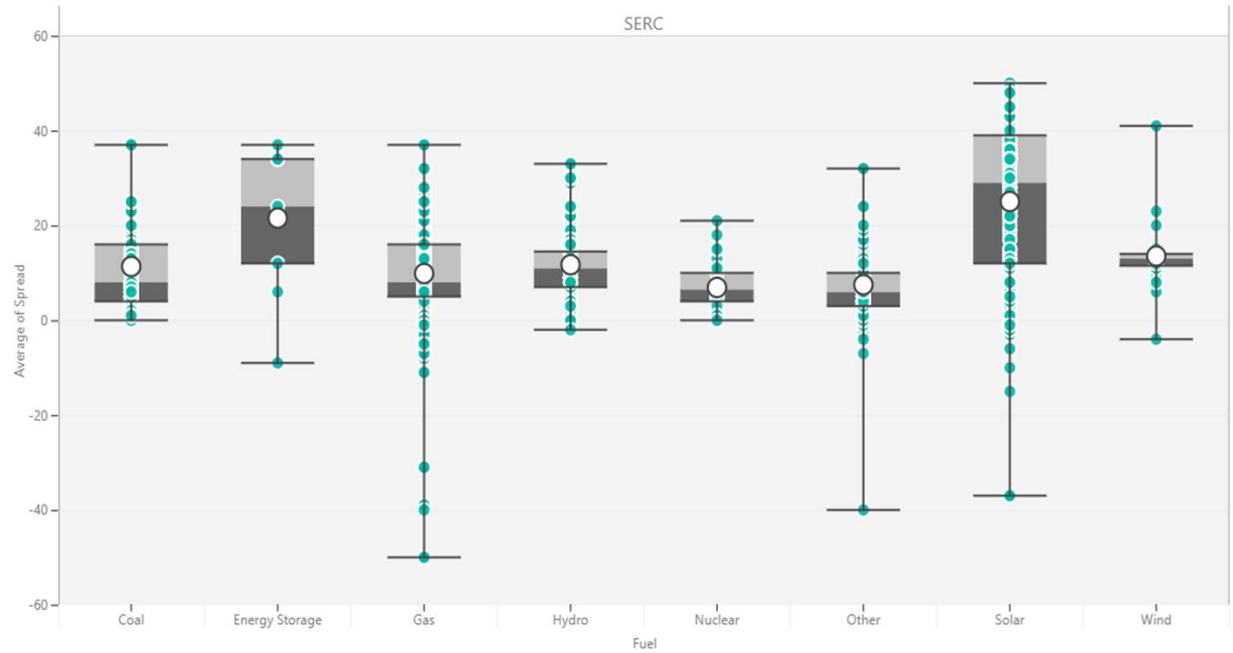


Figure B.24: SERC Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

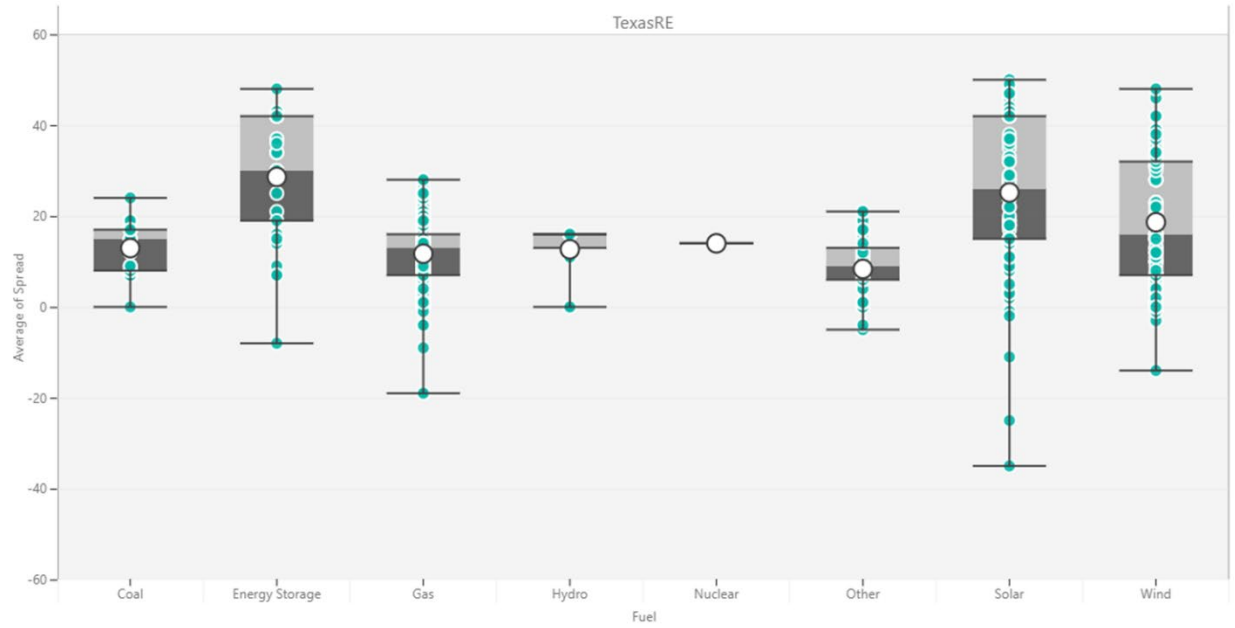


Figure B.25: Texas RE Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

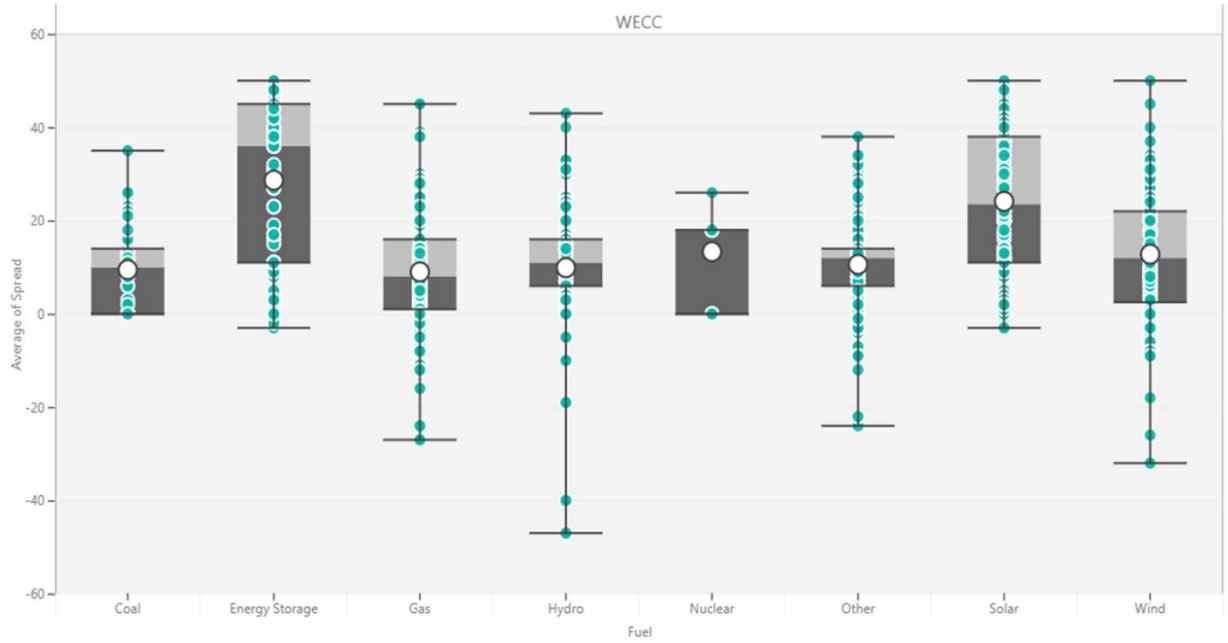
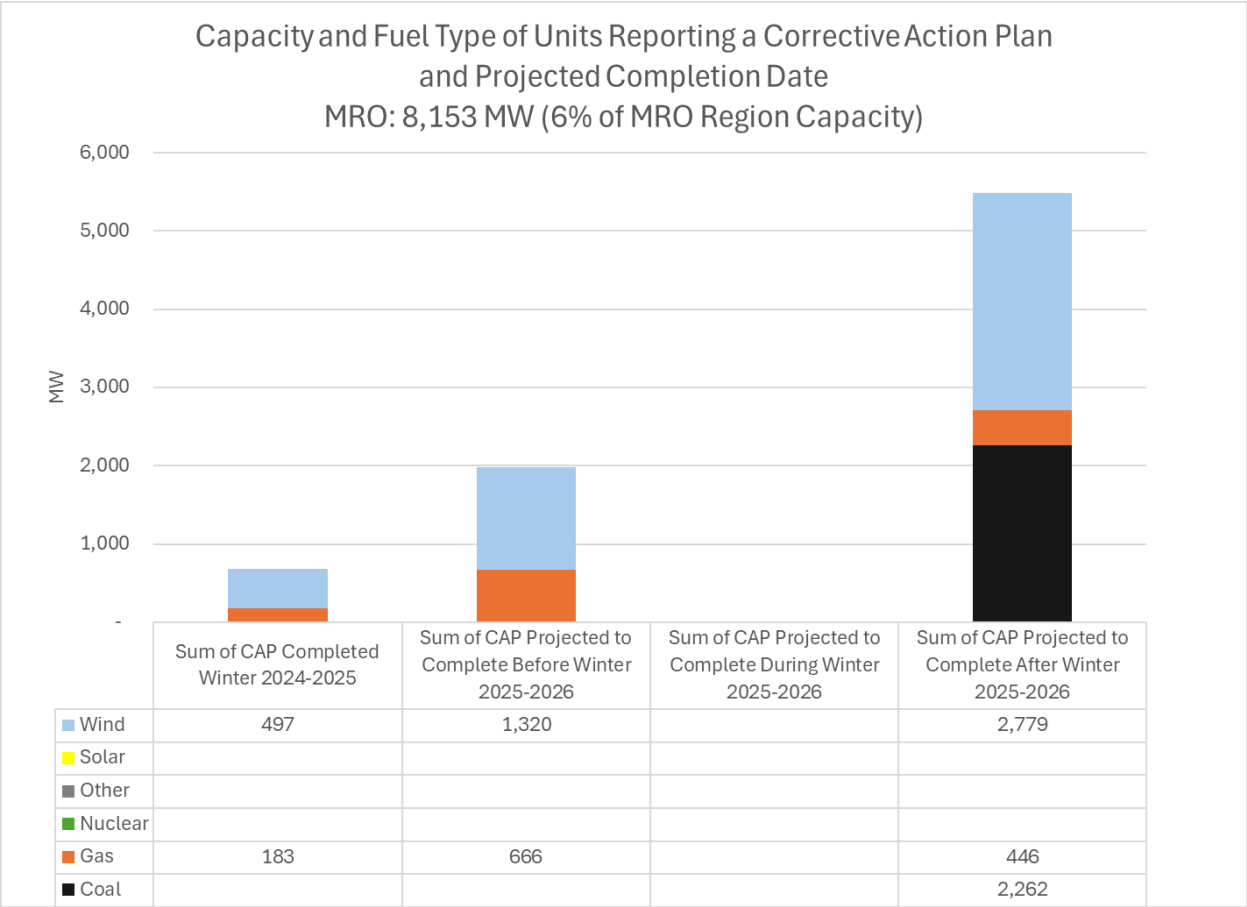


Figure B.26: WECC Region: Temperature Spread by Fuel Type between ECWT and Minimum Ambient Operating Temperature

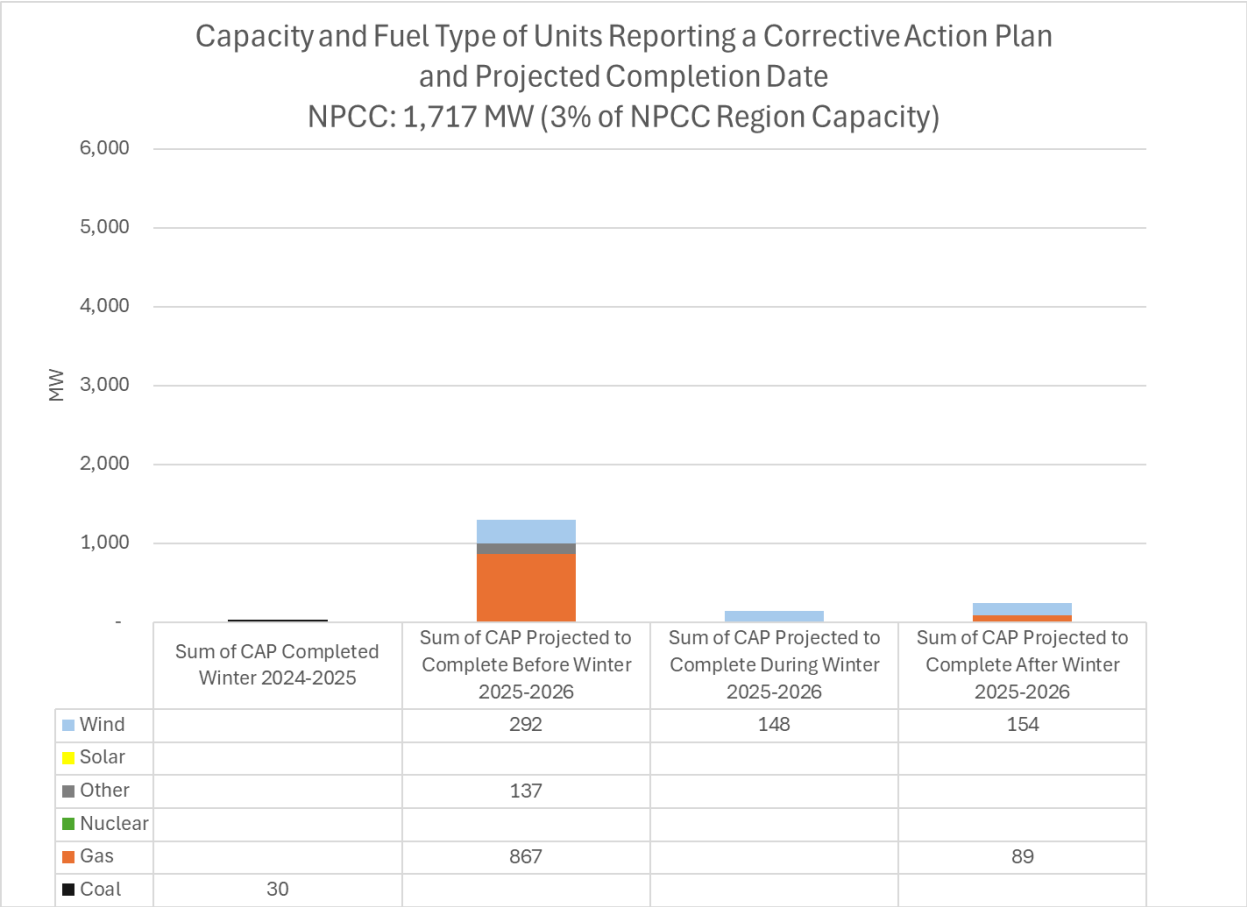
Capacity and Fuel Type of Units Reporting a Corrective Action Plan

The figures below show the amount of capacity by fuel type by region for four periods of the Projected CAP Completion Date: CAPs completed during Winter 2024 – 2025 (before March 31, 2025), CAPs projected to be complete before Winter 2025 – 2026 (April 1, 2025 – November 30, 2025), CAPs projected to be complete during Winter 2025 – 2026 (December 1, 2025 – March 31, 2026), and CAPs projected to be complete after Winter 2025 – 2026 (April 1, 2026 or later).



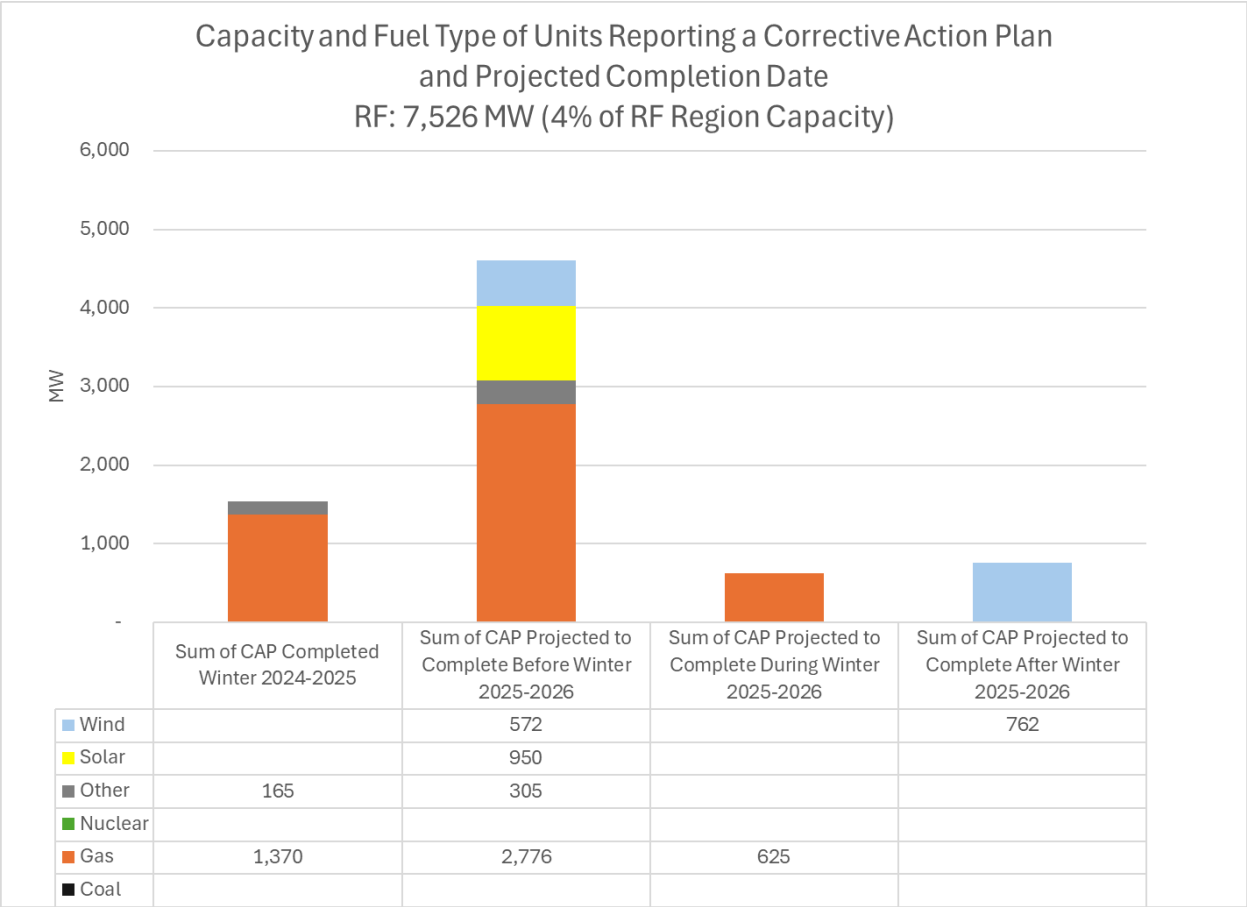
	Sum of CAP Completed Winter 2024-2025	Sum of CAP Projected to Complete Before Winter 2025-2026	Sum of CAP Projected to Complete During Winter 2025-2026	Sum of CAP Projected to Complete After Winter 2025-2026
Wind	497	1,320		2,779
Solar				
Other				
Nuclear				
Gas	183	666		446
Coal				2,262

Figure B.27: MRO Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan



	Sum of CAP Completed Winter 2024-2025	Sum of CAP Projected to Complete Before Winter 2025-2026	Sum of CAP Projected to Complete During Winter 2025-2026	Sum of CAP Projected to Complete After Winter 2025-2026
Wind		292	148	154
Solar				
Other		137		
Nuclear				
Gas		867		89
Coal	30			

Figure B.28: NPCC Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan



	Sum of CAP Completed Winter 2024-2025	Sum of CAP Projected to Complete Before Winter 2025-2026	Sum of CAP Projected to Complete During Winter 2025-2026	Sum of CAP Projected to Complete After Winter 2025-2026
Wind		572		762
Solar		950		
Other	165	305		
Nuclear				
Gas	1,370	2,776	625	
Coal				

Figure B.29: RF Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan

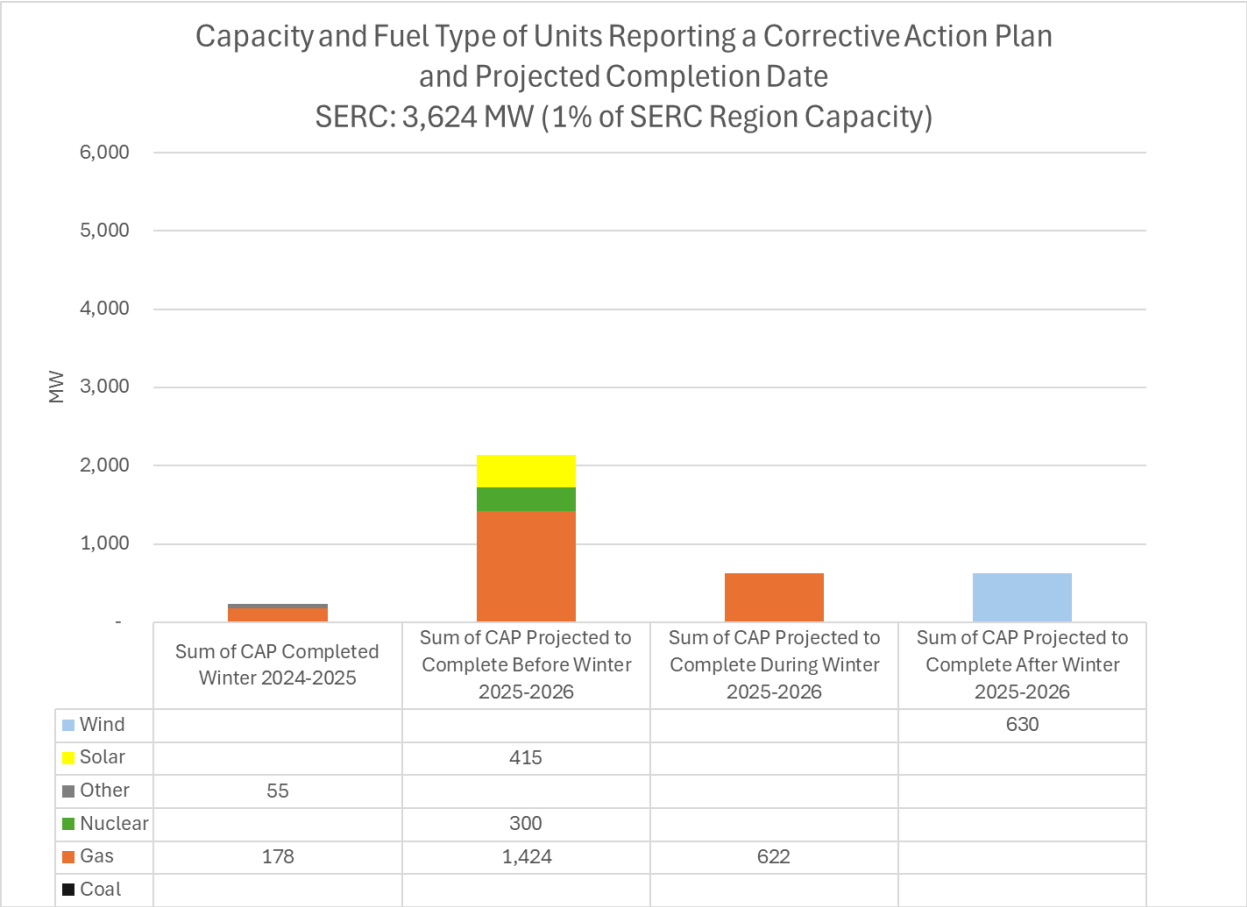


Figure B.30: SERC Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan

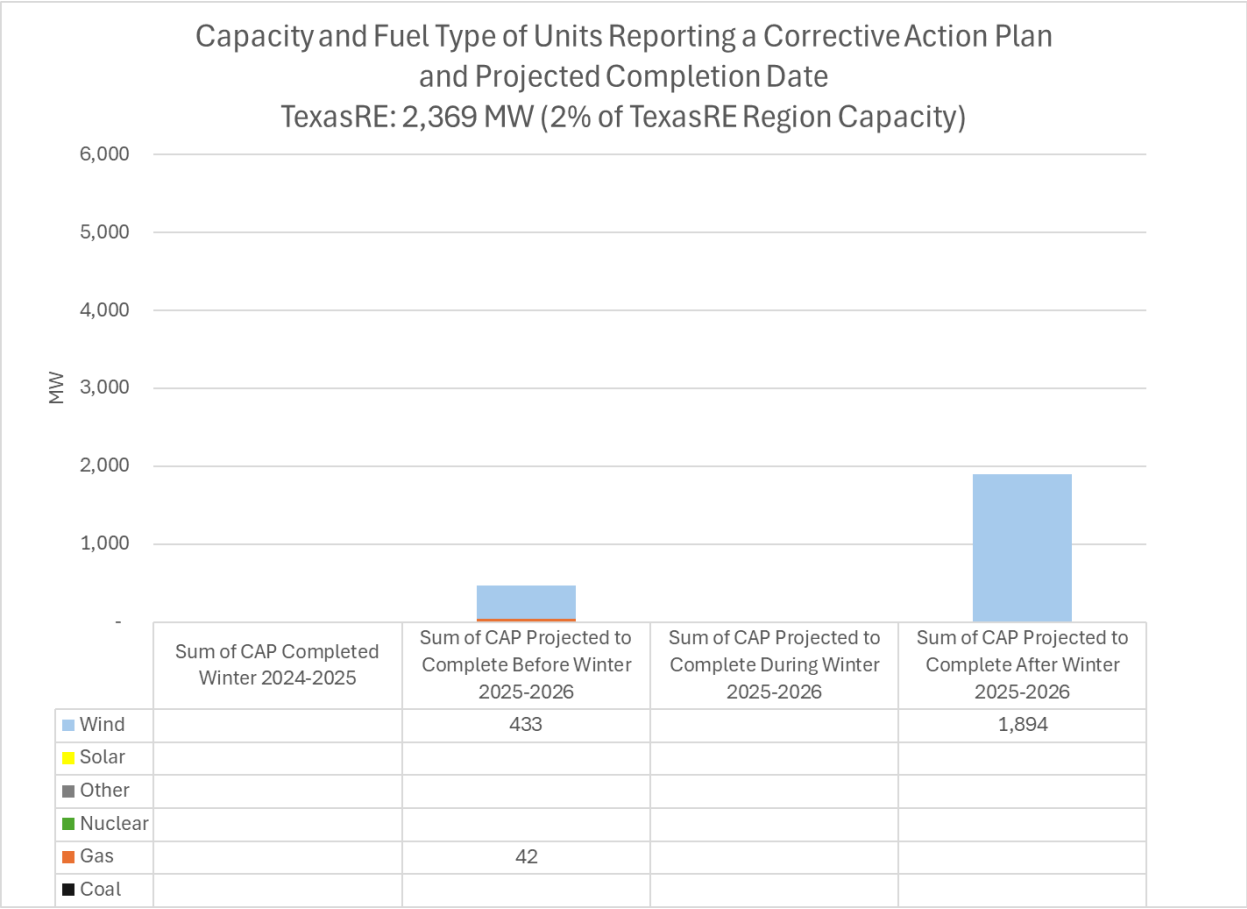


Figure B.31: Texas RE Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan

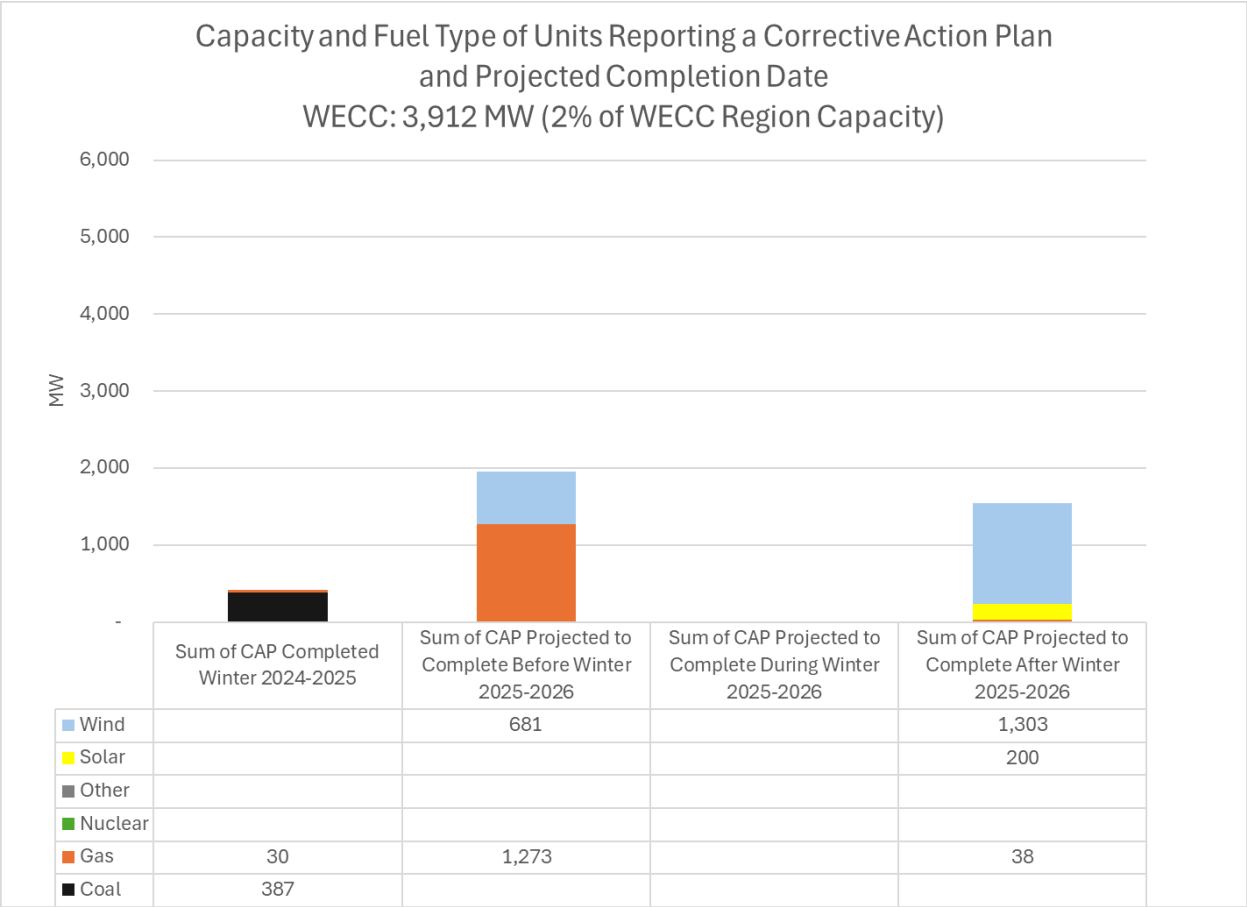


Figure B.32: WECC Region: Capacity and Fuel Type of Units Reporting a Corrective Action Plan

Generator Cold Weather Constraint Analysis by Fuel Type and Region

The tables below detail the Generator Cold Weather Constraint analysis by fuel type and region.

Region: MRO

% Units with Generator Cold Weather Constraints:	12%
% Total Net Winter Capacity	11%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Gas	19	1,603	-21	-30
Commercial – significant expense on equipment with minimal remaining life	14	985	-27	-37
OTHER	5	618	-15	-22
Wind	82	12,651	-8	-13
Commercial – cost is prohibitively expensive	5	890	-8	0
Commercial – significant expense on equipment with minimal remaining life	1	99	-18	-22
Environmental - other	1	298	4	-4
Operational - other	3	639	-5	-10
OTHER	1	288	-8	-22
Technical – no commercially viable solutions	71	10,437	-16	-18
Grand Total	101	14,254	-12	-17

Figure B.33: MRO Region: Generator Cold Weather Constraints by Fuel Type and Region

Region: NPCC

% Units with Generator Cold Weather Constraints: 2%

% Total Net Winter Capacity 1%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Wind	**7**	**696**	**-4**	**-18**
Technical – no commercially viable solutions	7	696	-4	-18
Grand Total	**7**	**696**	**-4**	**-18**

Figure B.34: NPCC Region: Generator Cold Weather Constraints by Fuel Type and Region

Region: RF

% Units with Generator Cold Weather Constraints: 3%

% Total Net Winter Capacity 2%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Solar	**3**	**753**	**-7**	**-11**
Technical – no commercially viable solutions	3	753	-7	-11
Wind	**30**	**3,412**	**-11**	**-18**
Commercial – significant expense on equipment with minimal remaining life	4	436	-15	-22
Technical – no commercially viable solutions	26	2,976	-7	-14
Grand Total	**33**	**4,165**	**-10**	**-16**

Figure B.35: RF Region: Generator Cold Weather Constraints by Fuel Type and Region

Region: SERC

% Units with Generator Cold Weather Constraints: 1%

% Total Net Winter Capacity 1%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Gas	**2**	**1,626**	**24**	**17**
Technical – no commercially viable solutions	2	1,626	24	17
Solar	**7**	**1,376**	**13**	**4**
Commercial – cost is prohibitively expensive	2	430	13	5
OTHER	1	120	15	14
Technical – no commercially viable solutions	4	826	10	-7
Wind	**7**	**1,571**	**-8**	**-21**
OTHER	1	381	-10	-22
Technical – no commercially viable solutions	6	1,190	-6	-19
Grand Total	**16**	**4,573**	**8**	**-2**

Figure B.36: SERC Region: Generator Cold Weather Constraints by Fuel Type and Region

Region: TexasRE

% Units with Generator Cold Weather Constraints:	6%
% Total Net Winter Capacity	6%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Energy Storage	**1**	**150**	**12**	**-49**
Environmental - other	1	150	12	-49
Gas	**2**	**0**	**14**	**33**
Commercial - other	2	0	14	33
Other	**3**	**24**	**12**	**17**
Operational - other	3	24	12	17
Solar	**5**	**936**	**20**	**5**
Environmental - other	1	200	21	23
Technical – no commercially viable solutions	4	736	18	-13
Wind	**33**	**6,625**	**21**	**5**
Environmental - other	2	438	31	12
Technical – no commercially viable solutions	31	6,187	12	-2
Grand Total	**44**	**7,735**	**17**	**3**

Figure B.37: Texas RE Region: Generator Cold Weather Constraints by Fuel Type and Region

Region: WECC

% Units with Generator Cold Weather Constraints:	4%
% Total Net Winter Capacity	5%

Fuel Type and Generator Cold Weather Constraint	Unit count	Net Winter Capacity	Average ECWT	Average Min. Ambient Operating Temp.
Coal	**2**	**233**	**-17**	**-29**
OTHER	2	233	-17	-29
Energy Storage	**2**	**660**	**29**	**-1**
Environmental - other	2	660	29	-1
Gas	**16**	**1,378**	**19**	**26**
Commercial – cost is prohibitively expensive	13	1,050	31	40
Operational - other	1	36	0	0
OTHER	2	292	27	37
Hydro	**5**	**316**	**22**	**-5**
Environmental - other	5	316	22	-5
Solar	**4**	**1,240**	**23**	**6**
Environmental - other	2	940	29	20
Technical – no commercially viable solutions	2	300	18	-9
Wind	**44**	**6,444**	**-4**	**-15**
Commercial – cost is prohibitively expensive	1	205	0	-8
Environmental - other	1	116	-14	-22
Operational – introduces increased personnel or safety risk	3	439	-7	-20
Technical – no commercially viable solutions	39	5,684	4	-10
Grand Total	**73**	**10,271**	**10**	**-1**

Figure B.38: WECC Region: Generator Cold Weather Constraints by Fuel Type and Region

Weighted Forced Outage Rates by Fuel Type and Region

The figures below show the weighted forced outage rates by fuel type for each region. This analysis uses all units reporting to GADS for seven of the eight fuel types included in this informational filing, regardless of whether they responded to the Cold Weather Data Request. At the time of this analysis, energy storage performance is not reported to GADS.

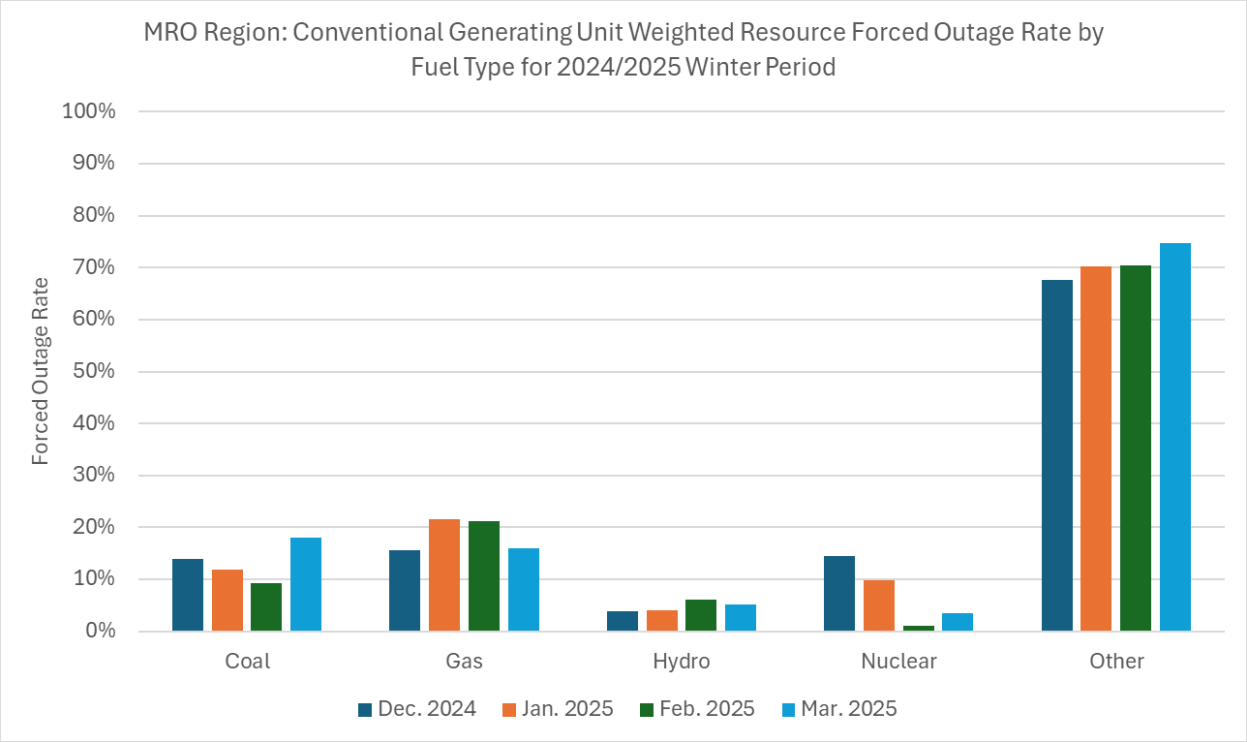


Figure B.39: MRO Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

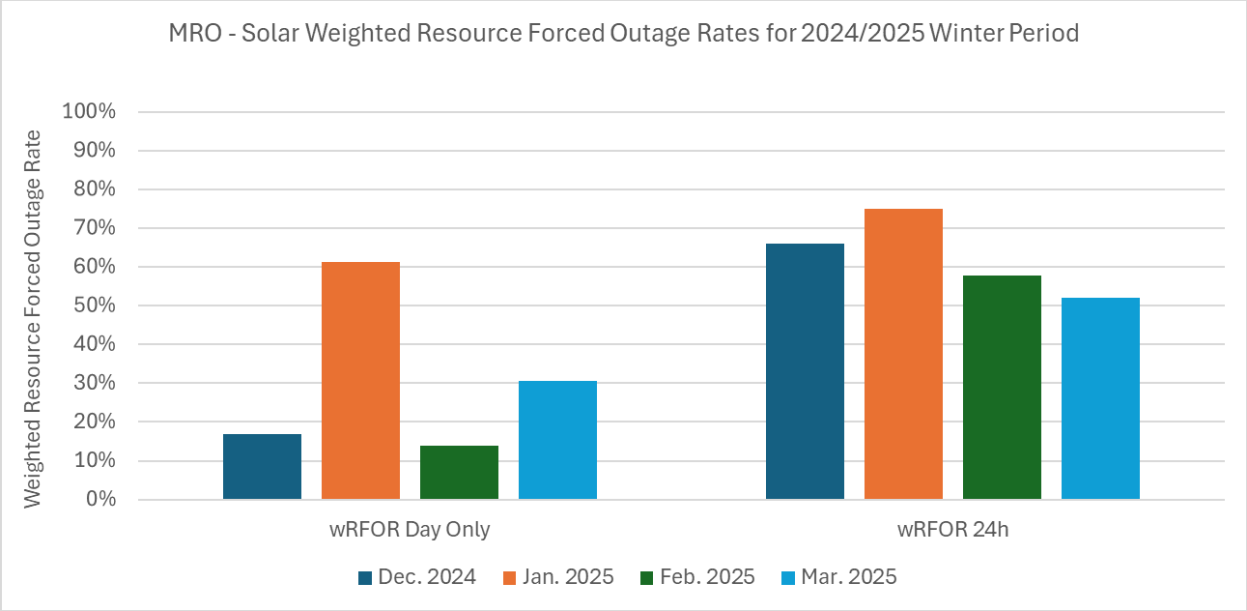


Figure B.40: MRO Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

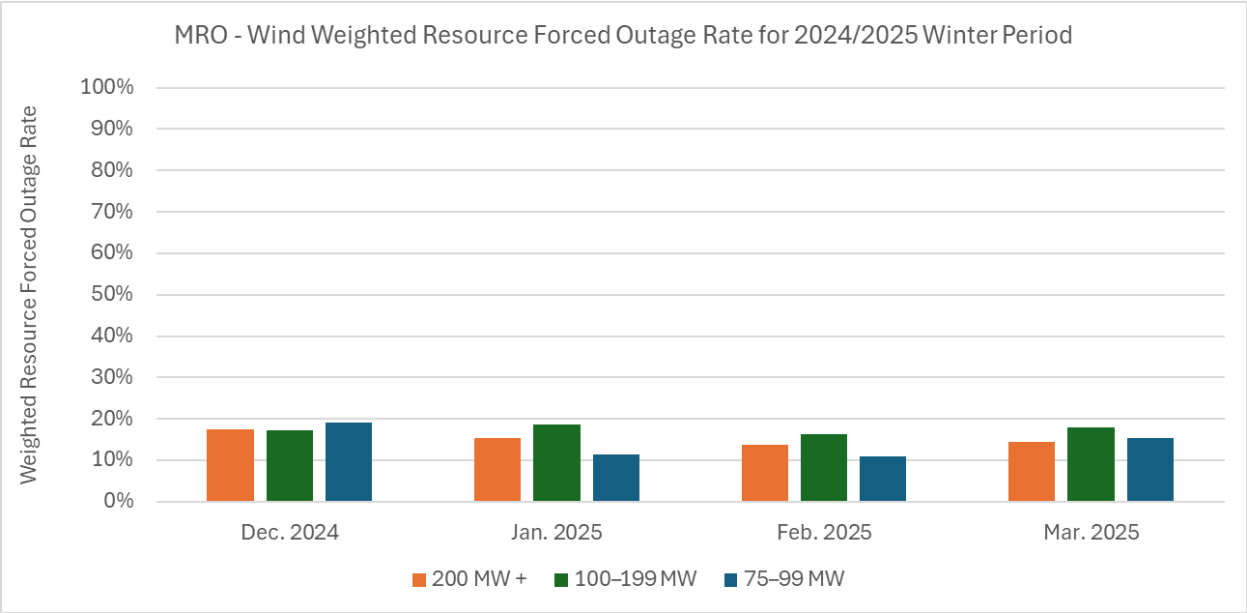


Figure B.41: MRO Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Wind

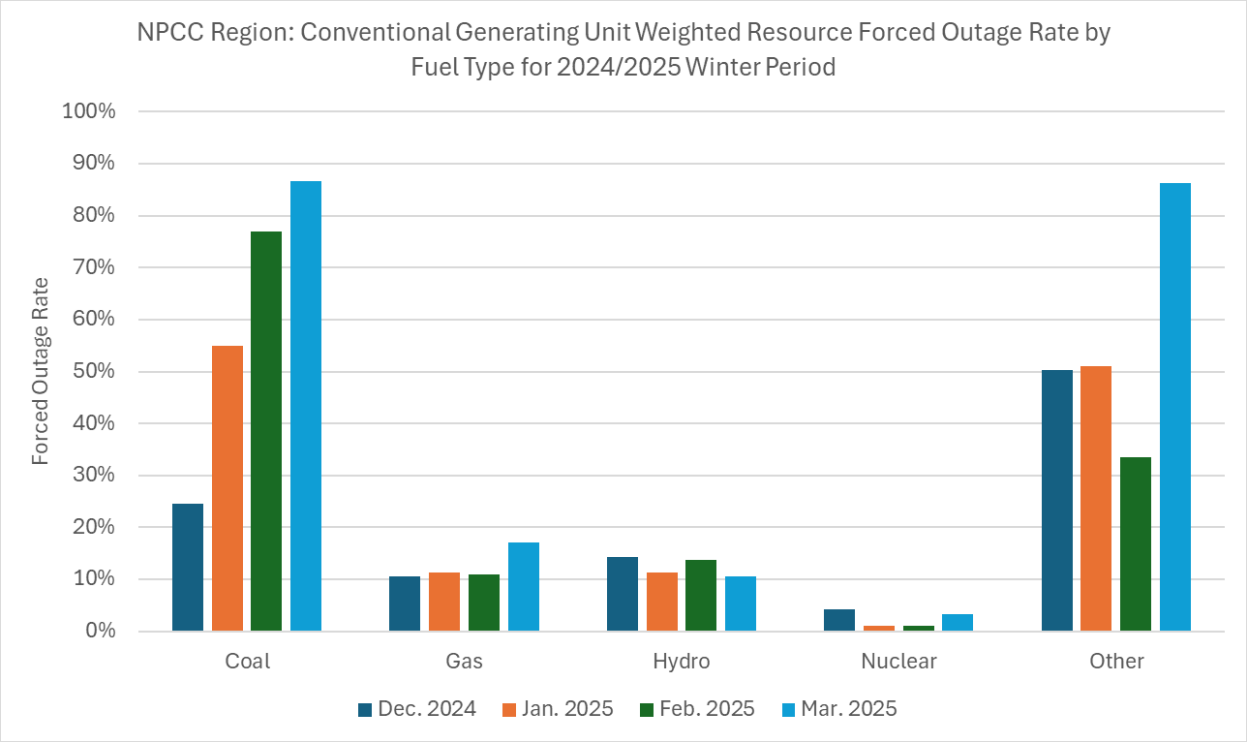


Figure B.42: NPCC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

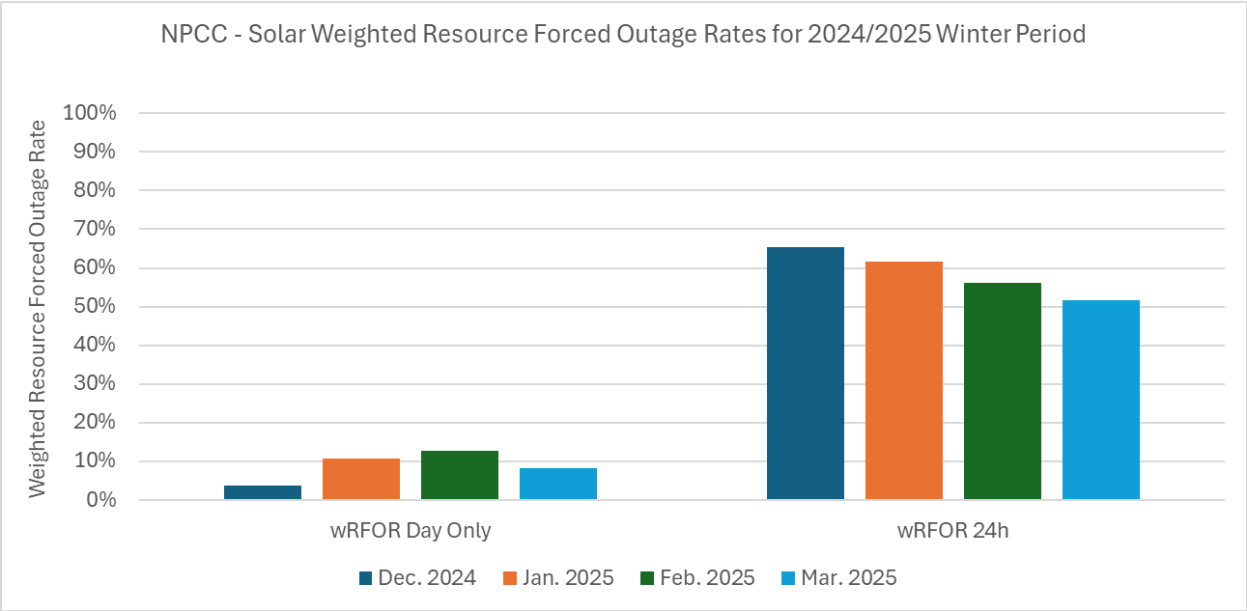


Figure B.43: NPCC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

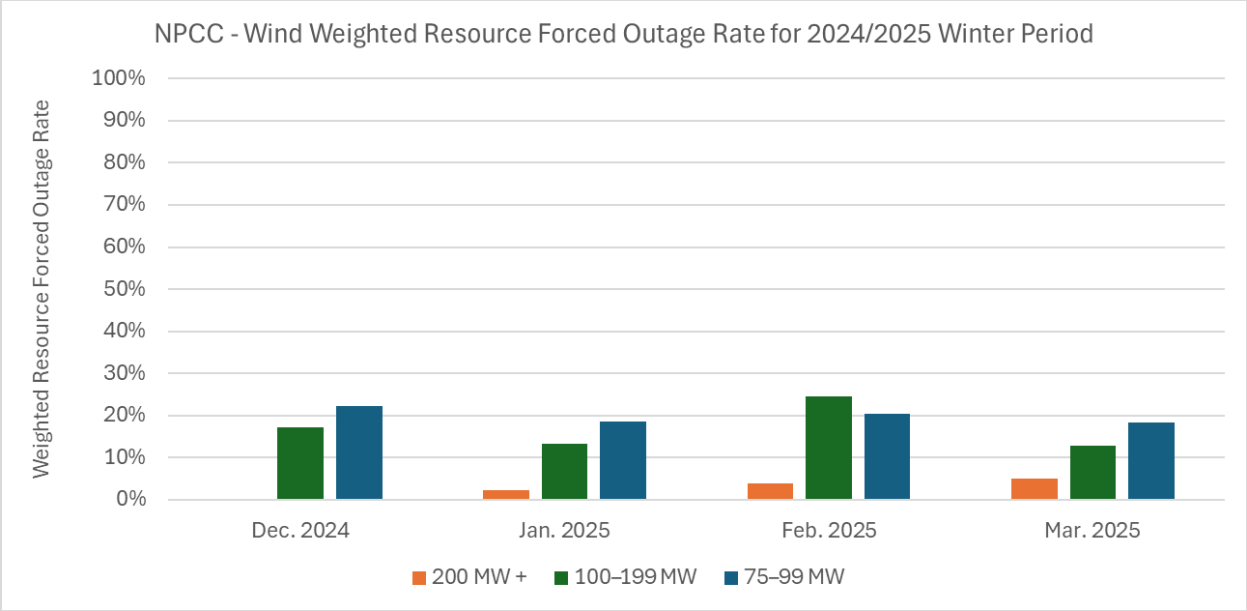


Figure B.44: NPCC Region: Weighted Equivalent Forced Outage Rate by Fuel Type - Wind

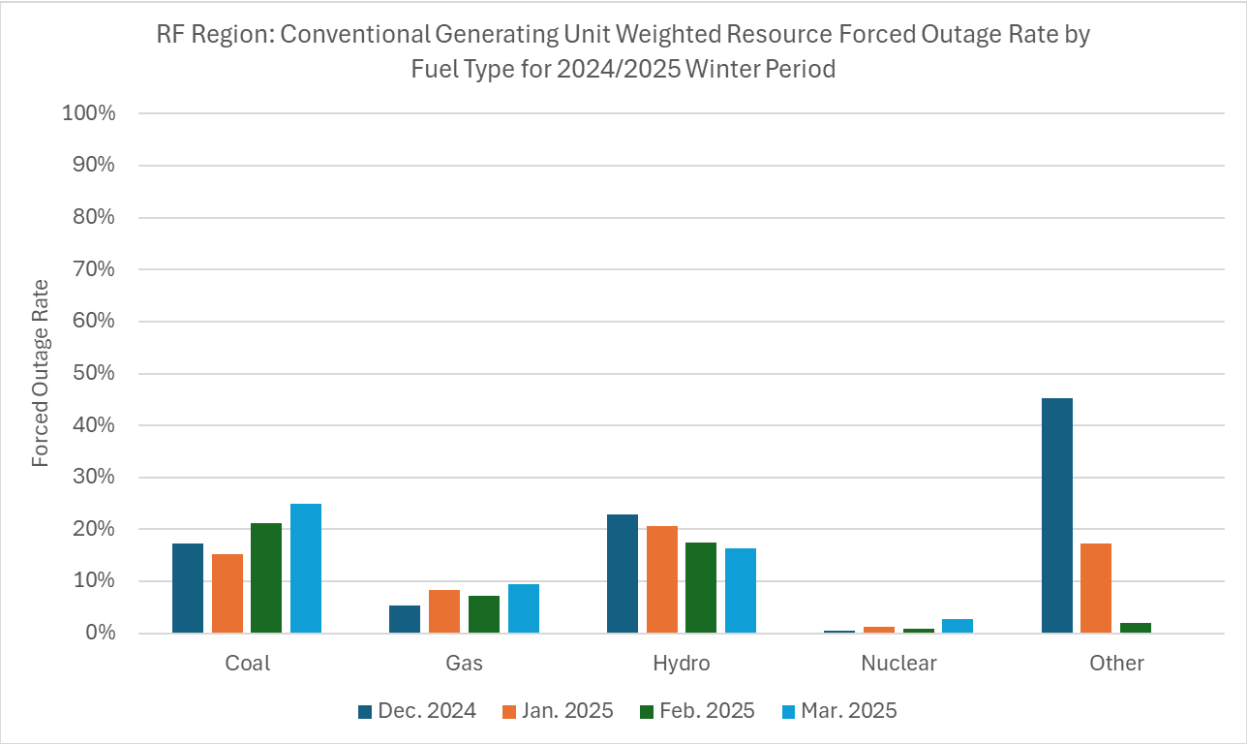


Figure B.45: RF Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

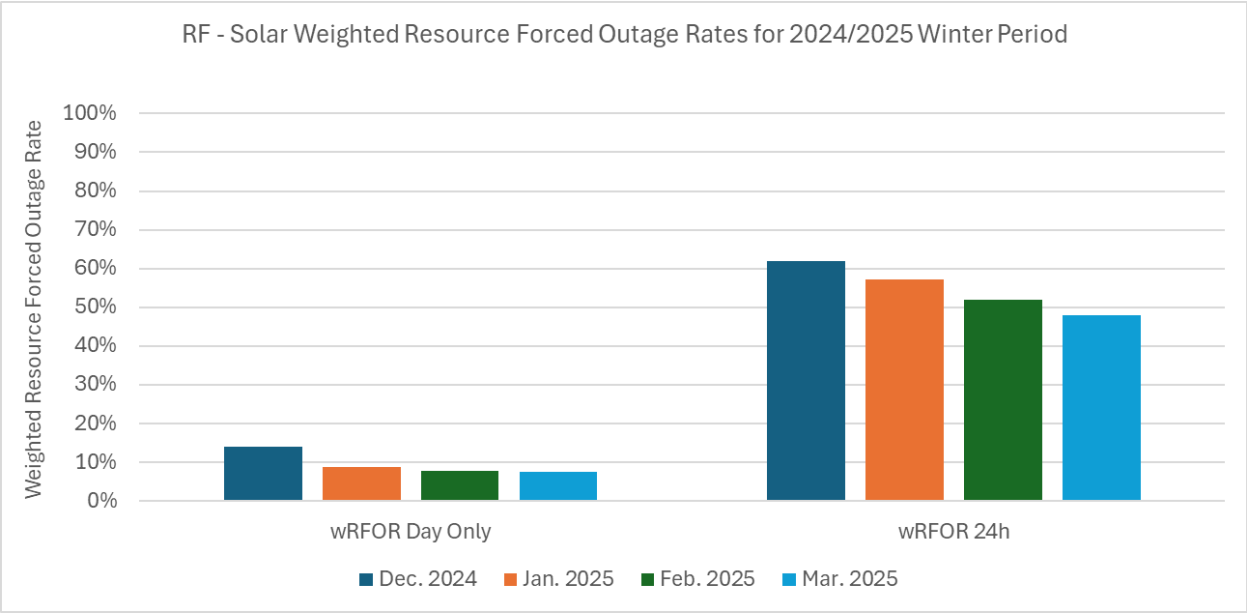


Figure B.46: RF Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

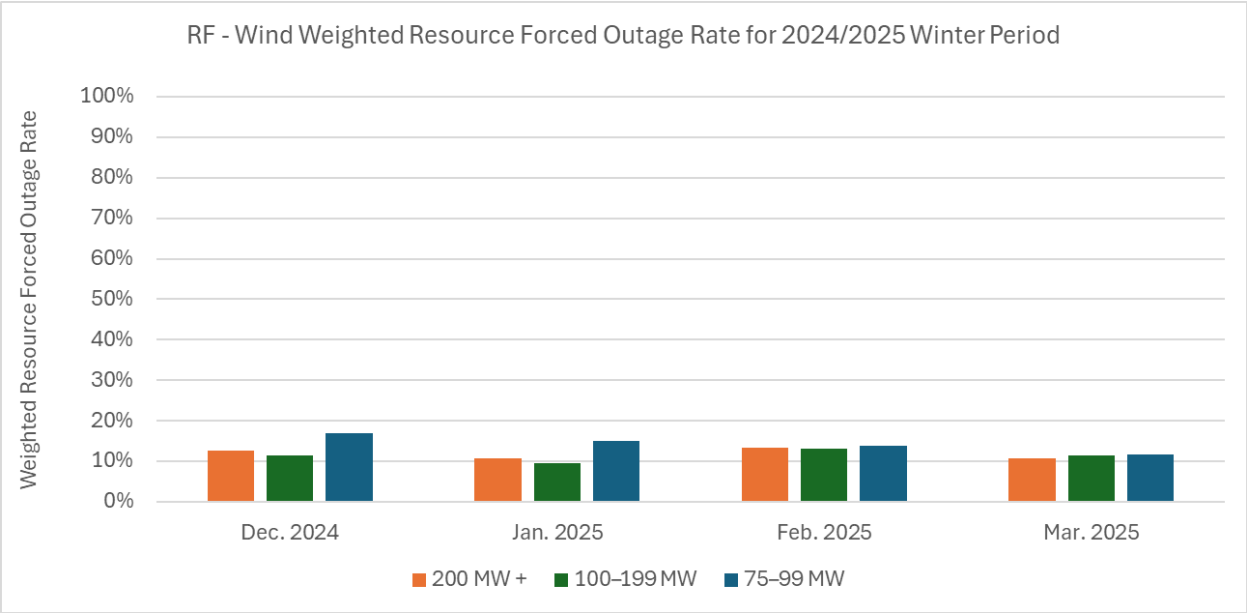


Figure B.47: RF Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Wind

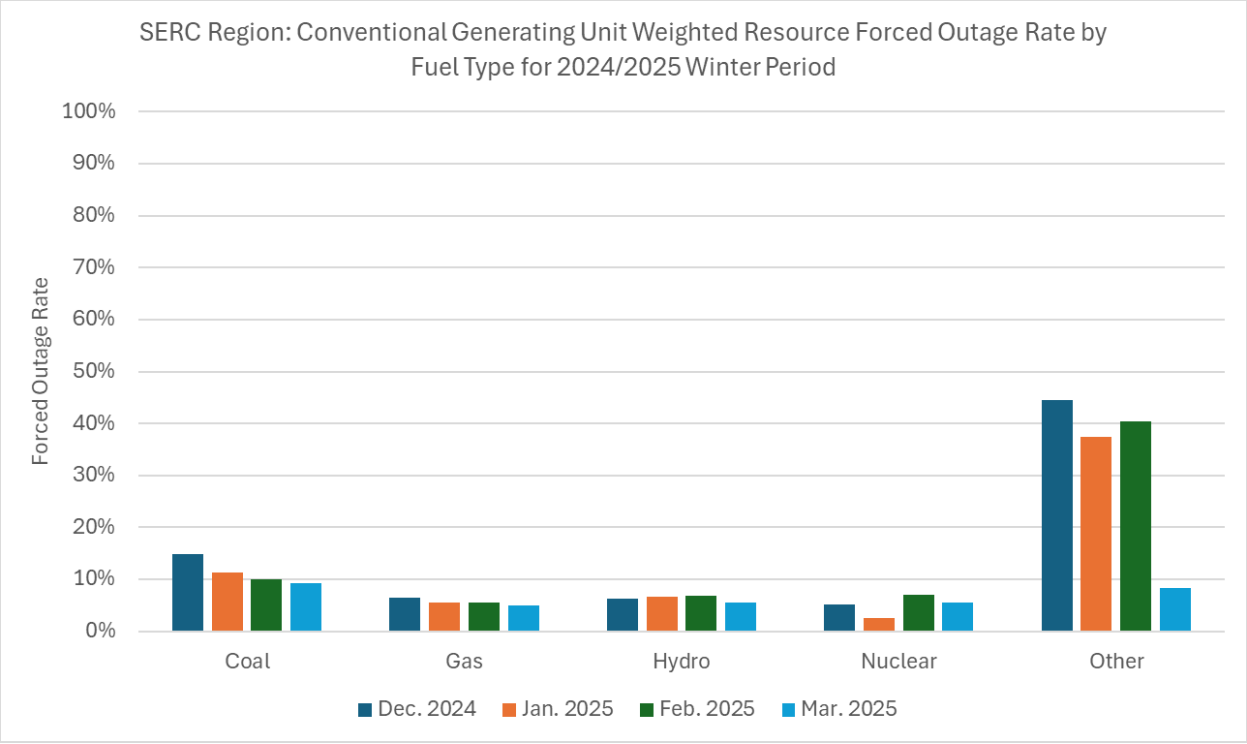


Figure B.48: SERC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

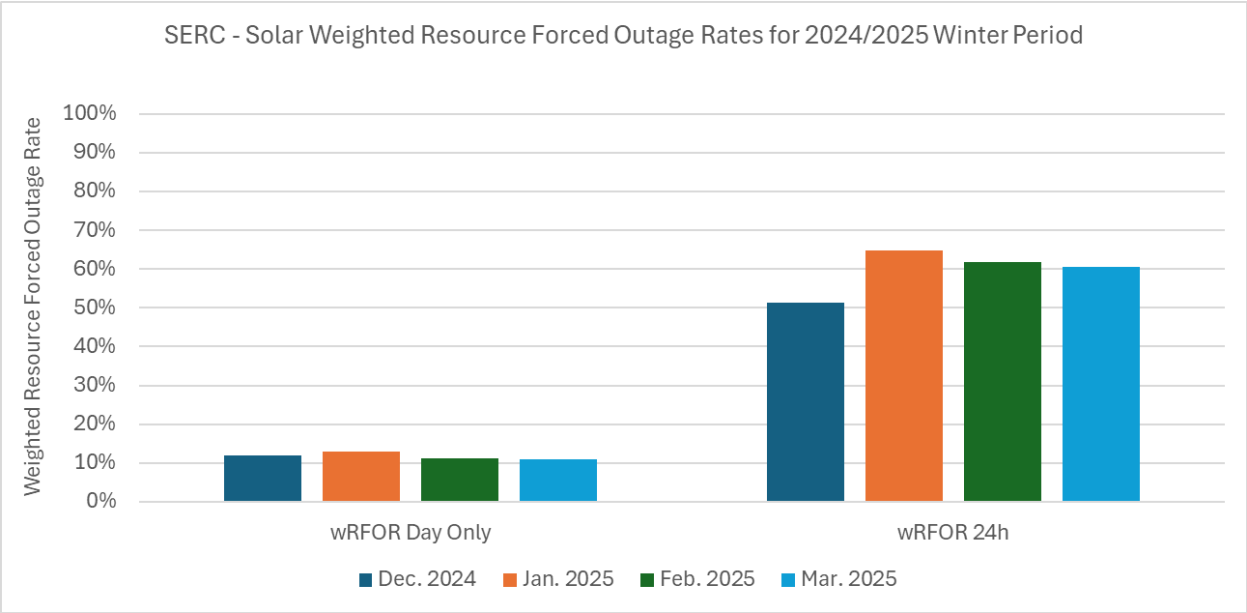


Figure B.49: SERC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

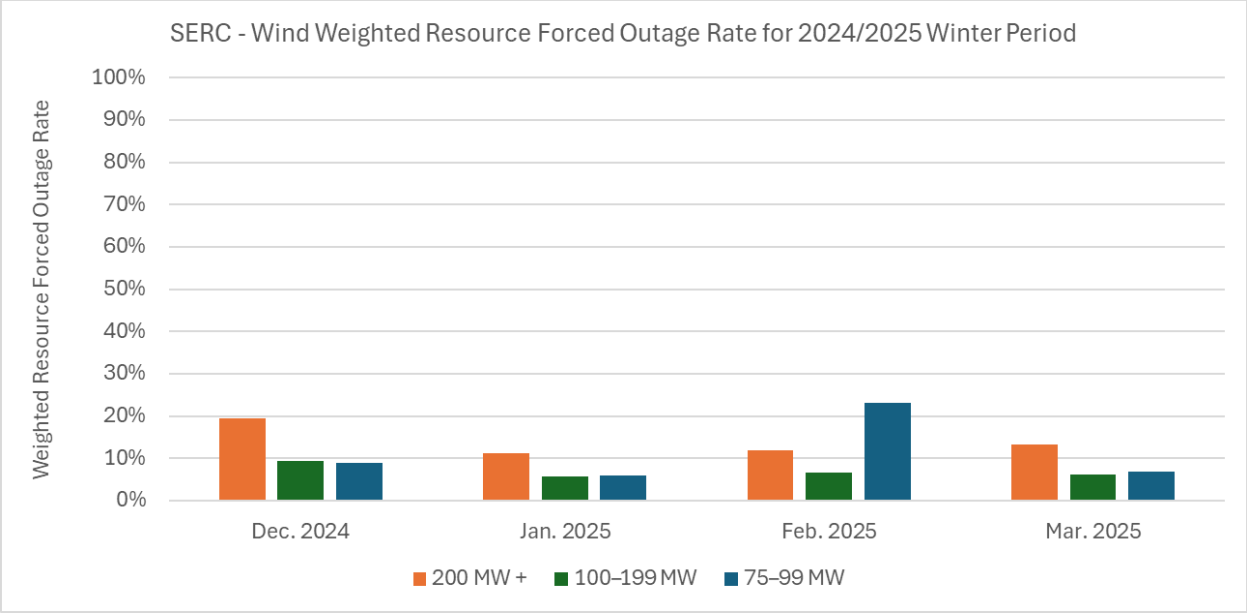


Figure B.50: SERC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Wind

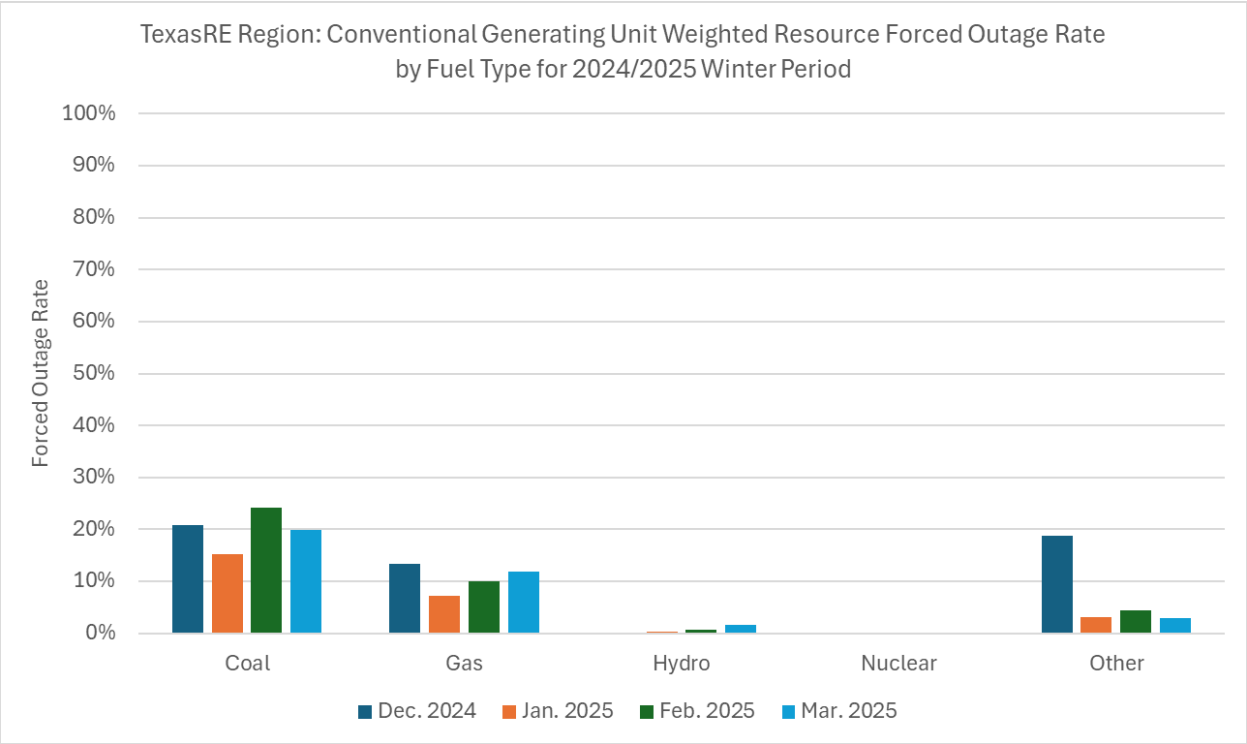


Figure B.51: Texas RE Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

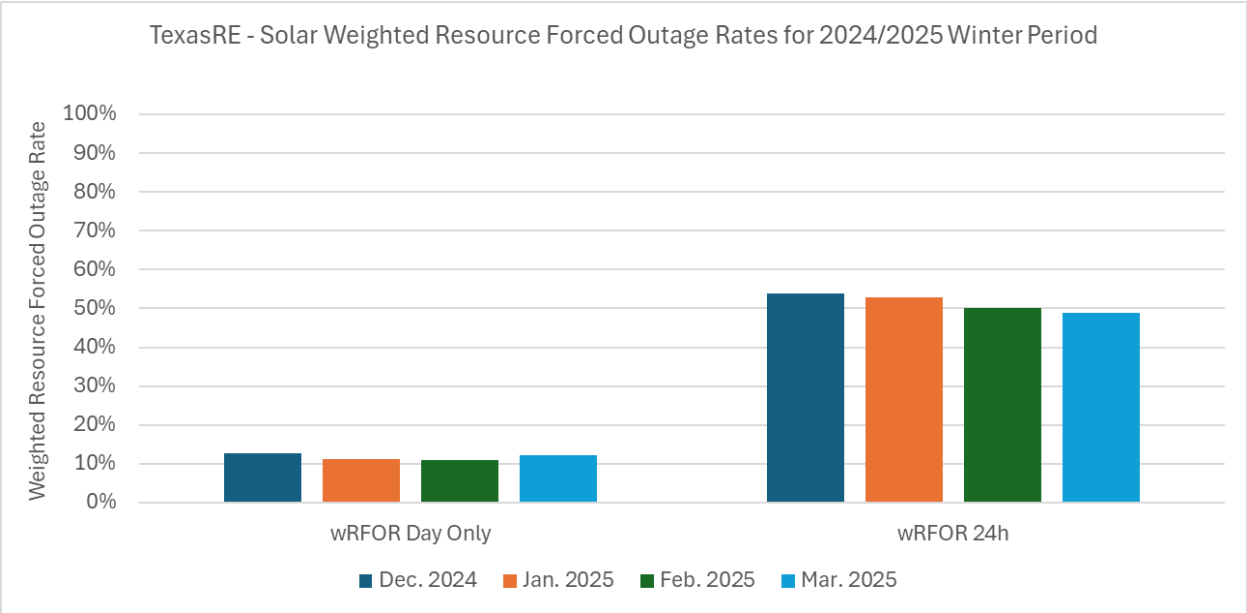


Figure B.52: Texas RE Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

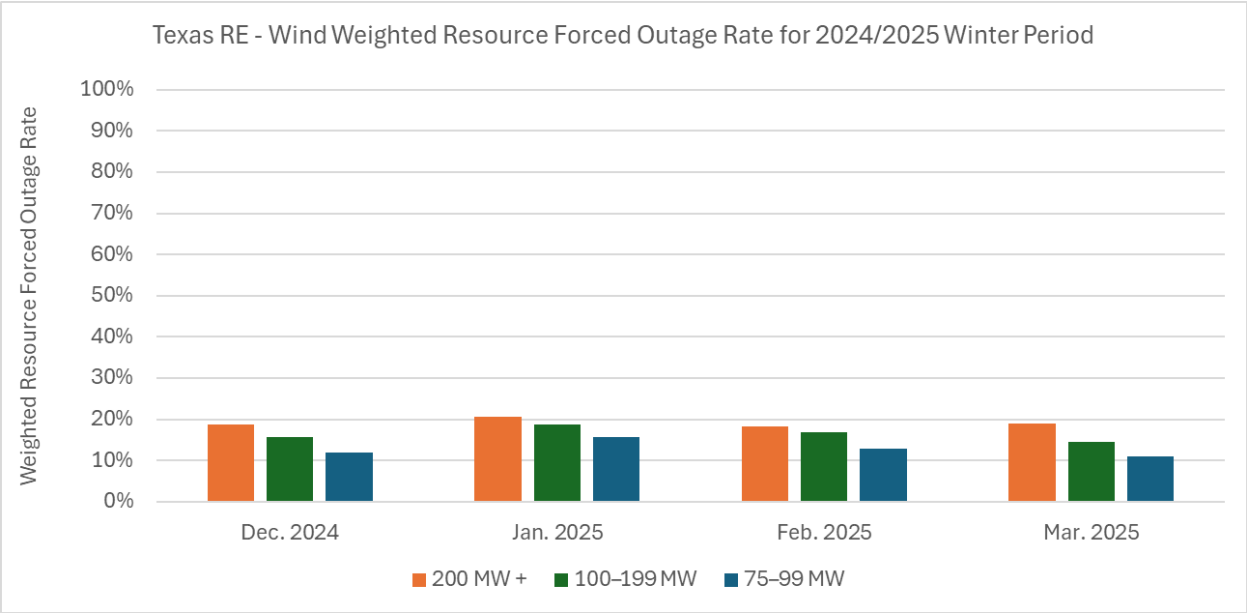


Figure B.53: Texas RE Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Wind

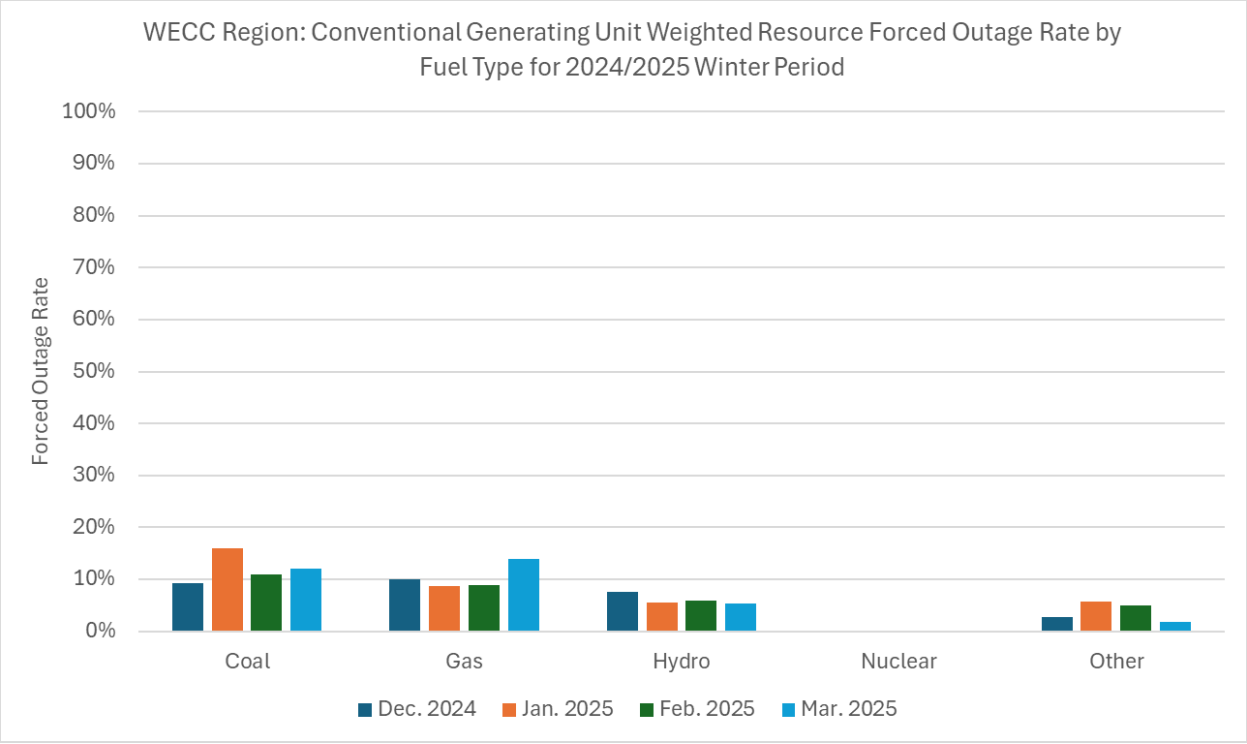


Figure B.54: WECC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Conventional Generating Units

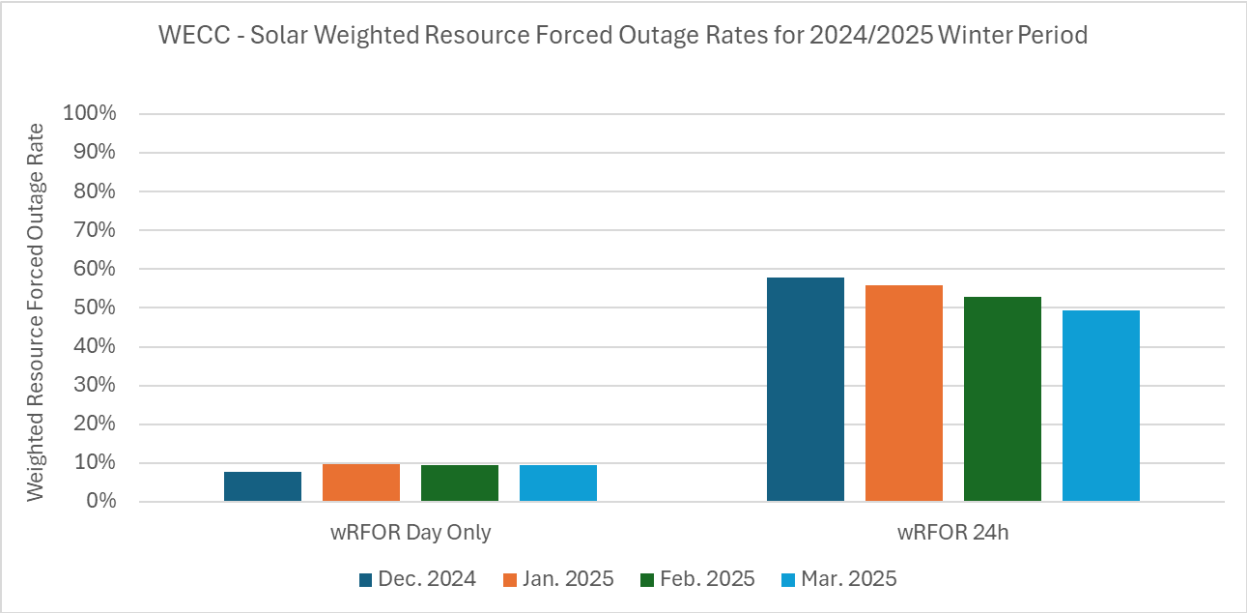


Figure B.55: WECC Region: Weighted Equivalent Forced Outage Rate by Fuel Type – Solar

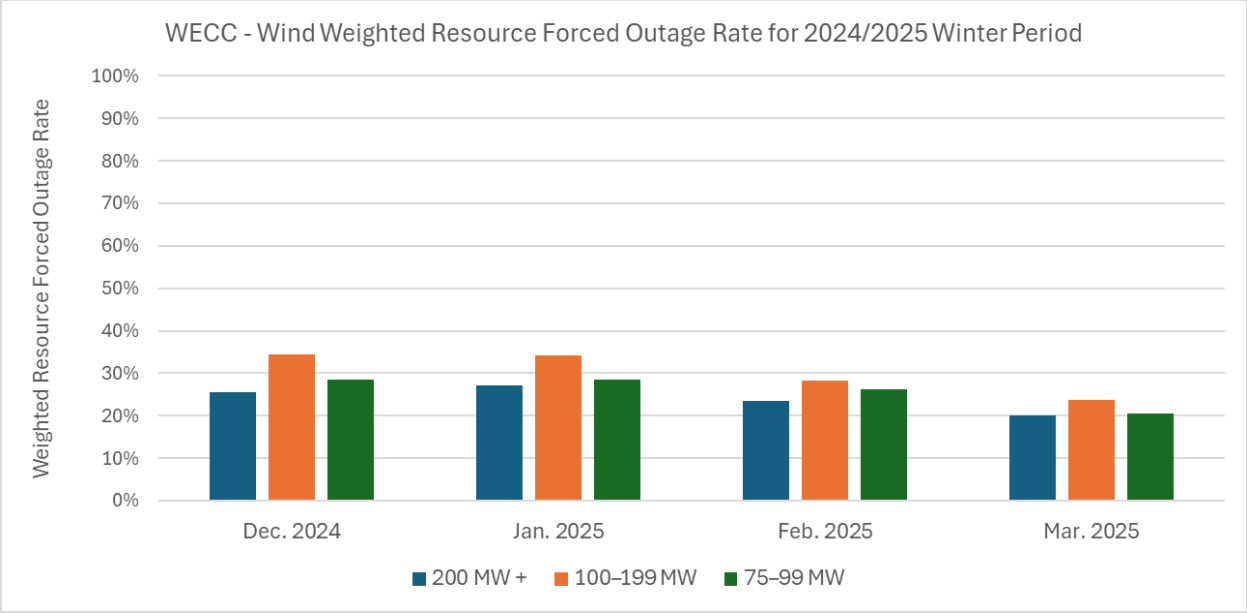


Figure B.56: WECC Region: Weighted Equivalent Forced Outage Rate by Fuel Type - Wind

Time Series of Capacity Reporting Forced Outages by Region

The following charts shows the daily changes in capacity reporting a forced outage event as a time series by region for all conventional units reporting to the GADS database during the winter 2024 – 2025 period (December 2025 – March 2025) covered by the Cold Weather Data Request. A detailed description of the format of the charts provided is included in Chapter 3 under the Time Series of Daily Forced Outage Capacity heading.

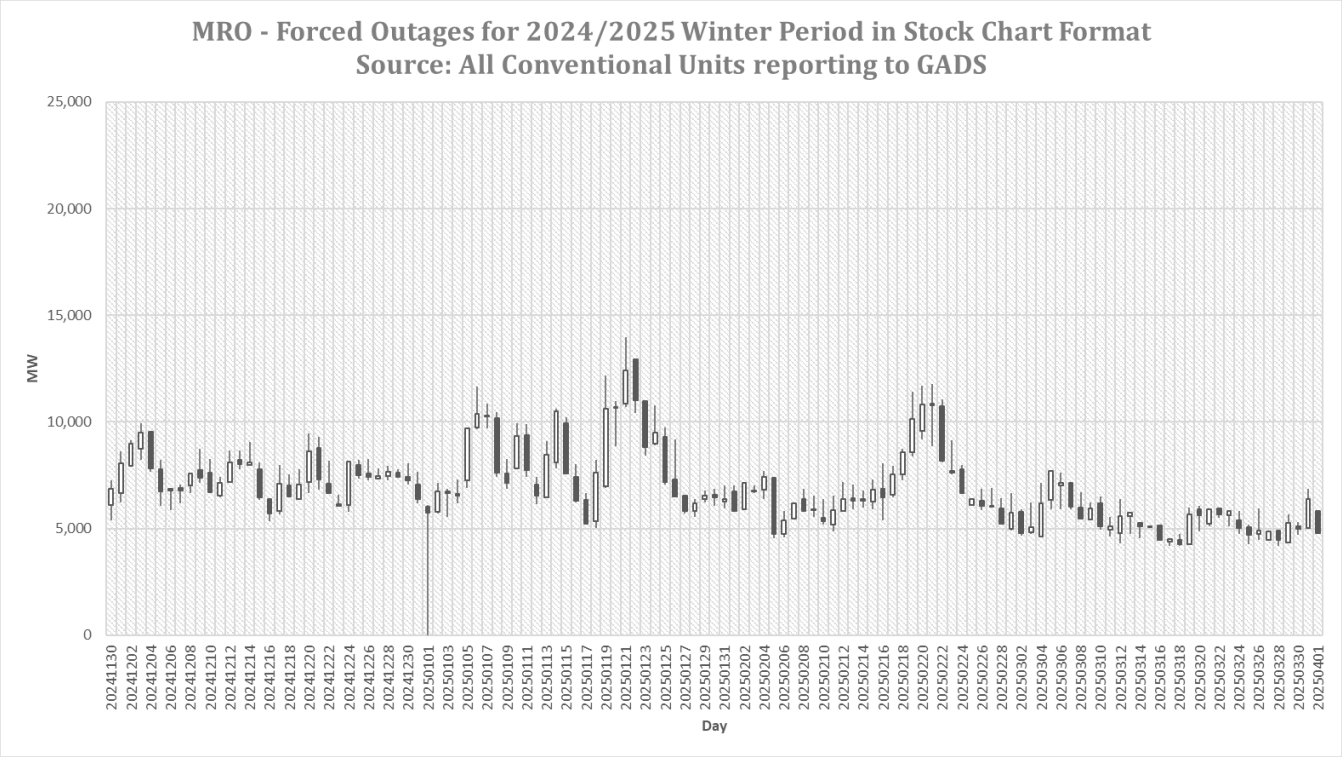


Figure B.57: MRO Region: Time Series of Capacity Reporting Forced Outages

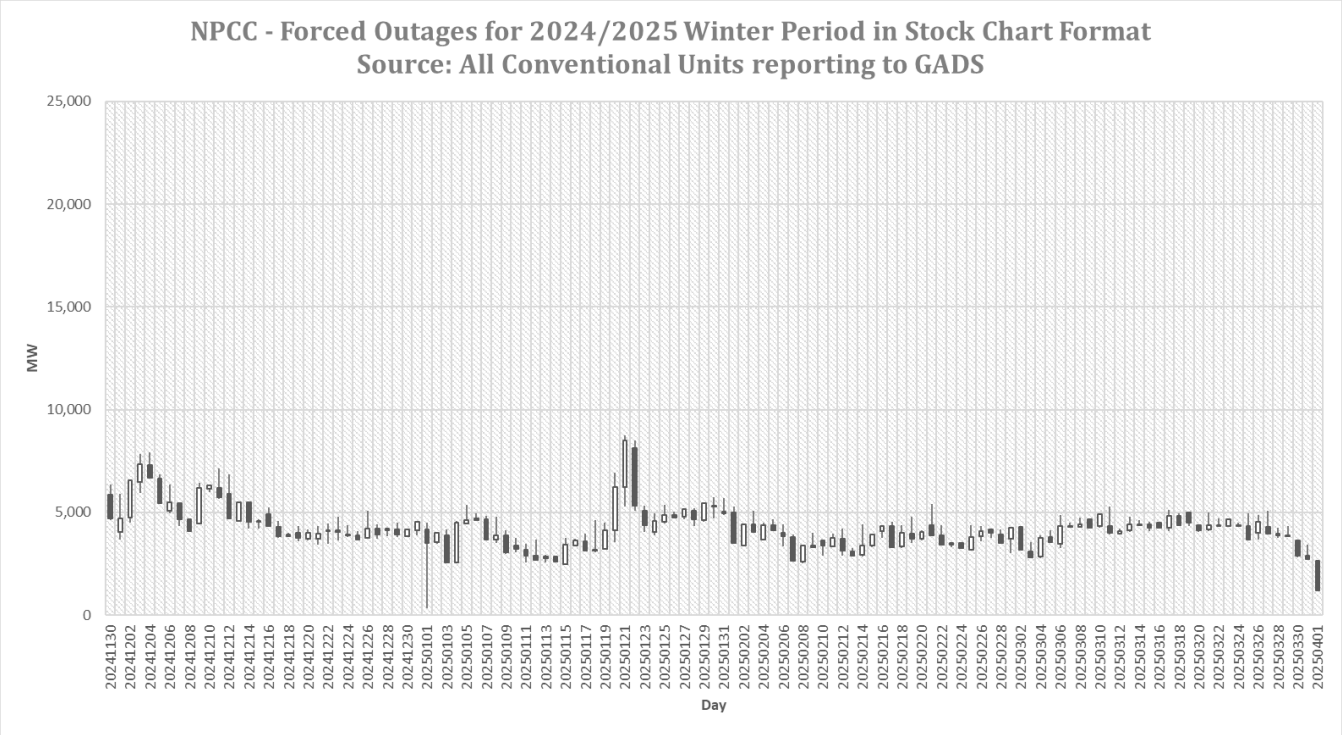


Figure B.58: NPCC Region: Time Series of Capacity Reporting Forced Outages

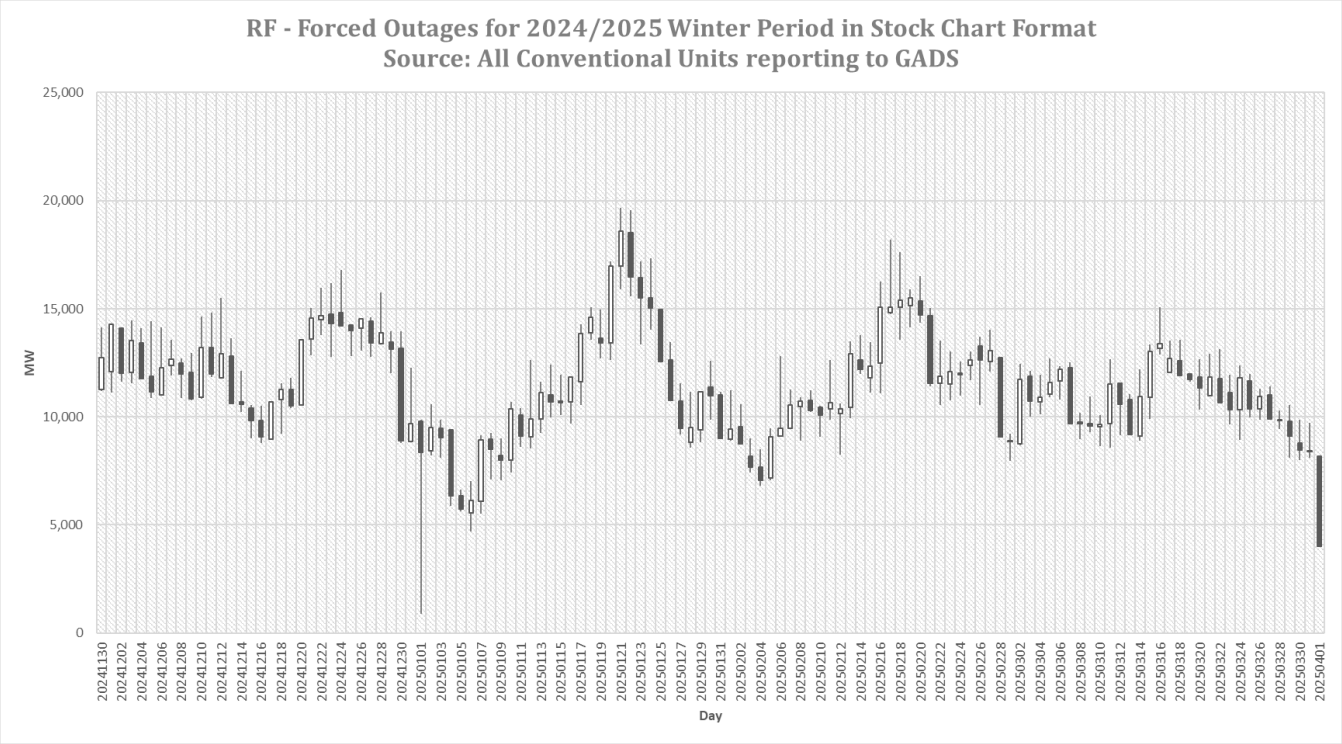


Figure B.59: RF Region: Time Series of Capacity Reporting Forced Outages

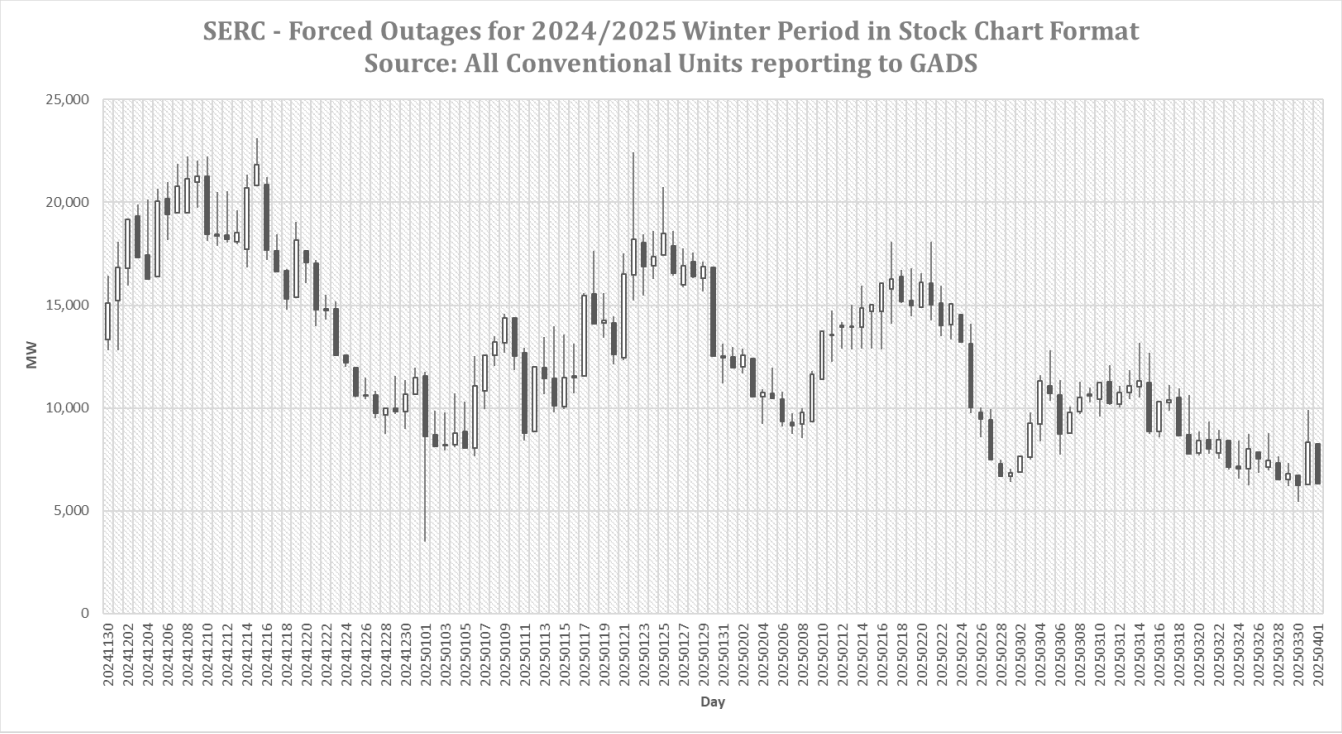


Figure B.60: SERC Region: Time Series of Capacity Reporting Forced Outages

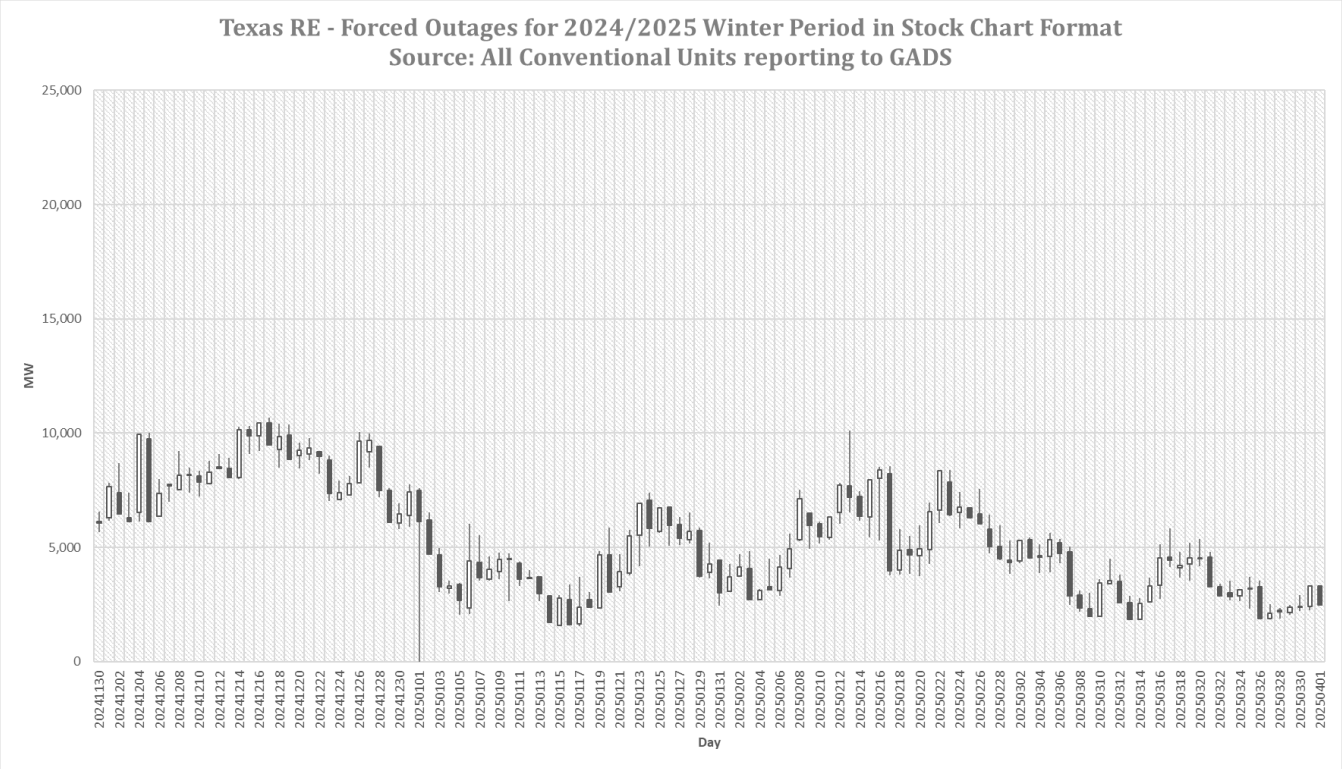


Figure B.61: Texas RE Region: Time Series of Capacity Reporting Forced Outages

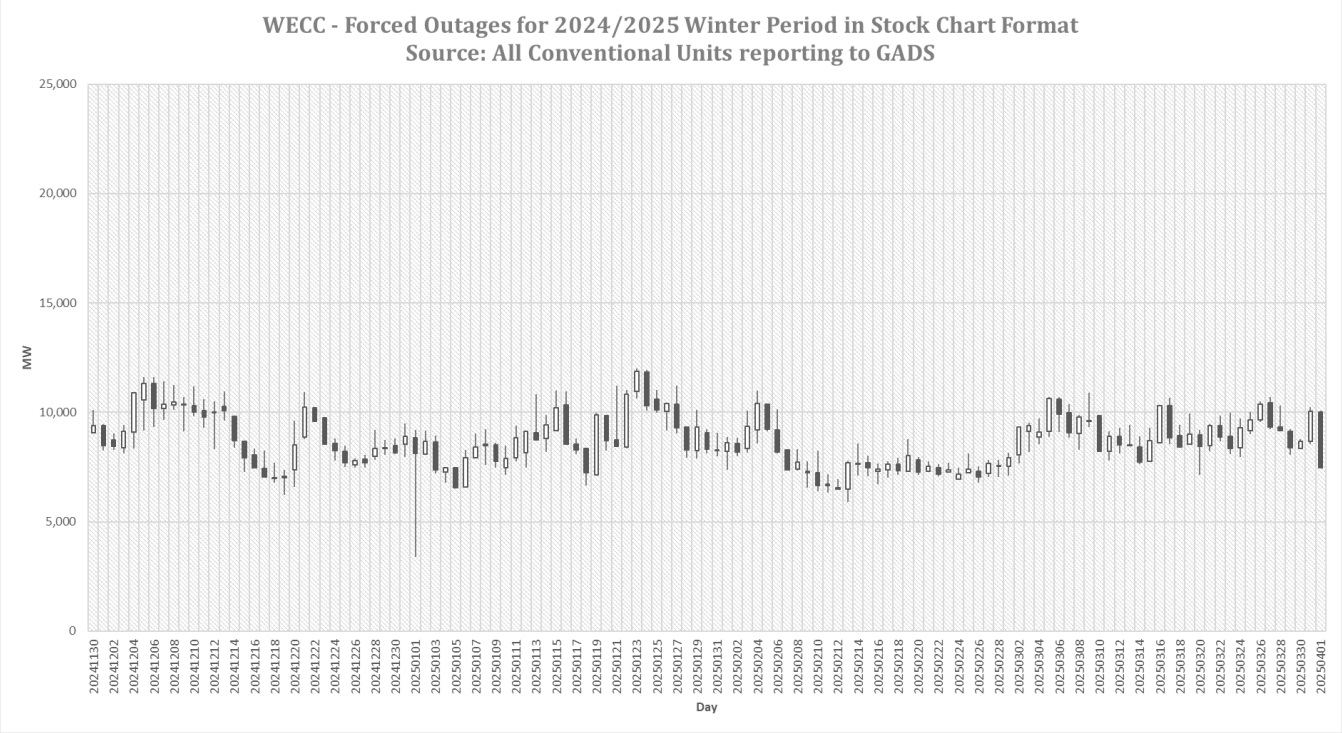


Figure B.62: WECC Region: Time Series of Capacity Reporting Forced Outages