Synapse/MA Clean Peak Council Analysis Update

Overview of Methodology

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Purpose & Steps

Synapse is conducting a MA fleetwide analysis to determine (a) the amount of generation likely to come from peaker power plants in a future year of interest (e.g., 2050) and (b) the quantity of resources that could reliably replace this quantity and address additional peaking needs due to electrification.

Step 1
Relate peaker dispatch to Massachusetts load

Step 2
Develop hourly load forecasts, with electrification aligned with MA state policy

Step 3
Estimate peaker generation in a future year

Step 4
Develop replacement solutions

Detail on Steps

Step 1

Relate peaker dispatch to Massachusetts load

- Using historical hourly data for 2021-2023, Synapse will develop a relationship between hourly demand for electricity in Massachusetts and peaker dispatch.
- Relies on data from EPA's hourly *AMP dataset* and ISO New England's *VER dataset*.
- Key assumption: The amount of demand met by peakers in future years maintains the same relationship as in the past.

Step 2

Develop hourly load forecasts

- Project load inclusive of electric vehicles, heat pumps, conventional load, energy efficiency, and distributed solar.
- Started with ISO 2024 load forecast and adjusted to be consistent with MA state policy (as described in subsequent slides)
- Use ISO New England's *VER dataset* and internal Synapse tools to develop hourly load impacts for each component, across 24 years of varying weather. This allows us to test the solution package in periods of both extreme heat and cold.

Detail on Steps (cont'd)

Step 3

Estimate peaker generation in a future year of interest

- Combine the results of Step 1 and Step 2 to estimate peaker generation in a future year of interest.
- Since the future year of interest is after the mid-2030s, the peak will be the winter.
- This quantity describes the amount of generation that comes from resources that have historically acted like peakers.

Step 4

Develop replacement solutions

- Use ISO New England's VER data and to-be-determined optimization algorithm to determine how many MW of resources would be needed to replace the generation estimated to be provided by peakers.
- Report on metrics such as quantity of generation replaced for the entire year, as well as during peak periods.

Peaker Definition

- Aligning with the definition of peaker used in the ETAB process, to the extent possible.
- In our analysis, “peaker” refers to any unit at any power plant in Massachusetts that is in EPA’s hourly AMP dataset (i.e., is emitting and >25 MW) with a capacity factor of 15% or lower, in calendar years 2021, 2022, or 2023. These power plants are almost entirely powered by fossil fuels (some may use biomass or landfill gas).
    - The major difference is the exclusion of 16 small peaker plants, for which we have no hourly operational data. These plants represent 2% of peaker capacity with weighted average capacity factors of 2%.
- Analysis will characterize resources to replace existing peakers as well as additional resources needed to serve new peak load due to electrification. We assume the amount of demand met by peakers in future years maintains the same relationship as in the past.
- Our analysis looks at peaker generation in aggregate, and assumes all peaker generation is equally replaceable (provided adequate replacement generation is available in the same hour).
- We have some site-specific information about each of the existing peakers (where they are, how big they are, when they operate, demographics of surrounding communities), but no information regarding specific grid constraints by site.

Forecasting Consistent with MA State Policy

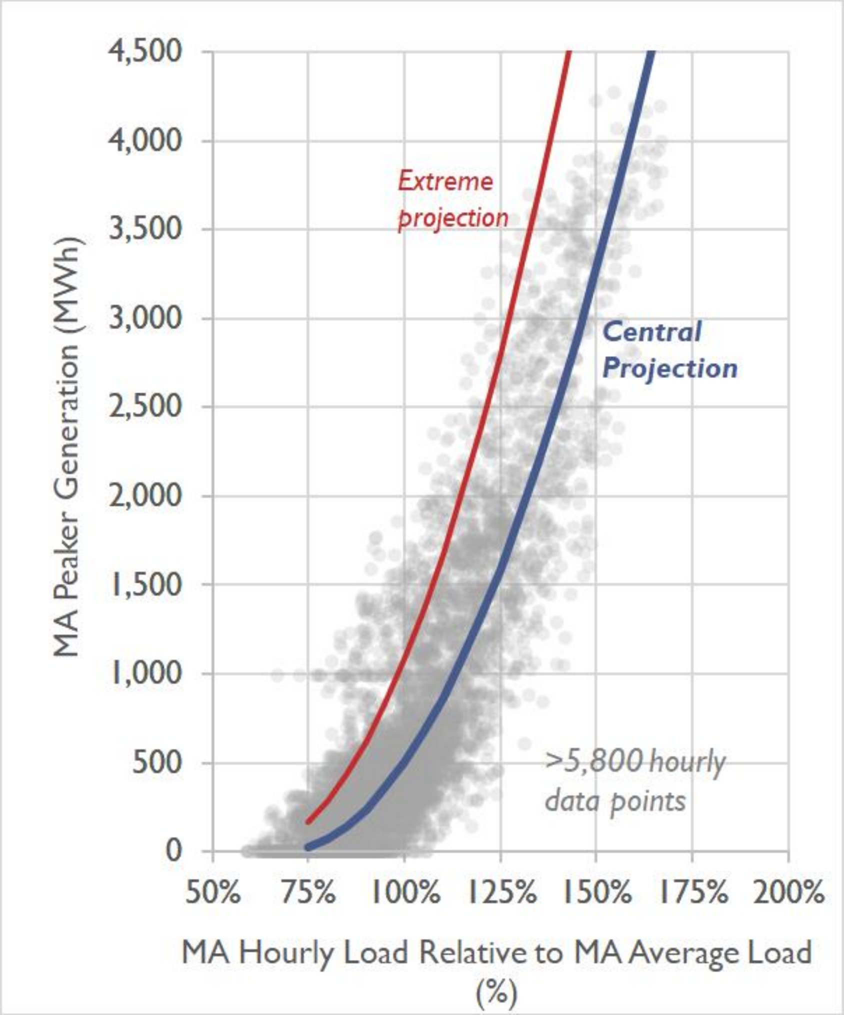
Synapse is adjusting the ISO 2024 Load Forecast in the following ways:

1. Building electrification – Clean Heat Standard
   - Draft framework released, draft regulations to be released soon (Spring 2025), final regulations to be released in Fall 2025
   - Draft framework includes 90 percent full replacements, 10 percent partial replacements (with fossil backup)
2. Vehicle electrification – Modeling EVs of all types
   - Based on ISO New England's 2024 forecast: assumes that 100% of light-duty vehicles are EVs by mid-2040s.
   - Other vehicle types (e.g., buses, heavy-duty vehicles) follow slightly faster or slower adoption trajectories.
3. Energy efficiency
   - Assumes that EE measures continue to persist into the future, but are installed at a slower rate as (a) EE measures become standardized as part of the conventional load forecast and (b) the MA three-year plan switches its main focus to heat pumps.
4. Behind the meter solar
   - Assumes that the SMART program continues to drive BTM solar adoption at similar rates through 2040.

In combination, all these assumptions lead to high winter peaks.

Relationship Between Load and Peaker Generation

Massachusetts hourly electricity load vs. Massachusetts generation from peaker plants, Summer Day hours



- We divide the year into four standard periods, each of which has its own strong relationship between electricity demand and peaker operation:
  - The four periods are summer Day, Summer Night, Winter Day, and Winter Night. This is a standard division of seasons and periods, used in other studies in New England
  - Summer = June through September
  - Winter = All other months
  - Day = Hours ending in 8 through 23
  - Night = All other hours
- For each set of hours, we develop a Central and Extreme projection that describes the relationship between statewide electricity demand and peaker generation.
  - Central = A regression fitting the median set of data points
  - Extreme = A shifted central regression to encompass all but the top 10% of hours.
  - These allow us to explore the most likely situation as well as the most extreme situation.

Peaker Replacement Options

We are modeling these peaker replacement options:

- Demand-Side Resources (energy efficiency, demand response, EVs with vehicle-to-grid capabilities)
- Distributed Energy Resources (behind-the-meter solar, virtual power plants)
- Energy Generation (onshore wind, offshore wind, utility-scale solar)
- Energy Storage (short-, mid-, and long-duration)

Outputs

- Model will build least-cost combination of resources needed to meet every hour of generation, for each weather year, in each scenario (central and extreme)
- Planning to report:
  - MW of each solution resource, for each weather year
  - Cost ($/MW and $) of resource construction
  - MWh not used for meeting peak or powering storage
  - Avoided CO_2 emissions

Questions?