CAR - Seasonal / Accreditation: Ambient Temperature Derates in New England

Impacts on the thermal fleet

Hannah Johlas

SENIOR ENERGY SECURITY ANALYST

CAR-SA: Ambient Temperature Derates in New England | WMPP ID: 185

- At the November MC, the ISO explained how further adjustments for ambient temperature would not be part of the CAR scope and that it plans to assess ambient temperature adjustments as part of its post-CAR roadmap
- Stakeholders requested additional information on the ambient temperature impacts on thermal fleet performance in New England
- Today's presentation provides some additional background and analyses which further support the decision to perform further assessments as part of the post-CAR effort

Today’s presentation

- Background
- Analysis 1: Third-party studies of thermal derates due to ambient temperatures
- Analysis 2: Capability audit (NX-12) data
- Analysis 3: Historical operational data
- Comparing results
- Implications for CAR
- Conclusion

Background

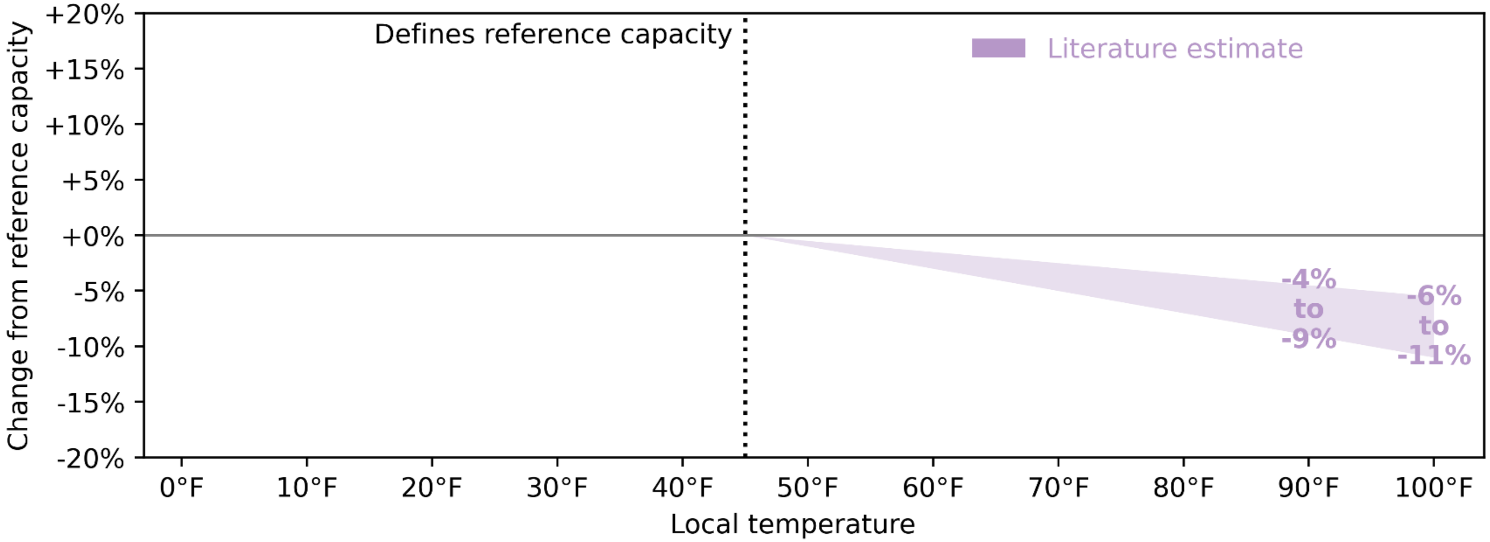
- Stakeholders have expressed interest in the extent to which ambient temperatures drive capacity derates in the thermal fleet
  - While questions have been asked for derates above certain temperatures, the core theme is a desire to understand the underlying dynamic
  - ***Specifically, how much does thermal fleet capacity decrease solely due to ambient temperature increases?***
- The ISO analyzed the issue from three different perspectives, using industry research and operational data
  - Focused on capability derates, not mechanical failures or fuel availability
  - Thermal units were defined as non-nuclear fossil units

Synopsis of Findings

- A mini-ensemble analysis shows a low impact of ambient temperatures on thermal units: 0.3% - 0.4% per degree, or only 3-4% between 90^0 F and 100^0 F
- Extreme heat events are still rare in New England, further reducing the impact of ambient temperature derates on an annual basis
- Modeling the impact of ambient temperatures would require significant additional ISO resources and time
- As explained at the November MC, and as further supported by these findings, the ISO is not proposing to include ambient temperature modeling in CCP 19 accreditation, but will perform further assessments as part of its post-CAR effort

Analysis 1: Third-party studies of thermal derates

- Oak Ridge National Laboratory[1] found linear reductions:
  - Combined cycles: 0.3-0.5% per 1°C rise
- California PUC[2] found linear reductions:
  - Combined cycles: 0.17% per 1°C rise
  - Combustion turbines: 0.21% per 1°C rise
- Converting to Fahrenheit: **0.1%-0.2% reduction per 1°F**
  - Even at an extreme 100°F, only 6-11% reduction from 45°F capability

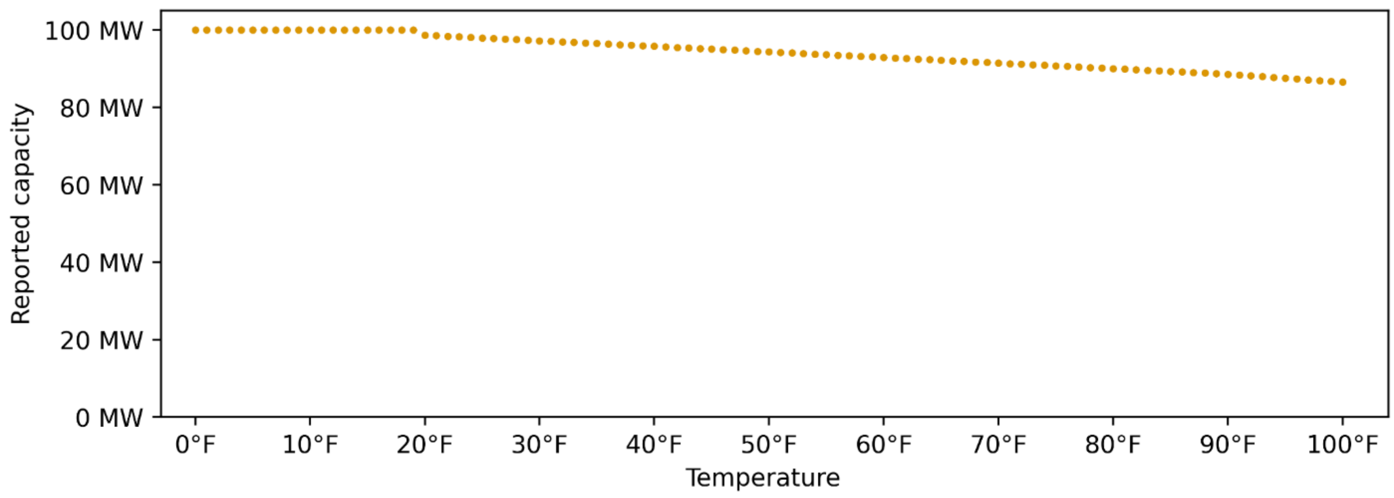


[1] Allen-Dumas, Binita, Cunliff (2019).
[2] Hansen (2023).

Analysis 2: Capacity audit data (NX-12)

- The ISO Claimed Capability Audit process requires detailed data from all units
  - NX-12 submissions give MW output from 0^{0} F to 100^{0} F in 1^{0} F increments
  - These values reflect the manufacturer-supplied relationship between ambient temperature and MW output

Sample Unit NX-12 Submission (masked)

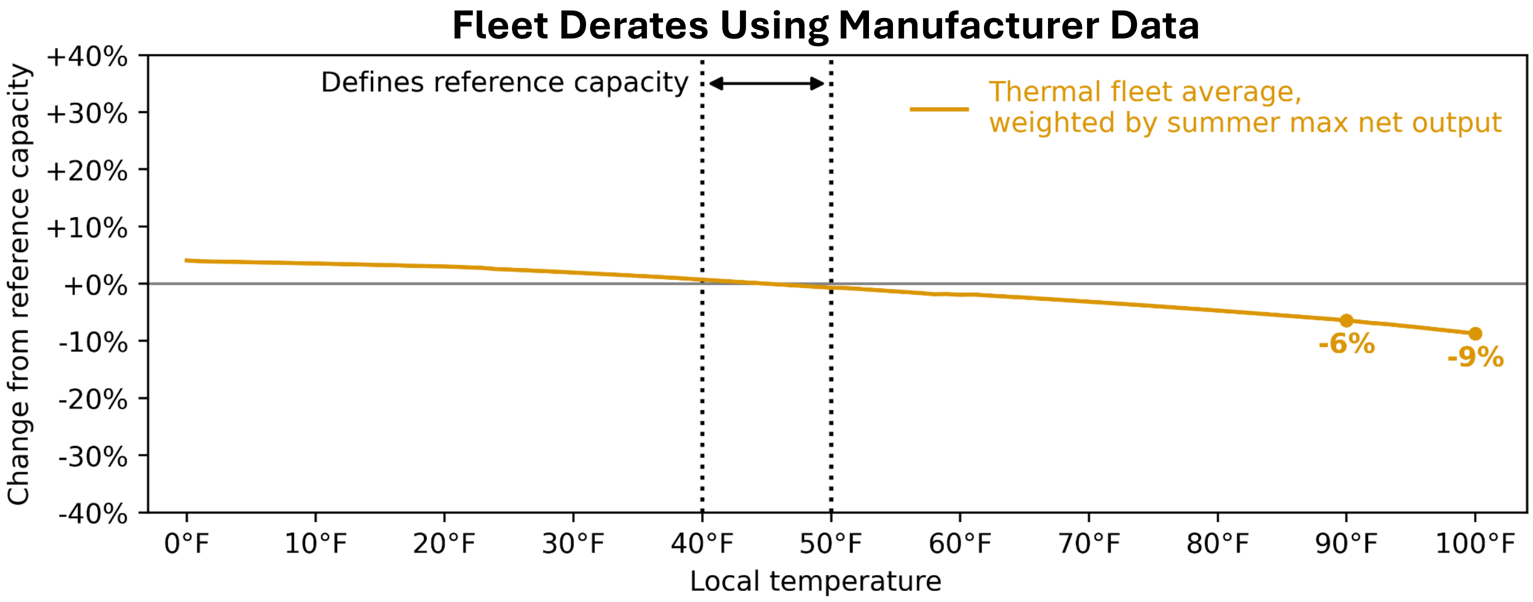


Analysis 2: Methodology

- A reference capacity was calculated for each thermal unit. This is its average NX-12 capacity between 40^0 and 50^0 F (baseline temperature)
- For each unit, its thermal derate can be expressed as a percentage change from reference capacity for every degree increase in ambient temperature
  - For example, if a unit averages 100 MW of output between 40^0 and 50^0, its reference capacity will be 100 MW
  - If its output drops 1 MW per degree and is 90 MW at 60^0 per the NX-12 data, its thermal derate will be 10% cumulatively at 60^0 or 1% per degree linearly
- Fleet thermal derate is similarly expressed as a percentage change from reference capacity per degree increase.
  - Specifically, fleet derate is the average of unit derates, weighted by unit size, to ensure compatibility with Analysis 3
  - Analysis 3 required this weighted average to account for the fact that not every unit had an offer for every temperature

Analysis 2: Results

- Thermal fleet average showed only a 6% cumulative derate at 90^{0} F and a 9% cumulative derate at 100^{0} F
- While the derate is nonlinear, it is only 0.3% per degree between 90^{0} F and 100^{0} F

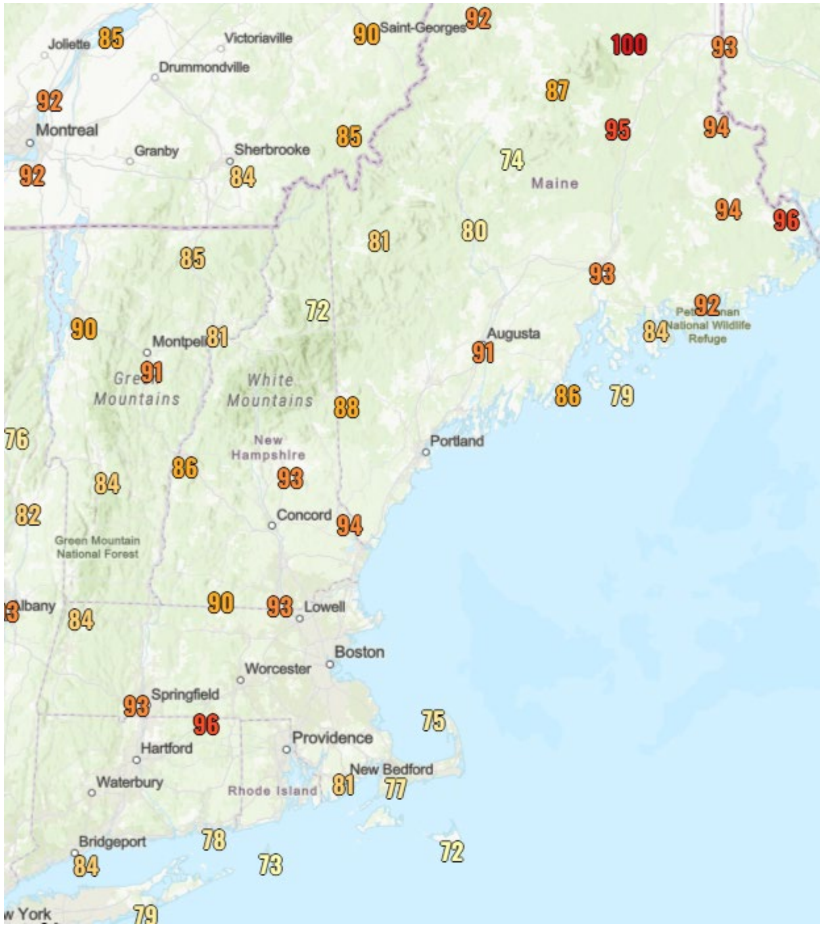


Analysis 3: Historical Operational Data

- We analyzed historical energy market offers (EcoMax) to understand thermal derates as a function of ambient temperatures
- For this analysis, we selected thermal units using the following criteria
  - Offers for the period 2019/01/01 through 2025/03/01
  - Commercially operational, i.e. not testing
  - Unit is online and available to respond to dispatch instructions
    - Excludes units providing voltage and frequency regulation
    - Excludes offline and unavailable units
    - Excludes offline but available to start units
      - At very high or low temperatures, units tend to be online and therefore are already captured
      - Failures to start or ramping, particularly for long-lead units, could skew data
      - Units which expect to be offline do not consistently update their offered EcoMax based on temperature alone
      - Offline thermal units' output can be challenging for participants to estimate when the unit is not already online
    - Additional filters to exclude non-temperature effects

Analysis 3: Calculating ambient temperatures

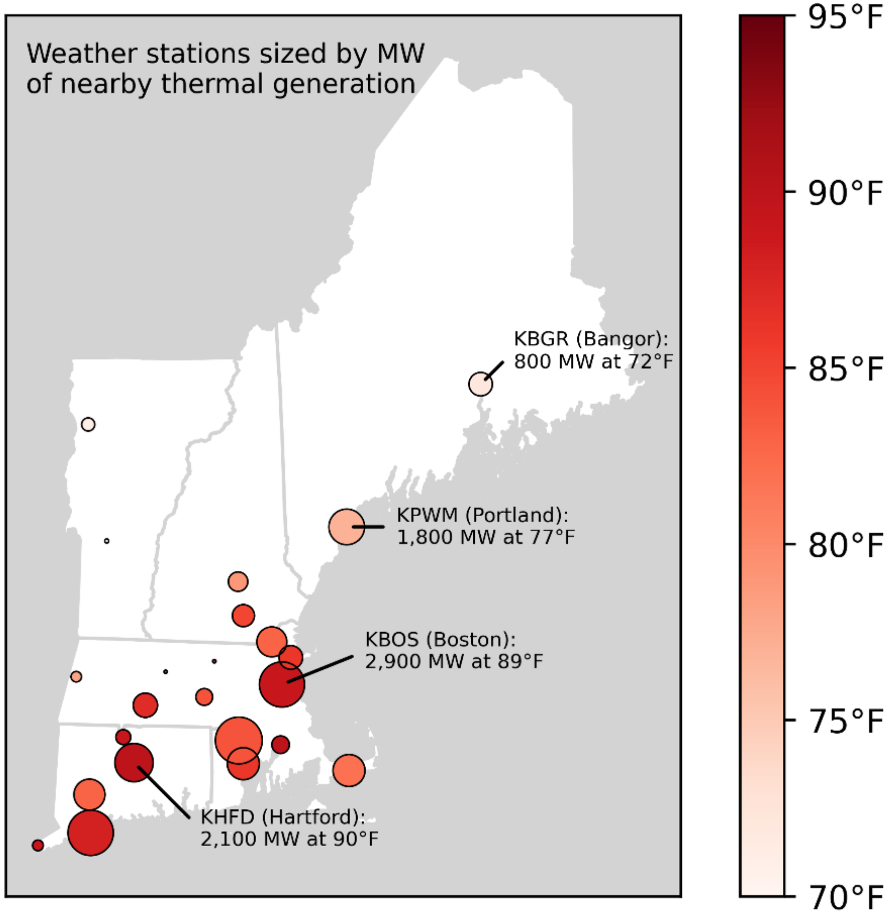
- Note that New England temperatures are widely dispersed, as is the generating fleet. There is no single “100 degree day” across the region
- Since ambient temperatures are inherently local, the local temperature was used for each unit



Analysis 3: Controlling for spatial variation

- Temperature variation means ambient temperatures for some units are 20^0 lower than others
- Some units may only see 75^0 while others are experiencing 90^0 – but both sets of units could be offering at the same moment in time. Therefore, the sample of units offering at 100^0 is smaller than the sample offering at 70^0
- To address this variation in temperatures across the fleet, we calculated fleet derates as the average of unit derates, weighted by unit size
  - We spot checked offers at extreme temperatures to validate this approach

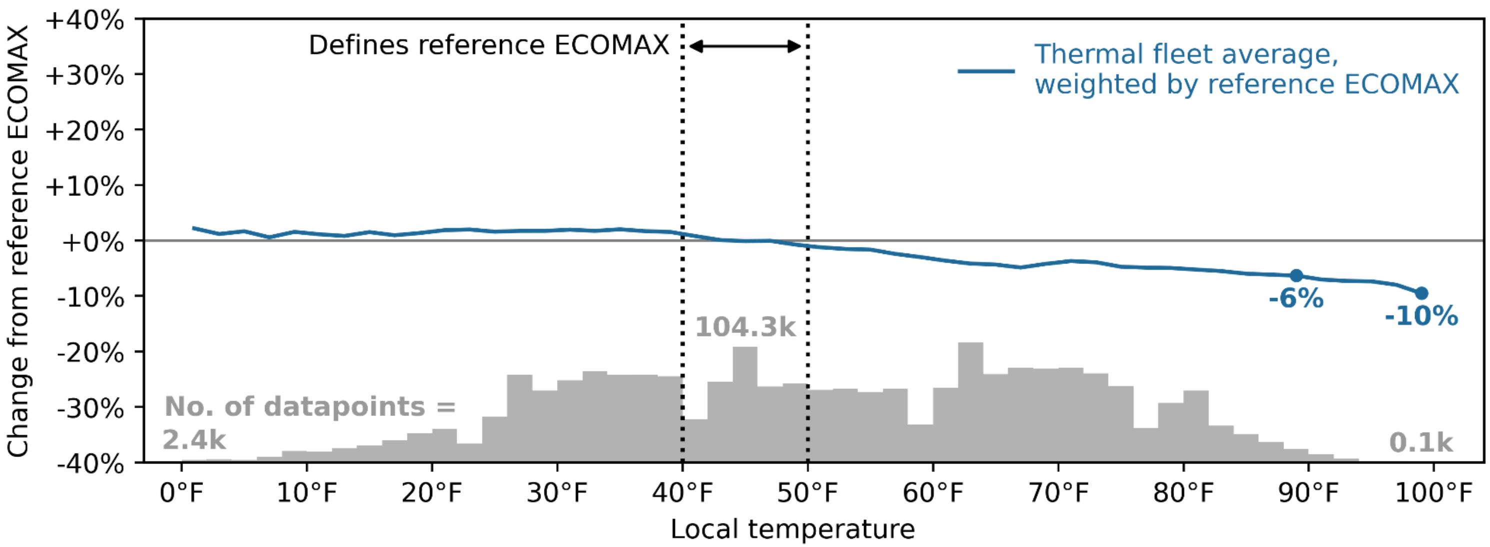
Local Temperatures for an Example Hour



Analysis 3: Results

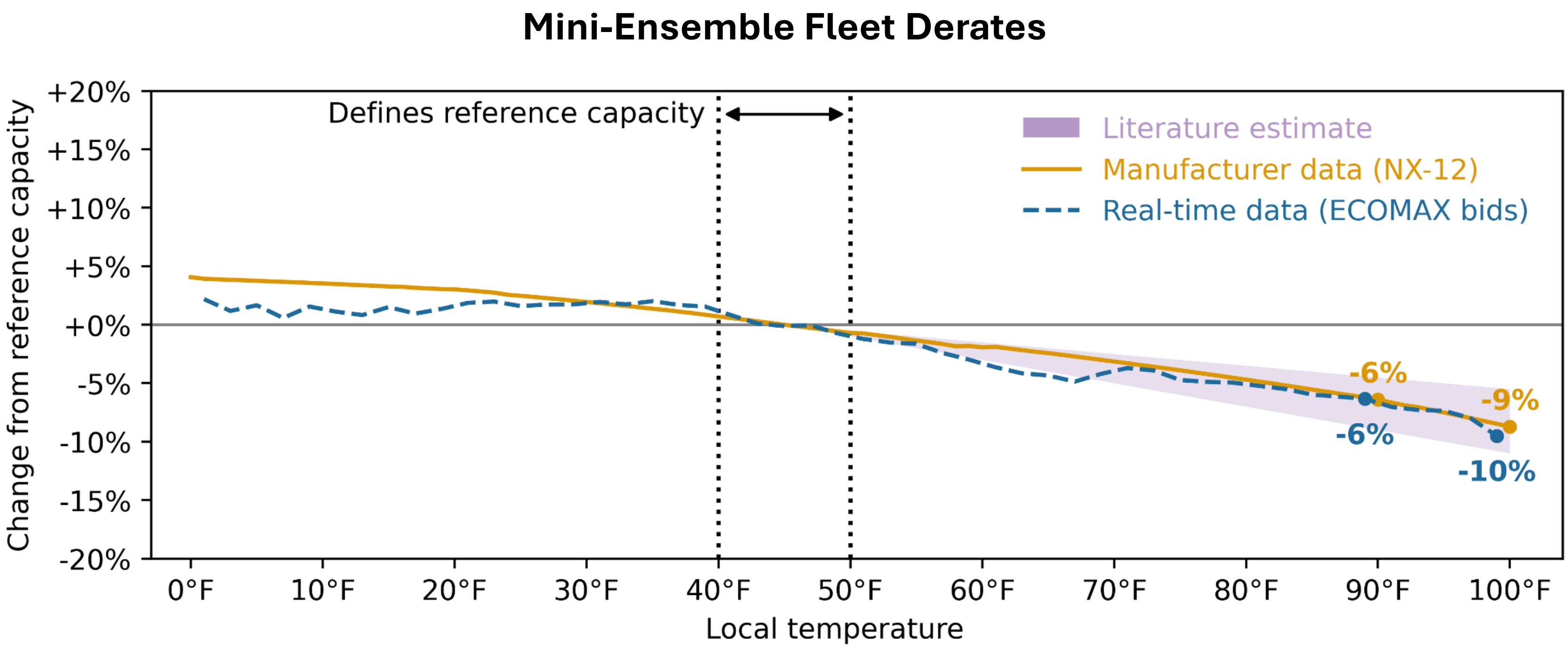
- Thermal fleet average showed only a 6% cumulative derate at 90^0 and a 10% cumulative derate at 100^0
- While the derate is nonlinear, it is only 0.4% per degree between 90^0 and 100^0
- This is consistent with the manufacturer data from Analysis 2
- Spot checks on specific hours revealed EcoMax MW offers consistent with this analysis. For example, on 2021/06/29 at 1:00pm, when the (average) New England ambient temperature was 93^0, the offered thermal fleet EcoMax was 5% lower than the reference EcoMax

Fleet Derates Using Historical Data



Combining the Results

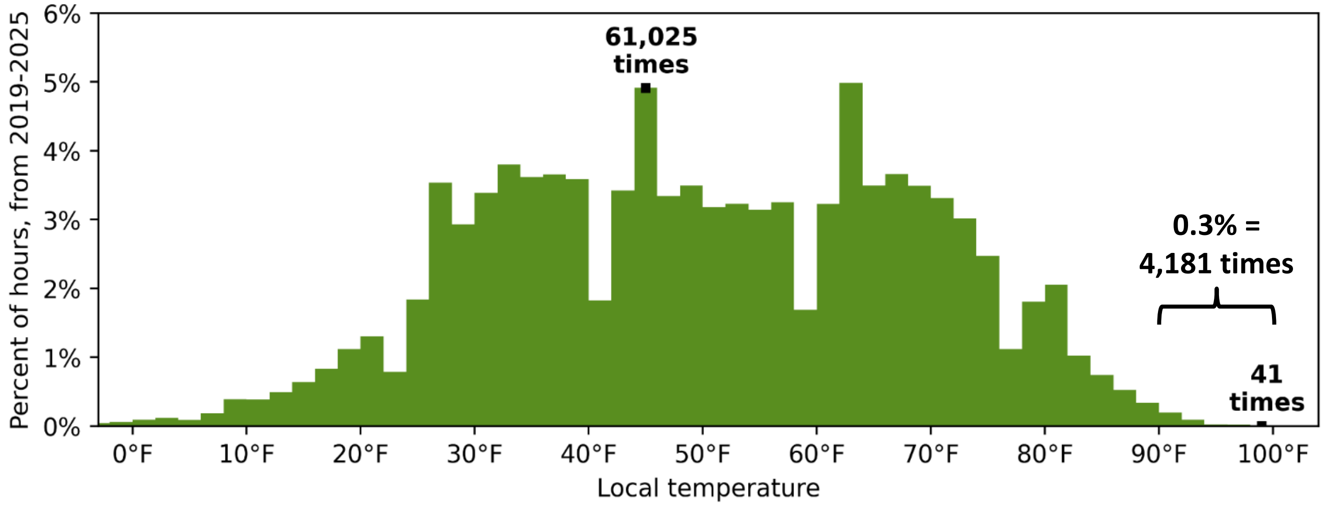
- For comparison purposes, we show the results from the 3 different methods below
- All 3 analyses show the drop in thermal fleet output between 90^0 and 100^0F ambient temperatures is 3-4% or 0.3%-0.4% per degree
- These are relatively small impacts – and the winter impacts are smaller still



Implications for CAR

- The incremental decrease in thermal fleet output is low: 0.3% - 0.4% per degree between 90 ^{0} and 100 ^{0}
- The occurrence of above-90^0 temperatures is still rare in New England
  - While that may change in the future, our focus is on a Prompt auction in 3 years
- This further supports the decision to perform further assessments as part of the post-CAR efforts as discussed at the November MC

Local Temperatures: 1/2019 – 2/2025



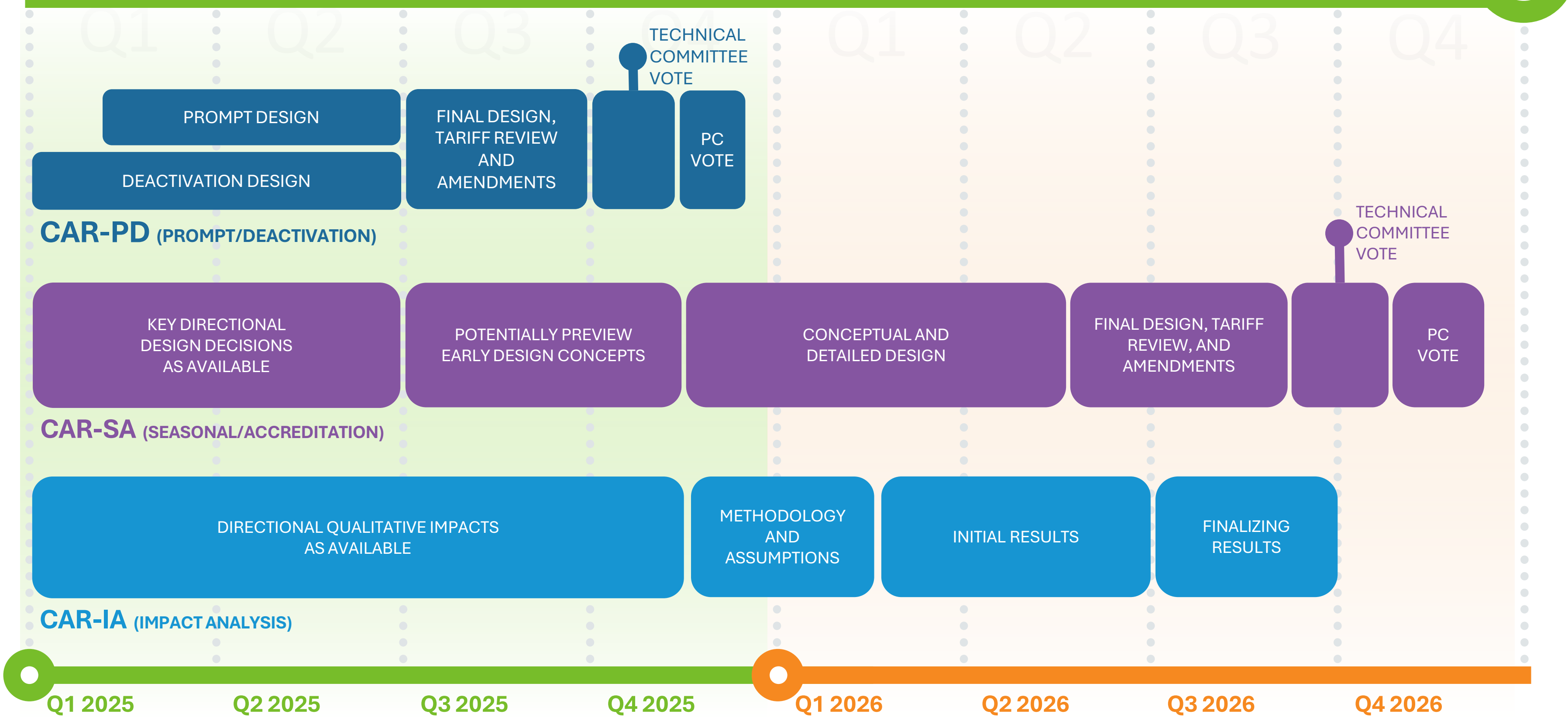
Conclusions

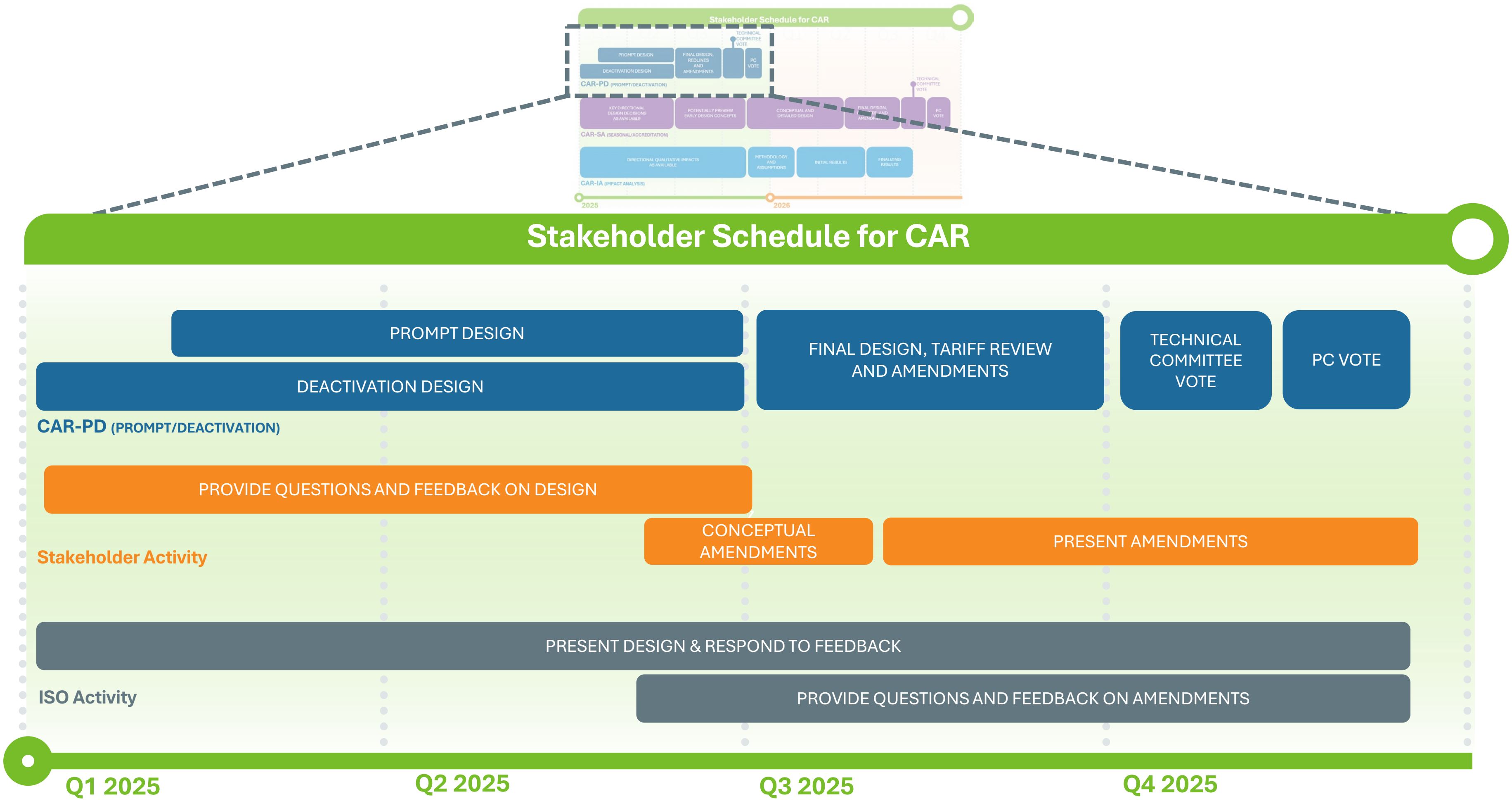
- A mini-ensemble analysis shows a low impact of ambient temperatures on thermal units (0.3% - 0.4% per degree between 90^0 F and 100^0 F)
- Extreme region-wide heat is still rare in New England, further reducing the impact on an annual basis
- Modeling the impact of ambient temperatures would require significant additional ISO resources and time
- As explained at the November MC, and as further supported by these findings, the ISO is not proposing to include ambient temperature modeling in CCP 19 accreditation, but will perform further assessments as part of its post-CAR effort

Questions

STAKEHOLDER SCHEDULE

Stakeholder Schedule for CAR




Stakeholder Schedule for CAR
PROMPT DESIGN
DEACTIVATION DESIGN
FINAL DESIGN, TARIFF REVIEW AND AMENDMENTS
TECHNICAL COMMITTEE VOTE
PC VOTE
CAR-PD (PROMPT/DEACTIVATION)
PROVIDE QUESTIONS AND FEEDBACK ON DESIGN
CONCEPTUAL AMENDMENTS
PRESENT AMENDMENTS
Stakeholder Activity
PRESENT DESIGN & RESPOND TO FEEDBACK
ISO Activity
PROVIDE QUESTIONS AND FEEDBACK ON AMENDMENTS
Q1 2025
Q2 2025
Q3 2025
Q4 2025

CAR-Prompt Topic Schedule

The list below provides a preliminary projection of when committee discussions will begin on the following CAR-Prompt topics:

Prompt Topic	Projected Start of Committee Discussions
Price Formation and Offer Formation	March 2025
Non-Commercial Participation	March 2025
Auction Design and Structure	March 2025
Activity Schedule Overview	March 2025
ICR Process	April 2025
Market Power and Mitigation	April 2025
Capacity Interconnection Service	May 2025
Resource Qualification Criteria & Process	May 2025
Activity Schedule Details	May 2025
Resource Auditing, Financial Assurance, Settlements, CSO Trading Activities	June 2025

CAR-Deactivation Topic Schedule

The list below provides a projection of when committee discussions will begin on topics related to the deactivation framework:

Deactivation Topic	Projected Start of Committee Discussions
Introduction and notification timeframe	January 2025
Additional design details on notifications and information release	February 2025
Reliability reviews	March 2025
Market power evaluation framework	March 2025
Market power evaluations detail	April 2025
Follow-ups and additional design details	May 2025
Introduce Tariff Changes	June 2025