Gas-Electric Coordination in New England and the ISO's Probabilistic Energy Adequacy Tool

Federal-State Current Issues Collaborative

Mike Knowland

MANAGER, OPERATIONS FORECAST AND SCHEDULING

Setting the Stage

- Analyses of gas-electric systems and extreme weather events often point to the need to strengthen energy adequacy and gas-electric coordination
- New England is an energy-constrained region and has significant operational experience with gas-electric interdependencies and coordination
- The electric and gas systems are operated separately and fall under different regulatory structures, but they make up a larger energy system
- ISO New England has built strong relationships with operators of the interstate gas pipeline system and has developed tools to enhance our situational awareness of the gas system
- The ISO is a leader in gas-electric coordination which is a necessity given that the region is energy-constrained and reliant on natural gas; the ISO does not anticipate that additional gas infrastructure will be developed in the region
- Energy adequacy is a key focal point for New England, leading the ISO to develop new tools to forecast energy adequacy risks

BACKGROUND

Energy Constraints in New England

Generation and Demand Resources Are Used to Meet New England's Energy Needs

- Nearly **400** dispatchable generators in the region
- **29,700 MW** of generating capacity
- Approximately **38,000 MW** of proposed generation in the ISO Queue
  - Mostly wind, storage, and solar proposals
- Roughly **7,000 MW** of generation have retired or will retire in the next few years
- Nearly **3,600 MW** of demand resources with obligations in the Forward Capacity Market*, including energy efficiency, load management, and distributed generation resources
  - Demand resources have had further opportunities in the wholesale markets since 2018

* In the Forward Capacity Market, demand-reduction resources are treated as capacity resources.

New England is Summer-Peaking, but Shifting to Winter

New England shifted from a winter-peaking system to a **summer-peaking** system in the early 1990s, largely because of the growth of air conditioning and a decline in electric heating

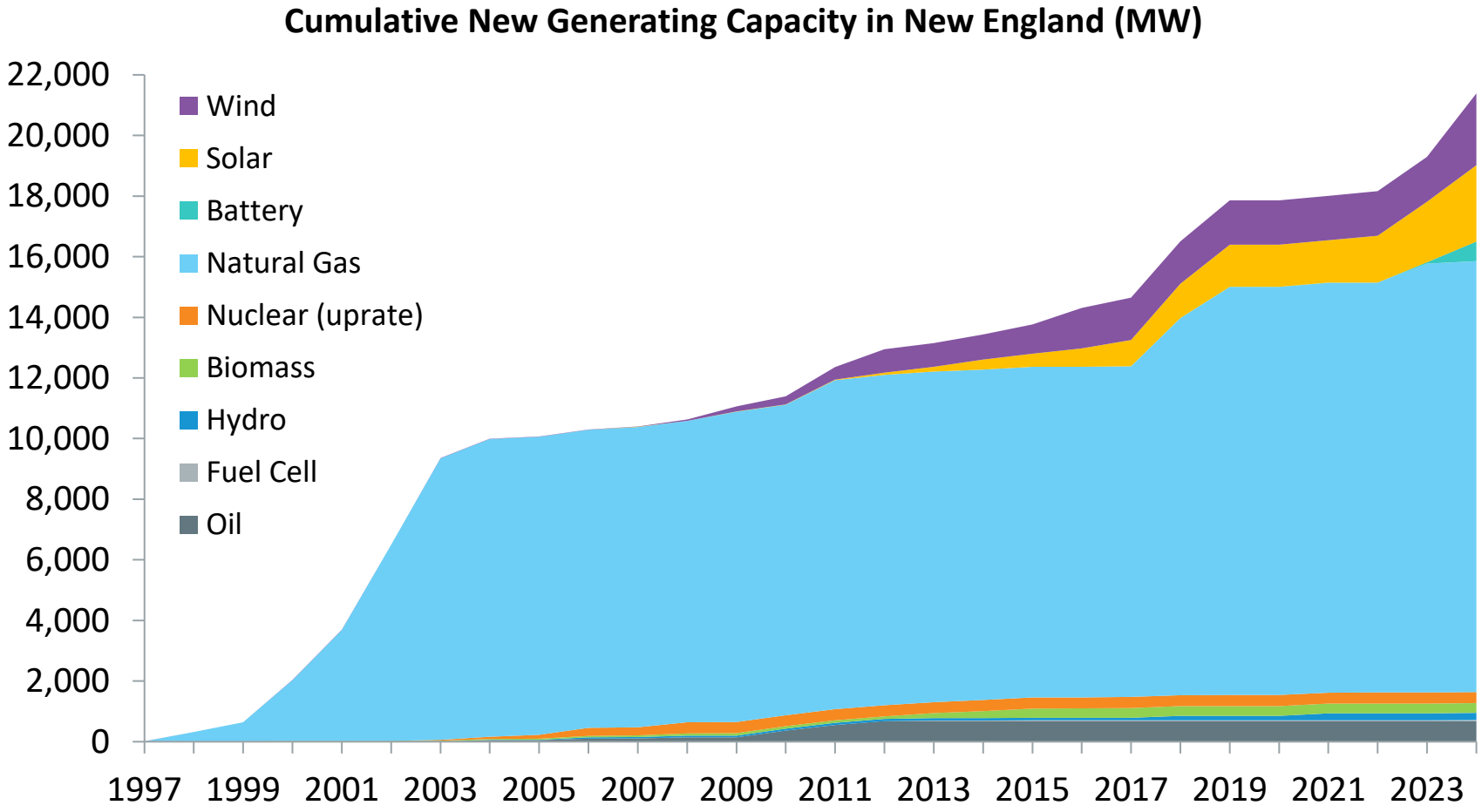
- Peak demand on a normal summer day has typically ranged from 17,500 MW to 22,000 MW
- Summer demand usually peaks on the hottest and **most humid** days and averaged roughly 25,600 MW since 2000

- Region's all-time summer peak demand was **28,130 MW** on **August 2, 2006**

The region is expected to shift back to a **winter-peaking system** with the electrification of heating demand

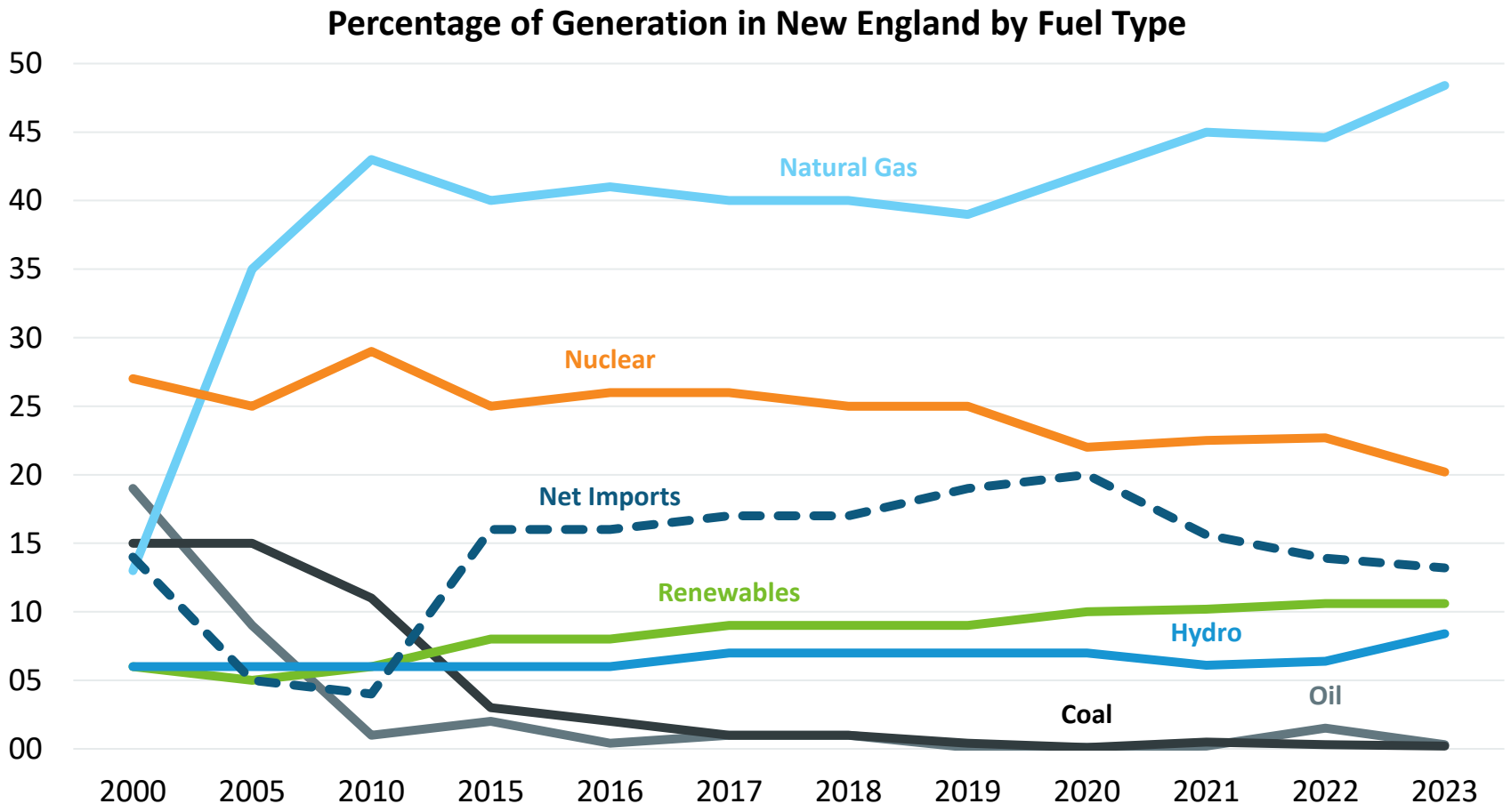
- Region's all-time **winter** peak demand was **22,818 MW** on **January 15, 2004**

Natural Gas Has Been the Dominant Fuel Source for Generating Capacity Built in New England



Note: New generating capacity for years 2021 – 2024 includes resources clearing in recent Forward Capacity Auctions.

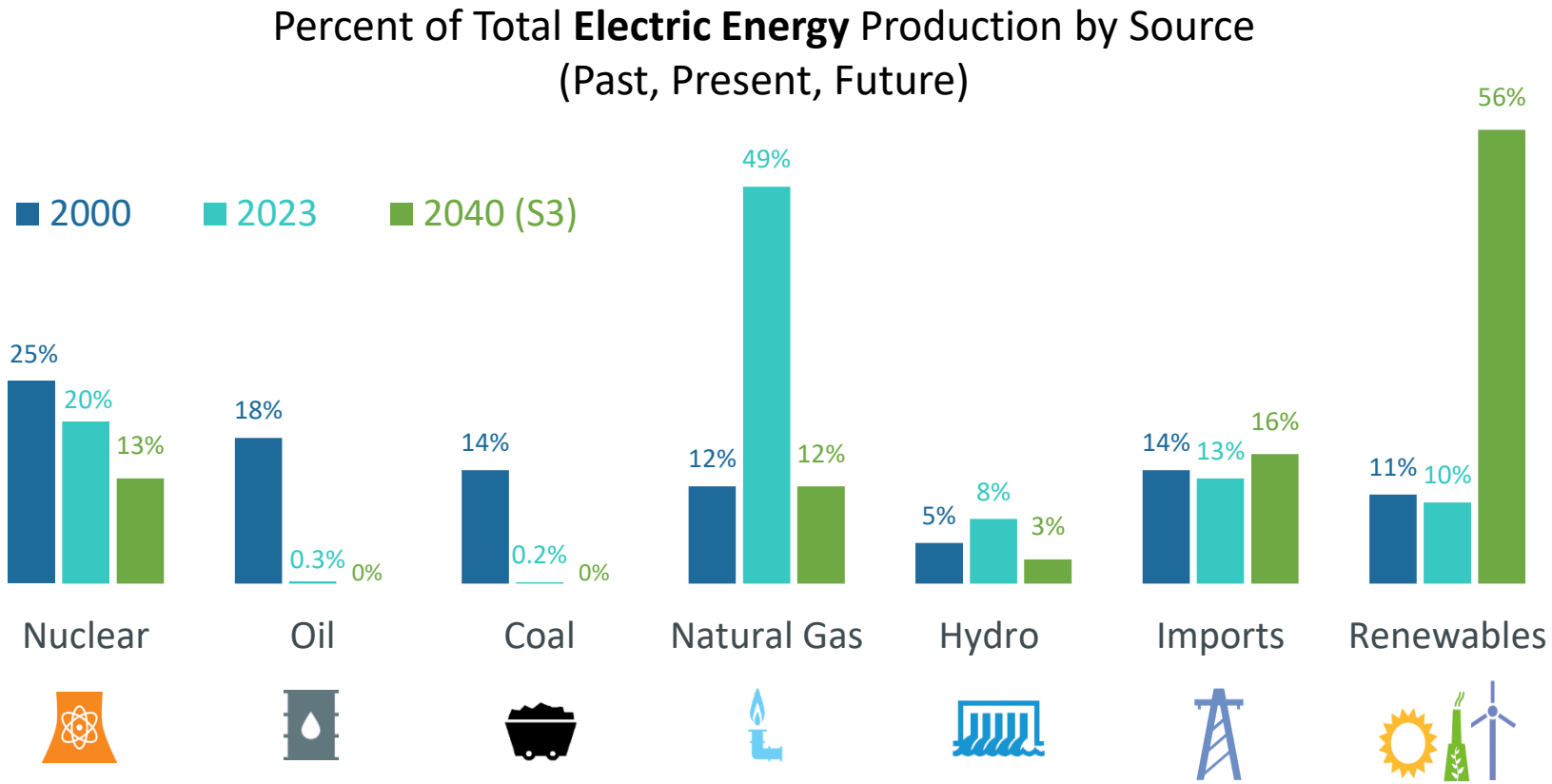
The Region Currently Gets Most of its Energy Supply from Natural Gas



***Source**: ISO-NE Net Energy and Peak Load by Source*
Electric generation within New England; excludes imports and behind-the-meter (BTM) resources, such as BTM solar.

Dramatic Changes in the Energy Mix Continue

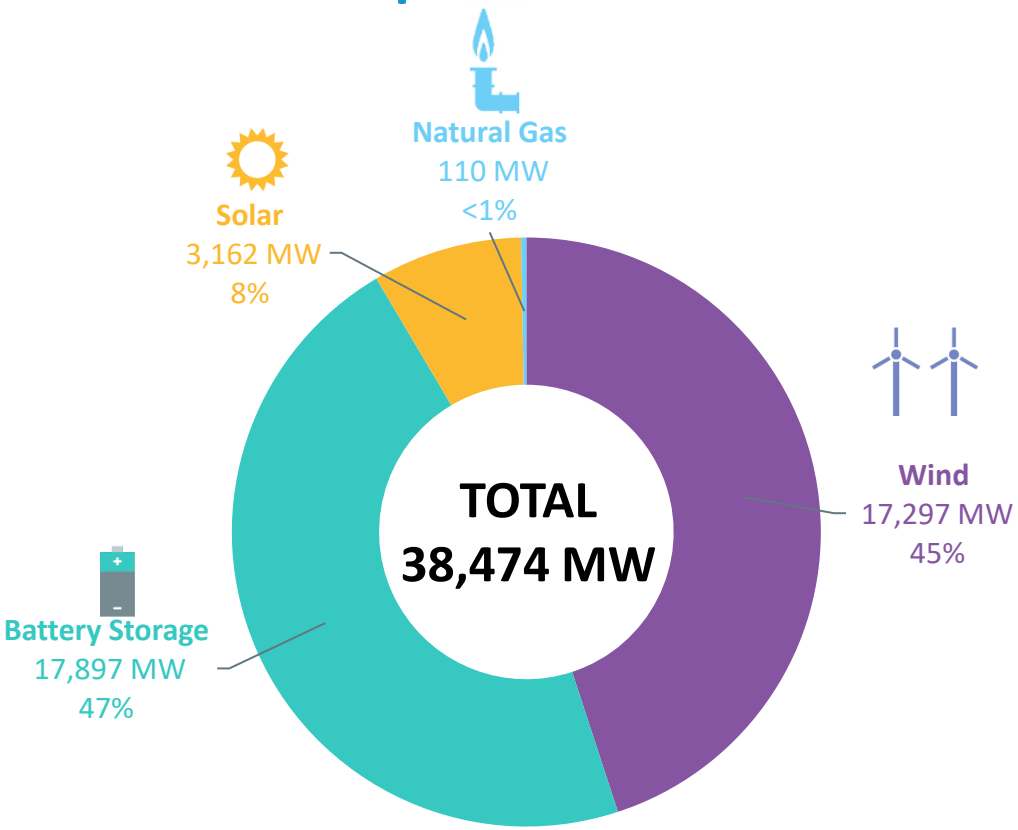
New England made a major shift from coal and oil to natural gas over the past two decades, and is shifting to renewable energy in the coming decades



Source: ISO New England Net Energy and Peak Load by Source; data for 2023 is preliminary and subject to resettlement; data for 2040 is based on Scenario 3 of the ISO New England 2021 Economic Study: Future Grid Reliability Study Phase 1.
Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, behind-the-meter solar, municipal solid waste, and miscellaneous fuels.

Wind Power & Battery Storage Comprise Most of the New Resource Proposals in the ISO Interconnection Queue

All Proposed Resources



Source: ISO Generator Interconnection Queue (January 2025)
FERC Jurisdictional Proposals; Nameplate Capacity Ratings
Note: Some natural gas proposals include dual-fuel units (with oil backup). Some natural gas, wind, and solar proposals include battery storage. Other includes hydro, biomass, fuel cells and nuclear uprate.

Proposals by State

(all proposed resources)

State	Megawatts (MW)
Connecticut	8,610
Massachusetts	20,903
Maine	5,120
New Hampshire	899
Rhode Island	2,597
Vermont	344
Total	**38,474**

Source: ISO Generator Interconnection Queue (January 2025)
FERC Jurisdictional Proposals

From 2013 to 2024, Over 7,000 MW of Generation Have Retired

- Include predominantly coal, oil, and nuclear resources
- Another **750 MW** of generation have announced plans for retirement
- These resources have played an **important** role in recent winters when natural gas supplies are constrained in New England

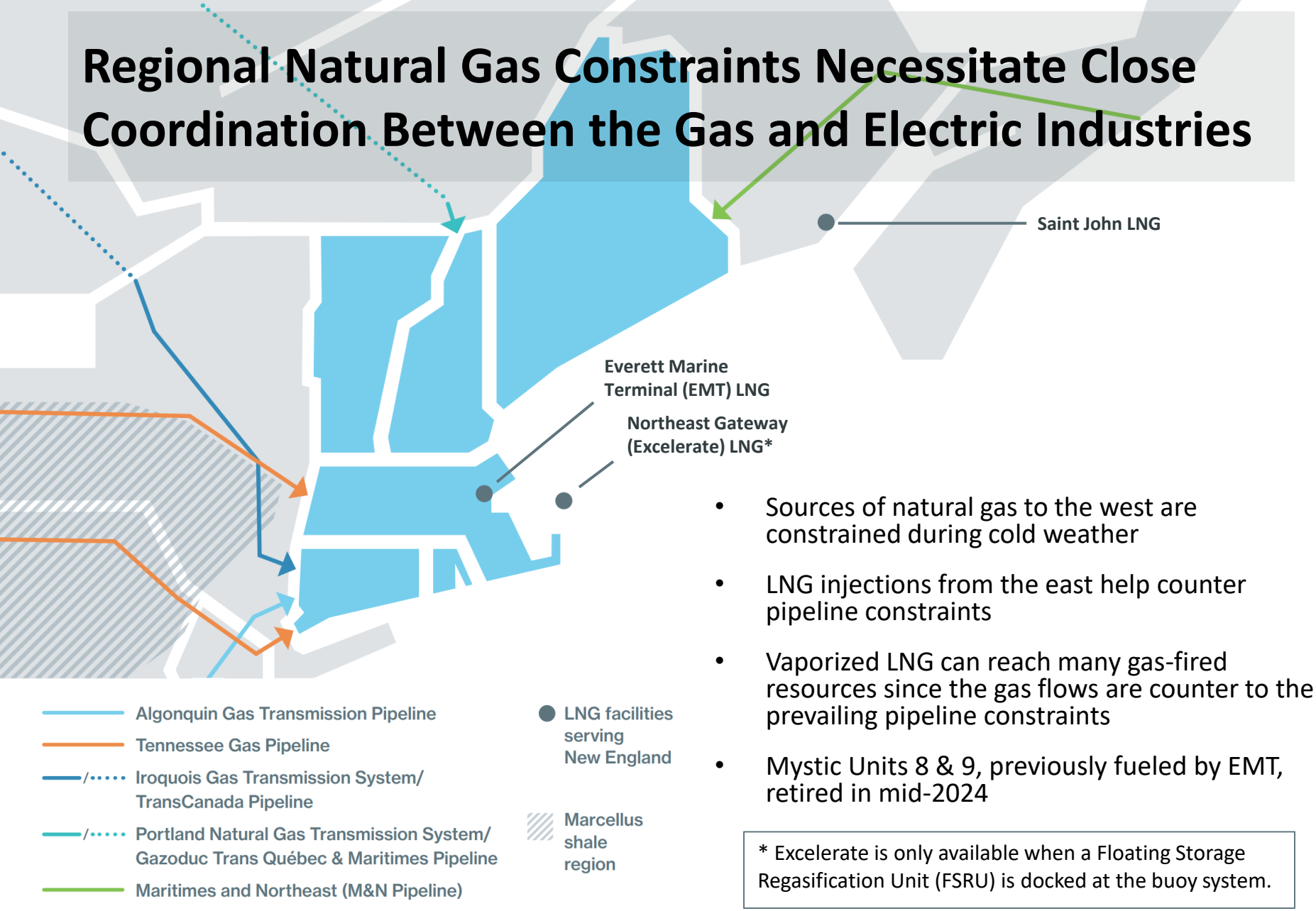
Source: ISO New England Status of Non-Price Retirement Requests and Retirement De-list Bids (February 2024)

ISO-NE Has Extensive Engagement with Industry and Government Entities on Gas-Electric Coordination

- North American Electric Reliability Corp. (NERC) working groups
  - Electric Gas Working Group (ISO-NE serves as chair)
  - Energy Reliability Assessment Working Group (ISO is founder and chair)
    - Additional work with NERC includes collaboration with the Interstate Natural Gas Assoc. of America (INGAA), Electric Power Supply Assoc. (EPSA), Natural Gas Supply Assoc. (NGSA), and American Gas Assoc. (AGA)
  - NERC Standards for Energy Reliability Assessments
- ISO-RTO Council Electric Gas Coordination Task Force (IRC EGCTF)
- Electric/Gas Operations Committee (EGOC) collaboration with the Northeast Gas Association (NGA)
- North American Energy Standards Board (NAESB) Gas Electric Harmonization Committee
- FERC Technical Conferences (e.g., New England Gas-Electric Forum)

GAS-ELECTRIC COORDINATION

Regional Natural Gas Constraints Necessitate Close Coordination Between the Gas and Electric Industries



- Sources of natural gas to the west are constrained during cold weather
- LNG injections from the east help counter pipeline constraints
- Vaporized LNG can reach many gas-fired resources since the gas flows are counter to the prevailing pipeline constraints
- Mystic Units 8 & 9, previously fueled by EMT, retired in mid-2024

* Excelerate is only available when a Floating Storage Regasification Unit (FSRU) is docked at the buoy system.

ISO-NE's Industry-Leading Gas-Electric Coordination

- New England has a long history of coordination between gas pipeline and electric system operators
  - Practices are in close alignment with the NERC Reliability Guideline: Gas and Electric Operational Coordination Considerations
  - Sharing of non-public information is allowed for by FERC Order No. 787 (Communication of Operational Information Between Natural Gas Pipelines and Transmission Operators)
- ISO staff has direct communication with the gas control of each interstate natural gas pipeline and communications can take place between operators of each system, as needed

Gas-Electric Coordination: Examples

- **Situational Awareness**: ISO uses pipeline bulletin board data and generator schedules to enhance situational awareness and to identify potential concerns
  - For example, ISO will contact natural gas-fired generators in cases where it appears that insufficient gas has been scheduled to support the expected dispatch of that generator
  - Additionally, ISO shares expectations for each generator's hourly gas burn with each applicable gas pipeline operator thereby enhancing each pipeline's awareness of hourly gas demands on its system
- **Outage Coordination**: ISO actively works to coordinate pipeline and generator outages on a real-time and forward-looking basis (up to 6 months out)

ISO 21-DAY ENERGY ASSESSMENT

Operating Procedure 21 (OP-21)

Note: Changes to OP-21 were put into effect in 2018, adding an energy forecasting and reporting framework to establish energy alert thresholds similar to those used in NERC standards.

Link: https://www.iso-ne.com/participate/rules-procedures/operating-procedures

ISO New England Publishes 21-Day Energy Assessments on a Weekly Basis During Winter

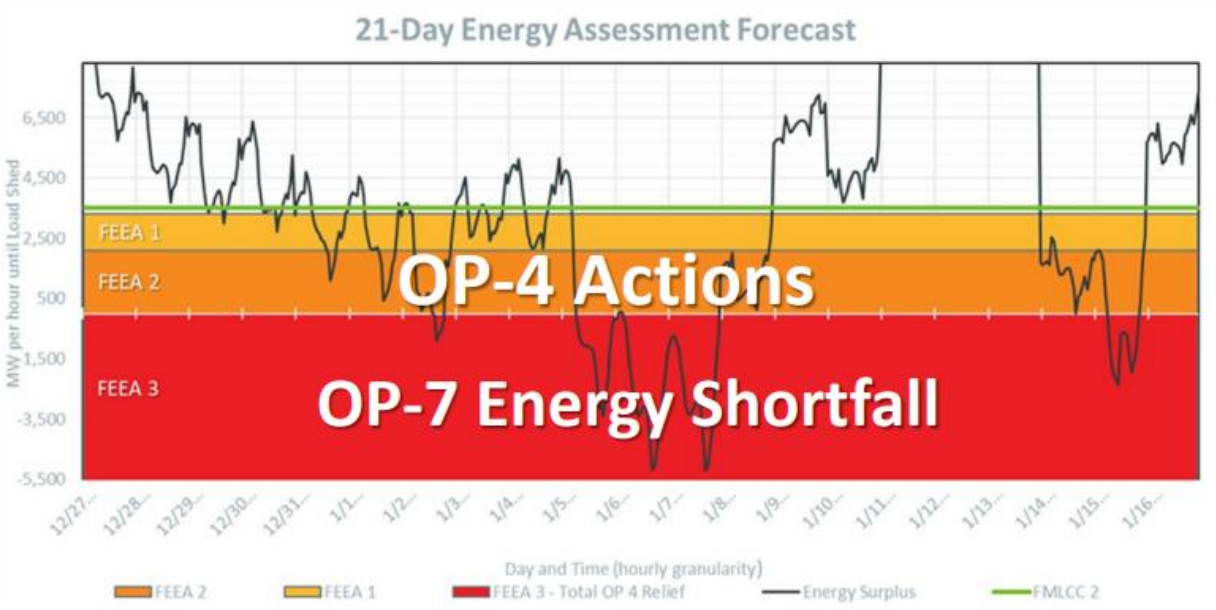
- The **energy assessment** is based on New England generators' reports of their fuel inventories, emissions limitations, and other factors that could limit their availability
  - ISO confers with natural gas pipeline companies regularly during the winter
- Hourly forecast results are compared against established thresholds to either project normal conditions or trigger the declaration of:
  - **Energy Alerts** (declared in Day 6-21 timeframe), or
  - **Energy Emergencies** (declared in Day 1-5 timeframe)
- Energy assessments are published to the ISO website (iso-ne.com)
  - **Weekly** (December – February)
  - **Bi-weekly** (March – November)
- During Energy Alert or Energy Emergency conditions, the ISO will publish energy assessments **daily**

The 21-Day Assessments are posted to the ISO website here, and includes a link to an explainer of the report:
https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/21-Day-Energy-Assessment-Forecast-and-Report-Results

21-Day Energy Assessment Raises Awareness About Energy Availability So Resources Can Take Action

- Resource owners and other stakeholders, including regulatory and government entities, will be made aware of actual or anticipated near-term **energy deficiencies**
  - For example, when oil or other fuels start running low or emissions limitations are constraining resource availability
- With up to three weeks' notice, resource owners have time to **evaluate status** of their resources and **take action** as needed to increase their availability
  - For example, make arrangements to have more fuel delivered or reschedule maintenance to transmission facilities

Example Reports with Forecasted Conditions Resulting in Energy Alerts and Emergencies



LEGEND:

FEEA: *Forecasted* Energy Emergency Alert
FMLCC-2: *Forecasted* Abnormal Conditions Alert

FMLCC-2: Resources are forecasted to be <200 MW above the operating reserve requirement

FEEA1: Resources are forecasted to fall below the operating reserve requirement and **OP-4 actions 1–5** are forecasted

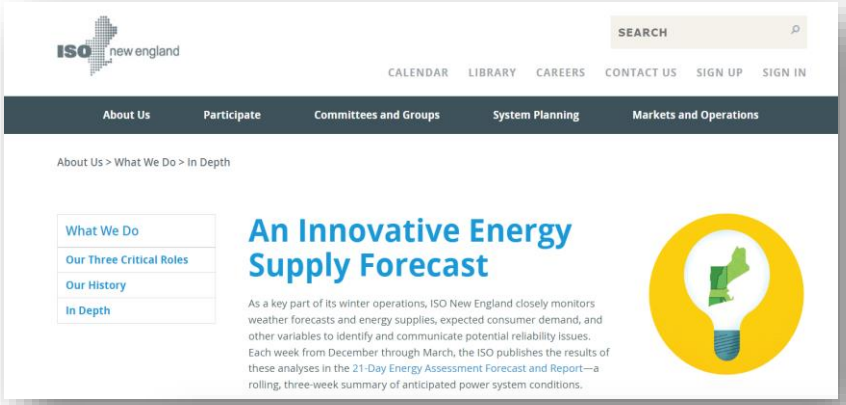
FEEA2: Resources are forecasted to fall below the operating reserve requirement and **OP-4 actions 6–11** are forecasted

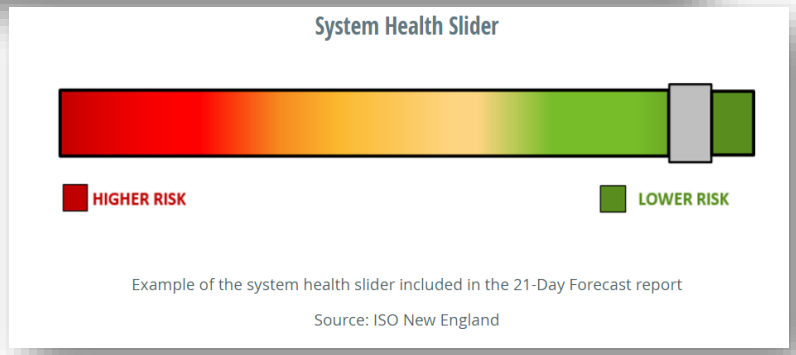
FEEA3: Resources are insufficient to meet firm load; **OP-7 actions** are forecasted

Note: EEA levels are described in Attachment 1 to NERC Reliability Standard EOP-011 - Emergency Operations. These alerts do not trigger any additional communications with OP-4 contacts.

ISO Resources for OP-21 Information

For background on how to read the OP-21 report…



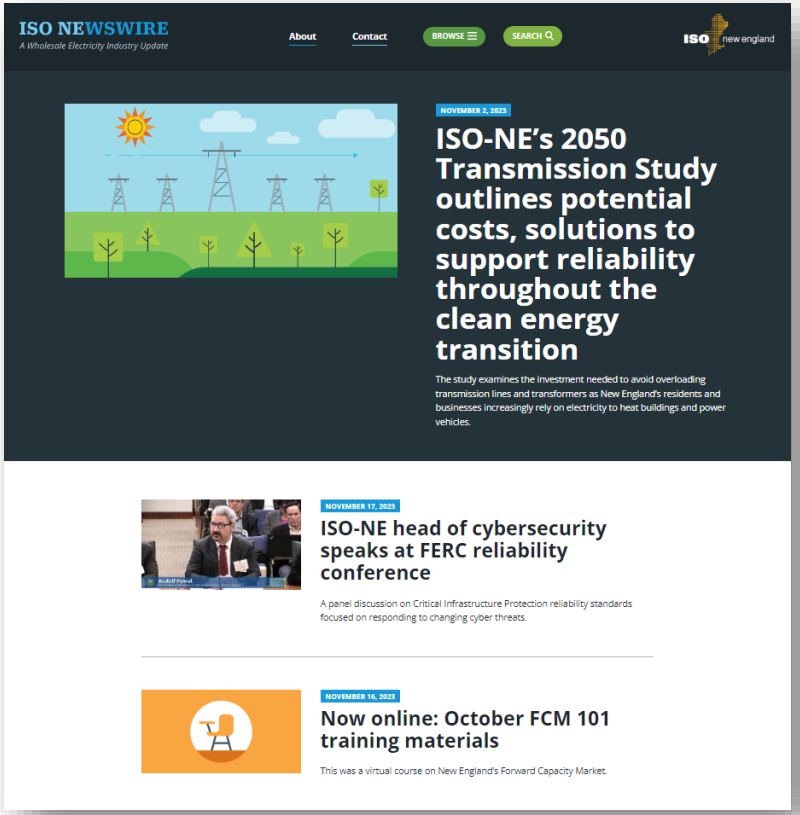


Example of the system health slider included in the 21-Day Forecast report

Source: ISO New England

https://www.iso-ne.com/about/what-we-do/21-day-forecast

For updates on real-time issues…



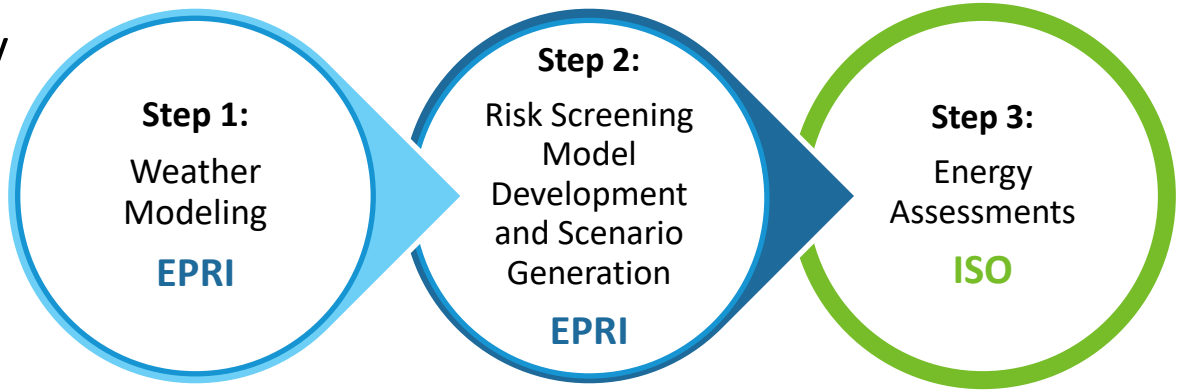
https://isonewswire.com/

PEAT

Probabilistic Energy Adequacy Tool

Operational Impact of Extreme Weather Events – Energy Adequacy Study

- ISO collaborated with EPRI to conduct a probabilistic energy adequacy study for New England under extreme weather events; initial studies focused on 2027 and 2032
- Study established the Probabilistic Energy Adequacy Tool (PEAT) framework for risk analysis; it is expected that this framework will be essential as climate projections are refined and the resource mix evolves
- Study results have informed the region on energy shortfall risks over the next decade; results are expected to inform the development of a regional energy shortfall threshold (REST) in 2025
- This presentation briefly reviews the study framework and results of energy assessments completed for the 2027 and 2032 events



In Step 1, Historical Weather Trends and Climate Projections Were Reviewed

- This step included a review of New England's historical weather (1950 to 2021), analysis of global climate model projections, and development of hourly weather variable and resource profiles
- EPRI used five global climate models spanning a range of climate sensitivities and two emissions pathways to project changes to weather variables for use in subsequent steps in the study
- Future weather realizations were developed for the 2027 and 2032 study years; realizations consisted of hourly synchronous profiles for temperature, wind, and solar reflecting climate model projections
- Hourly profiles of weather variables were used to develop hourly demand forecasts and energy output profiles for wind and solar resources

In Step 2, a Risk Screening Model Was Developed to Facilitate Extreme Event Selection

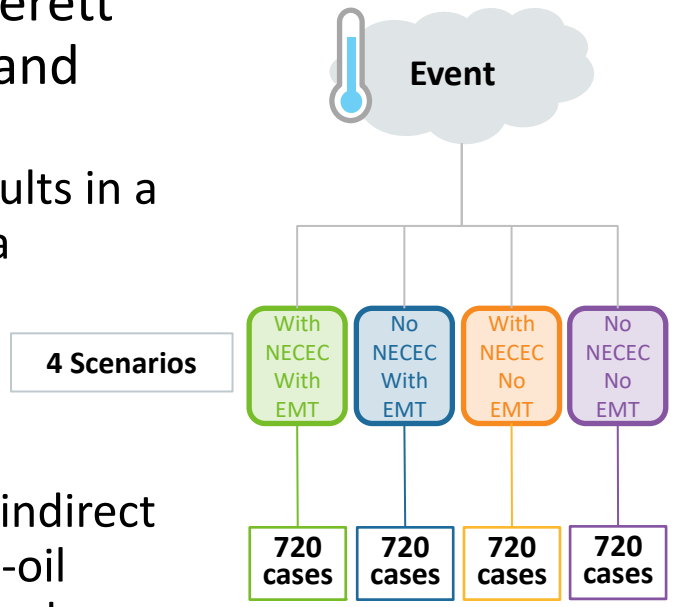
- The objective of the Risk Screening Model is to search the weather data and select a set of 21-day events that appear most stressful (extreme) to the future New England power system in terms of energy availability
- For each study year, the input to the risk screening model is 37,440 21-day events based on 72 years (1950 – 2021) of climate-adjusted weather
  - Output of risk screening model is 1,470 high risk events (top ~4%)
- A clustering algorithm was used to group the 1,470 events into clusters consisting of similar types of events

Events Selected by the Risk Screening Model for Study Years 2027 and 2032

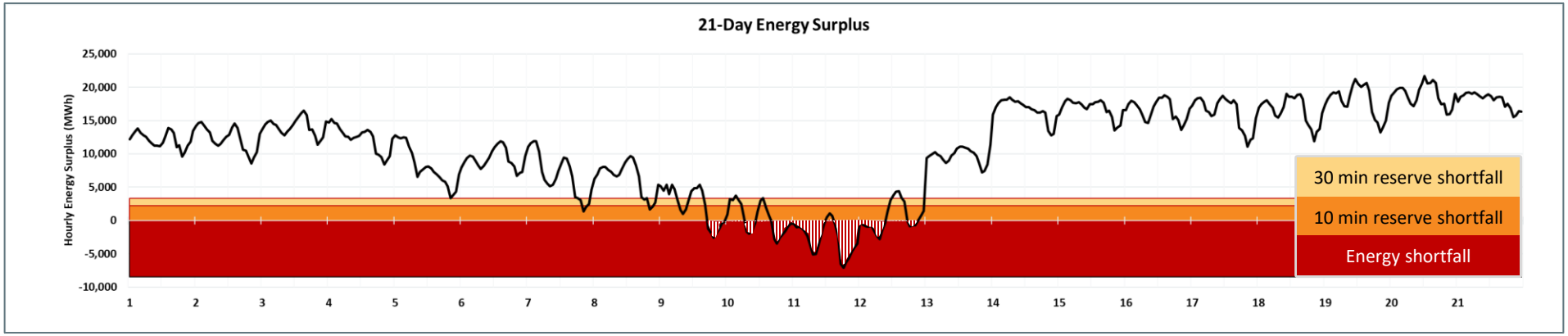
- For 2027 and 2032, two winter clusters were identified
  - Winter Cluster 1: consists of longer-duration events with low winds and low solar irradiance
  - Winter Cluster 2: consists of shorter-duration events with low winds and low solar irradiance
- Three distinct summer clusters were identified for each year of study, but results showed no energy shortfall
- A single winter event, the 21-day period beginning on Jan 22, 1961, was identified as having the highest potential for energy shortfall and was a focal point of ISO's winter energy assessments

Following Extreme Event Selection, Scenarios Were Developed for Use in Step 3

- Each selected event was studied with a combination of two key variables – the Everett Marine Terminal (EMT) and the New England Clean Energy Connect (NECEC) facility
  - Each combination of these two variables results in a "scenario", each of which was not assigned a probability of occurrence
- Each of the four scenarios is modeled using 720 "cases"
  - Each case reflects different combinations of indirect weather-related uncertainties (LNG and fuel-oil inventories, imports, forced outages, etc.), each having an assigned probability of occurrence
  - Uncertainty assumptions vary based on the unique characteristics of each 21-day event (e.g. event start date, temperatures, etc.)



In Step 3, ISO's 21-Day Energy Assessment Forecasts Hourly Energy Surplus for Each Case



*The figure above is an example illustration of a 21-day energy assessment forecast

- For each case, energy assessment results include:
  - Energy surplus (black curve)
  - Energy shortfall (red/white striped area): quantity in MWh and duration
  - Reserve shortfalls (black curve in yellow/orange): quantity in MWh and duration
- For each scenario, energy assessment results are a statistical summary across all 720 cases within scenario:
  - "Expected" energy shortfall = probability-weighted average across all cases
  - "Worst-case" energy shortfall = case with highest energy shortfall quantity

Key Takeaways of 2027 and 2032 Studies

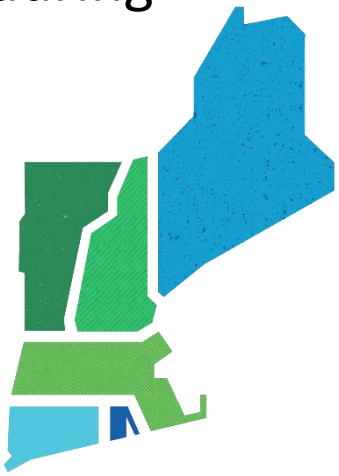
- The region's energy shortfall risk is dynamic and will be a function of the evolution of the supply and demand profiles
  - Various assumptions inform the analysis and significant deviation from any of these assumptions may result in an increasingly risky profile
  - The studies anticipate a reliable gas system, a responsive oil supply chain, and no significant disruptions in energy production due to emissions limitations
- Results of the energy adequacy studies reveal a range of energy shortfall risk and associated probabilities
  - In the near-term, the winter energy shortfall risk appears manageable over a 21-day period; results are consistent with expectations for load growth and significant quantities of solar, offshore wind, battery storage resources, and additional imports

Key Takeaways of 2027 and 2032 Studies, cont.

- Sensitivity analysis of 2032 worst-case scenarios indicates an increasing energy shortfall risk profile between 2027 and 2032
  - Timely additions of BTM and utility-scale solar, offshore wind, and incremental imports from NECEC are critical to mitigate energy shortfall risks that result from significant winter load growth and retirements
- The PEAT framework provides a much needed foundation to study energy shortfall risk as the system evolves

Regional Energy Shortfall Threshold (REST)

- The ISO's initial 2027 and 2032 energy adequacy study results from the PEAT will help inform the development of a **reliability-based threshold** that reflects the region's level of **risk tolerance** with respect to energy shortfalls during extreme weather
- Considerations for development of the REST:
  - Periodicity of Studies (*When?*)
  - Extreme Event Selection Process (*How?*)
  - REST Metrics and Threshold (*What?*)



New England's energy shortfall risk is dynamic, and will **evolve** as the region continues its **clean energy transition**

Questions