The Challenges of Orchestrating a Successful Clean Energy Transition Across Multiple Jurisdictions

Energy Systems Integration Group (ESIG)
2024 Fall Technical Workshop

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STARTING WITH THE KEY INGREDIENTS

The Four Pillars Necessary for a Successful Clean Energy Transition in New England

There Are Four Pillars Necessary to Support a Successful Clean Energy Transition

PILLAR ONE

Clean Energy

Significant amounts of clean energy to power the economy with a greener grid

PILLAR TWO

Balancing Resources

Resources that can supply electricity, reduce demand, or provide other services to maintain power system equilibrium

PILLAR THREE

Energy Adequacy

A dependable energy supply chain and/or a robust energy reserve to manage through extended periods of severe weather or energy supply constraints

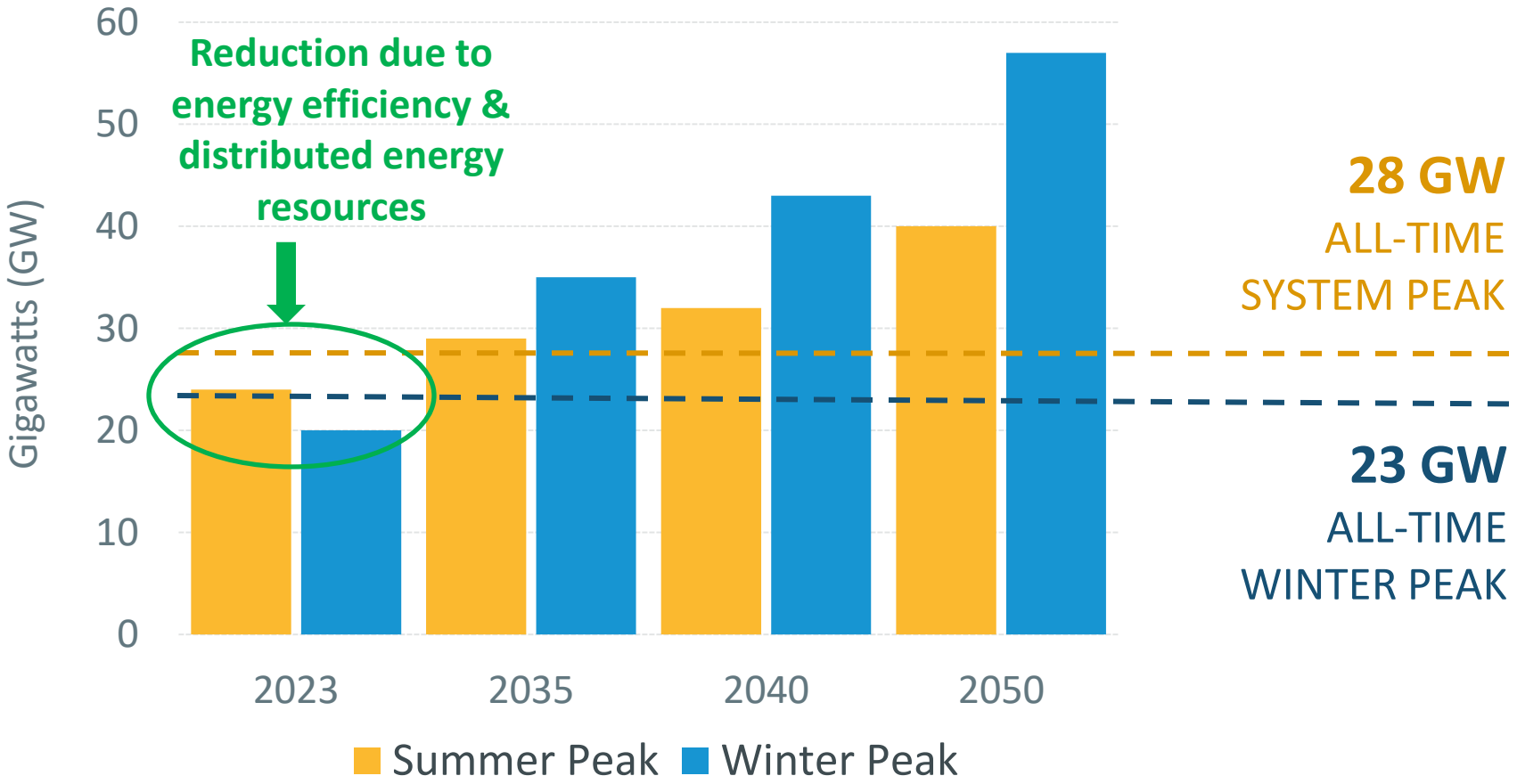
PILLAR FOUR

Robust Transmission

To integrate renewable resources and move clean energy to consumers across New England

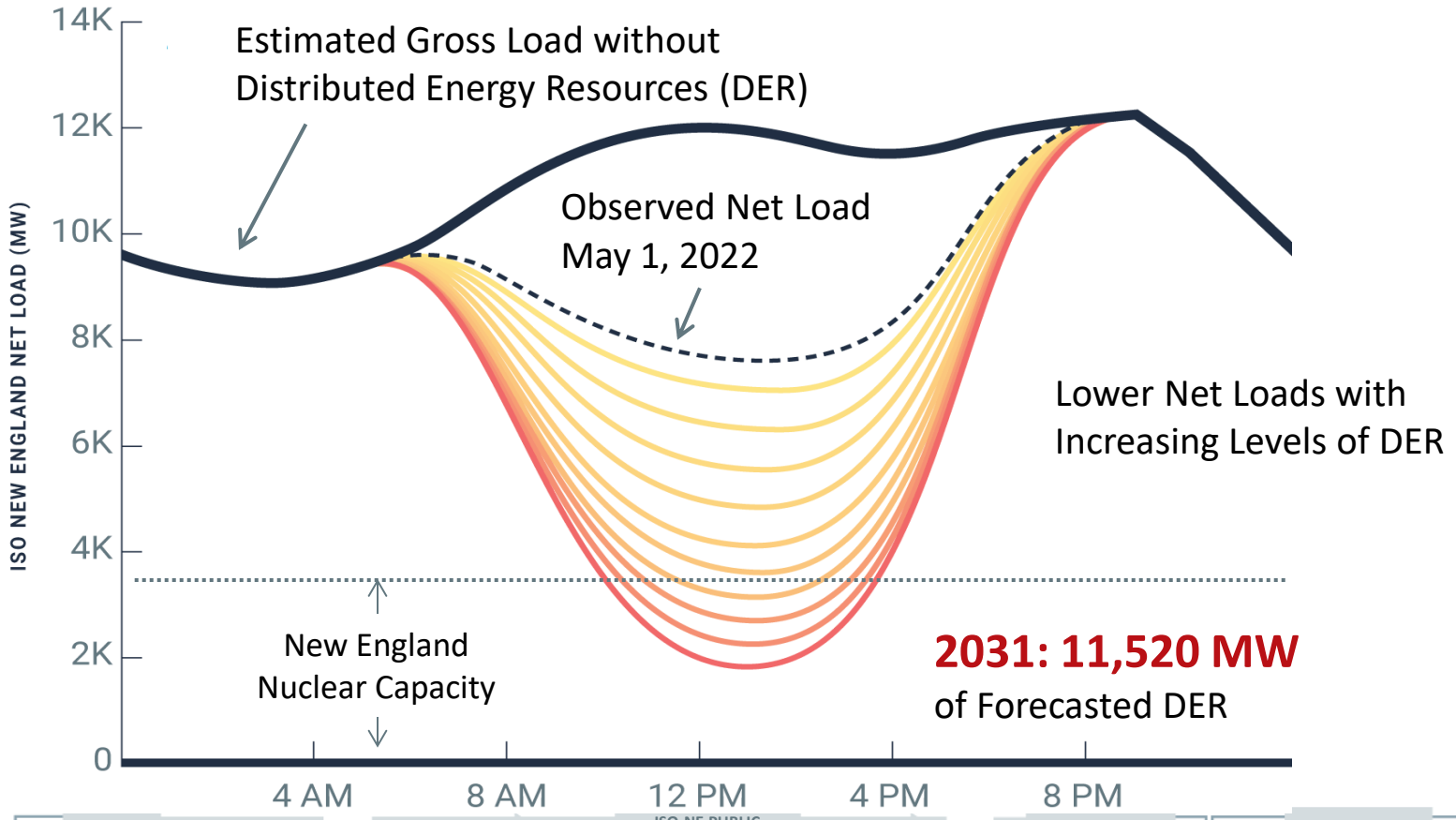
Pillar One: Significant Amounts of Clean Energy

Significant amounts of clean energy will be needed to meet state decarbonization goals while serving significantly increased demand



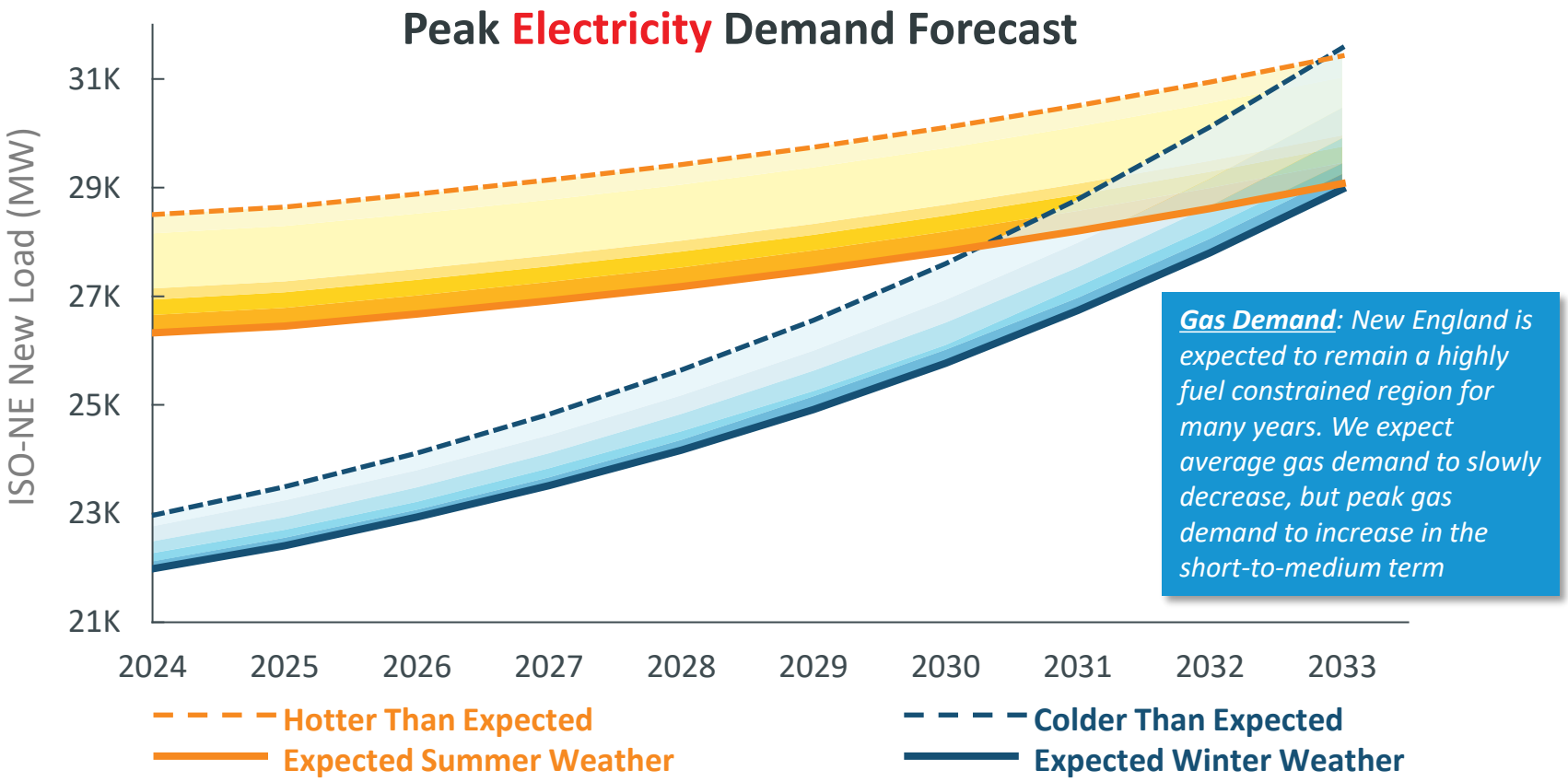
Pillar Two: Balancing Resources

Dispatchable generators, energy storage, demand response, and a range of services will be crucial to ensure equilibrium as intermittent resources see swings in energy production



Pillar Three: Energy Adequacy

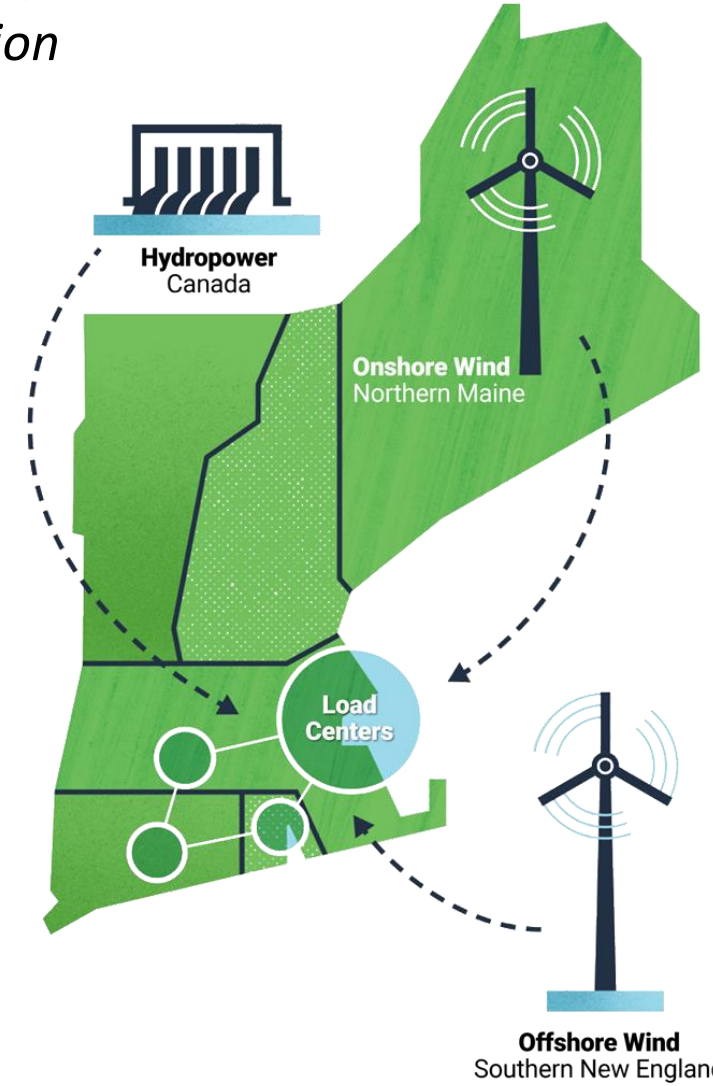
A dependable energy supply chain and/or a robust energy reserve to manage through extended periods of severe weather



Pillar Four: Robust Transmission

Significant investment in new and existing infrastructure will be critical to enabling the clean energy transition

$620 million to **$1 billion** in transmission reliability investment will be needed **each year through 2050** to support the clean energy transition



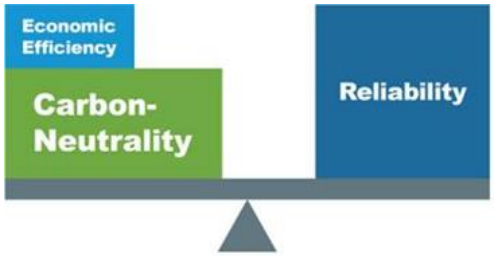
Source: Massachusetts Energy Pathways to Deep Decarbonization study and ISO New England 2050 Transmission Study

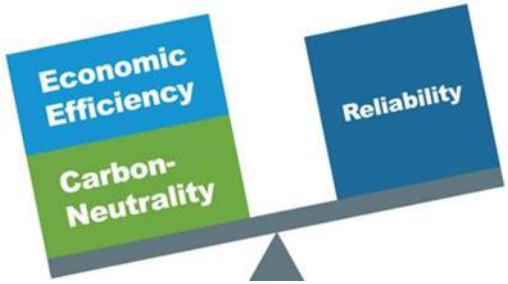
ILLUSTRATING THE ECONOMIC, RELIABILITY AND ENVIRONMENTAL TRADEOFFS IN THE JOURNEY AHEAD

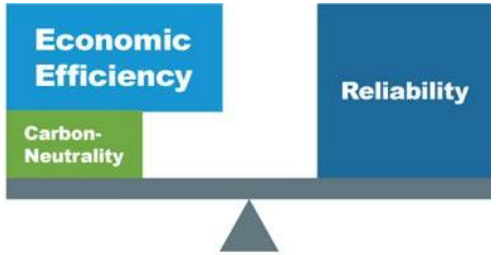
Economic Planning for the Clean Energy Transition (EPCET)

Economic Planning for the Clean Energy Transition (EPCET) Overview

- EPCET explores the reliability, engineering, environmental and economic challenges the region must address in order to support the New England States' commitment to reduce carbon emissions over the next several decades
- Most of the six states aim to cut emissions by at least 80% from 1990 levels by the year 2050 through a shift to renewable energy and electrification of heating and transportation
- Work performed over two years, draft report published in August







EPCET's key findings converge on a common theme: ***designing the power system of the future requires balancing reliability, economic efficiency, and carbon-neutrality***

Average Annual Buildout Necessary to Achieve State Goals by 2050

1,293 MW
per year
of offshore wind (OSW)

955 MW
per year
of solar

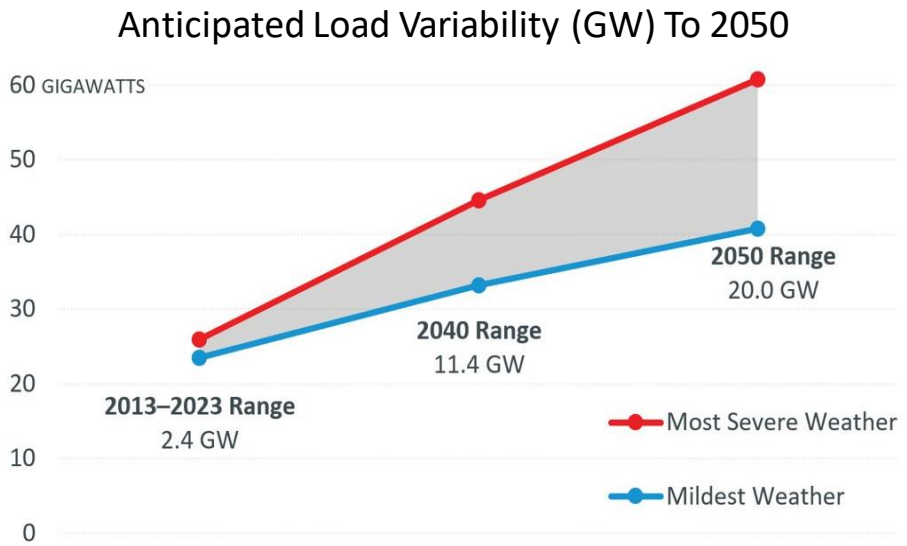
268 MW
per year
of land-based wind (LBW)

952 MW
per year
of batteries

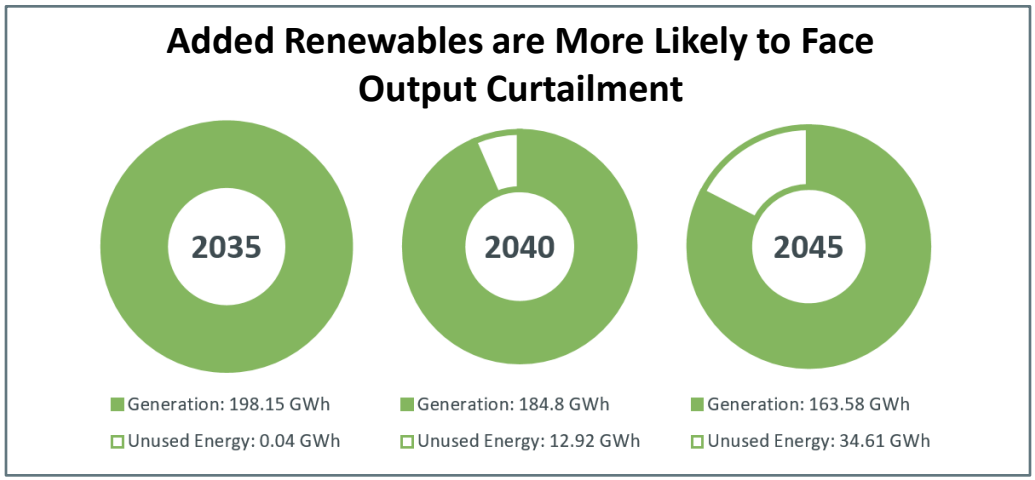
Escalating Variability in Supply and Demand

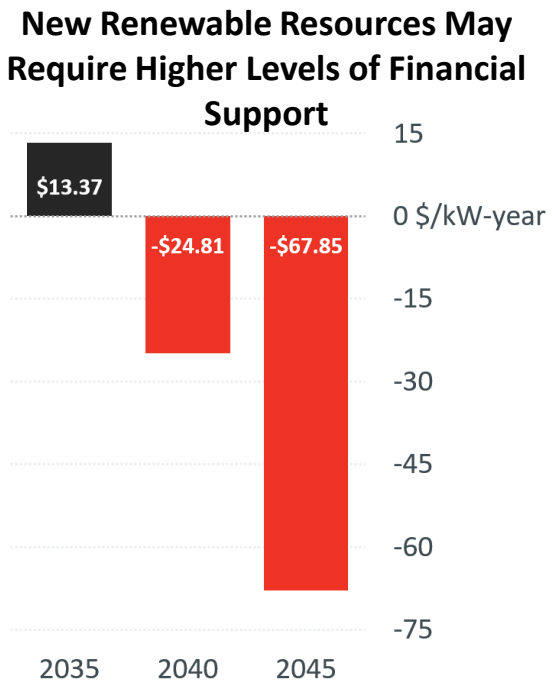
Most pathways to a low-carbon grid involve high variability in both supply and demand, which will result in either reliability challenges or higher costs

- Today's electrical grid experiences only small variations in peak annual demand between years, allowing for efficient planning for a limited number of possible outcomes
- As penetration of wind and solar resources increases, supply is also expected to become much more weather-dependent, and thus much more variable



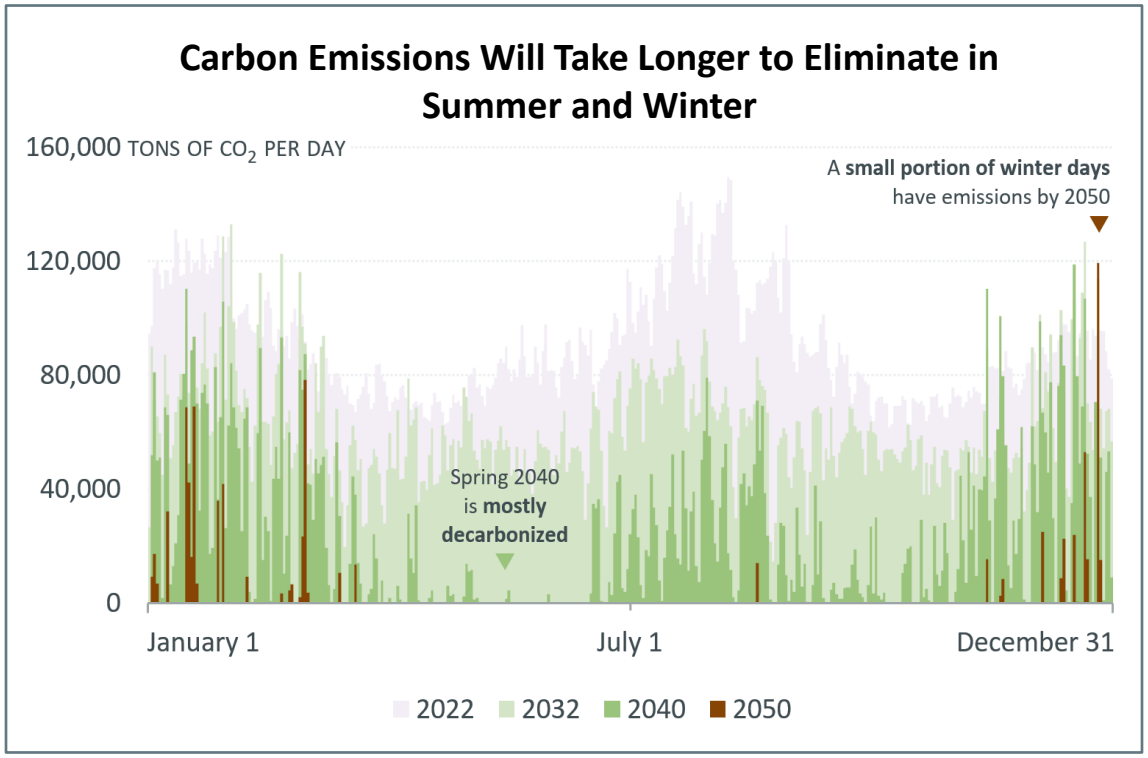
As Decarbonization Accelerates, but Remains Highly Correlated with the Seasons, Zero-Carbon Resource Additions will Produce Surplus Energy for Increasing Periods of Time, and Their Cost per MWh will Rise





- Current power purchase agreement (PPA) strategies are designed for a grid with carbon emissions throughout the year
- Modeling shows that PPA contracts become part of a "race to the bottom," with the final new resources needed to complete winter decarbonization struggling to compete with resources that secured agreements years or decades earlier

In Order to Fully Decarbonize the New England Power System (Outside of Winter), Renewable Buildout Will Need to be Substantial

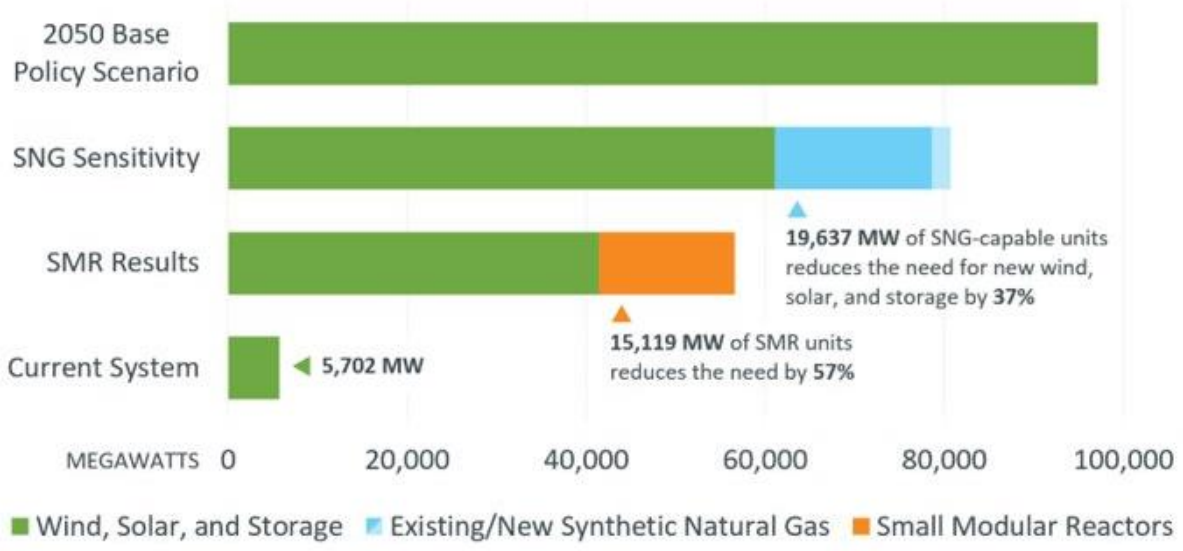


- 36 GW of new capacity will significantly decarbonize the spring and fall months and provide increased decarbonization in other months
- 73 GW of new capacity will almost fully decarbonize spring, fall, and summer
- 97 GW of new capacity will decarbonize every month outside of winter and significantly reduce winter emissions

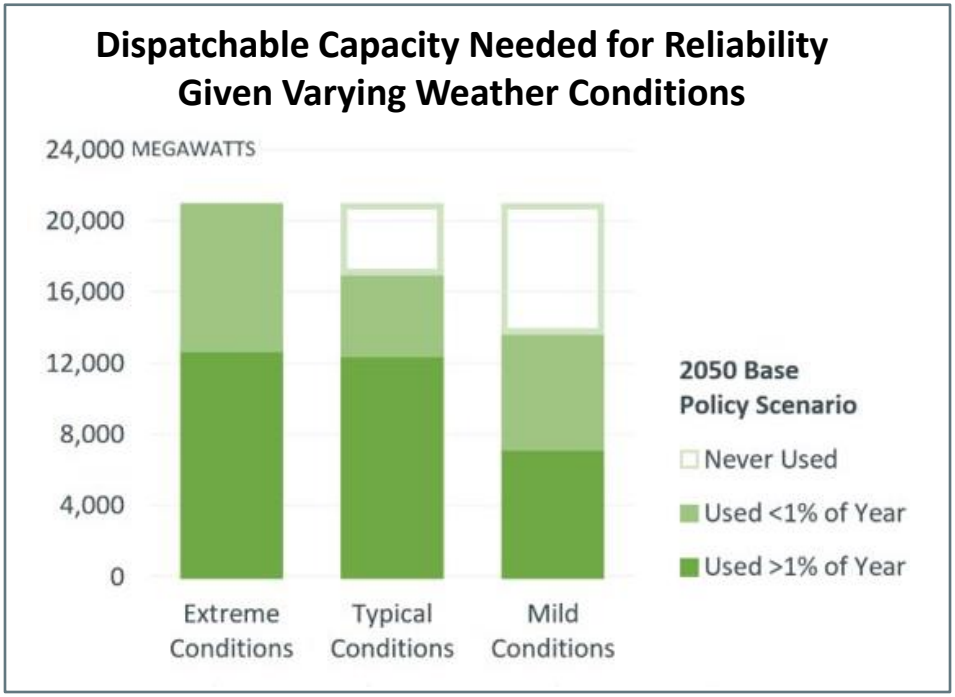
Dispatchable, Emissions-Free Resources Could Reduce the Costs of the Transition and Help Address Winter Peak Demands

- Technology at a scale needed to power the grid solely with carbon-free resources hasn't arrived yet
- Some amount of flexible, dispatchable resources—whether they are carbon-emitting or not—will continue to play a role in filling supply gaps and ensuring the reliable flow of electricity we've come to expect and rely on

Substitution of Dispatchable Emissions-Free Resources Reduces the Need for New Wind, Solar, and Storage Units



Dispatchable Capacity Needed for Reliability May Operate Infrequently During the Year



- Since the grid must be ready to serve load under the most extreme conditions, significant quantities of dispatchable resources will sit idle during milder winters
- All 20 weather years in the modeled 2050 system require dispatchable generation to serve load for between 8% and 13% of that year
- In 2050 there will be a small number of winter days with emissions
- As energy prices and capacity factors drop, the market design will have to adjust to pay for flexibility, and ensure reliability services are adequately compensated. Capacity and ancillary services prices will increase.

EPCET: Conclusion and Next Steps

- Eliminating carbon emissions through complete electrification of the heating and transportation sectors and a near-exclusive reliance on wind, solar, and storage to generate electric power is possible, but involves **significant cost and unresolved reliability concerns**
- The ISO plans to assess the need for future market rule enhancements to support the ongoing reliability and economy of the region's grid
  - While the precise nature of these enhancements requires further exploration, they could include new ancillary services intended to incentivize the resource attributes that will become more important as the clean energy transition continues

WHO/WHAT WILL DRIVE THE NECESSARY CHANGES AND THE FUTURE SHAPE OF THE GRID?

This is a collaborative journey in the context of a wholesale market construct. There is no central planner in control of all the variables and there are significant structural challenges and frictions

The Major Variables and the Need for Collaboration Across Multiple State and Federal Jurisdictions

- **Supply**: States are driving supply through competitive procurements of wind, solar and battery storage; via new transmission to increase imports (hydro); and through combinations of generation and transmission
  - This occurs via long-term contracting outside of the wholesale markets
  - This activity is driving proposals in the ISO interconnection queue
  - States (with technical advice from the ISO) have secured federal funding to bolster points of interconnection for offshore wind and to develop multi-day energy storage
- **Demand**: States are driving demand through policies to electrify heating and vehicles (after years of controlling load growth via EE and solar incentives)
  - The pace of consumer adoption of heat pumps and EVs is a key variable
  - States have the ability to further shape demand growth and responsiveness through retail rate designs

The Major Variables and the Need for Collaboration Across Multiple State and Federal Jurisdictions, cont.

- **Transmission**: States (supported by the ISO) are driving transmission to achieve public policy goals
  - New competitive solicitation for long-term transmission planning
    - The ISO's 2050 Transmission Study identified four areas of potential investment:
      - Strengthen ties to Québec (underway with NECEC)
      - Enable integration of offshore wind (enabled through DOE GRIP investments)
      - Strengthen transmission between northern and southern New England to enable renewable development
      - Strengthen ties to New York (also identified in recent DOE study)
  - ISO still needs to comply with FERC order on transmission planning
- **Reliability Services**: The ISO (overseen by FERC) has to ensure adequate compensation for balancing resources and energy adequacy through the wholesale markets

Summary of Frictions and Structural Challenges

- **Lack of a structure to coordinate gas/electric infrastructure and gas/electric markets**
  - Unlikely to be resolved soon; would require changes to the Federal Power Act and/or the Natural Gas Act
- **Inadequate price on carbon to achieve decarbonization objectives**
  - RGGI price is insufficient to drive clean energy investments
  - Decarbonization objective is mostly priced outside of the wholesale markets through clean energy incentives and PPAs, leading to decreasing energy market revenues and increasing dependency on capacity markets and PPAs
- **Asymmetry between load and supply entity views on contracting for future needs** (including the reliability objective)
  - Load is typically a short-to-medium-term player in the wholesale market, and not for full needs
  - New supply (particularly highly capital intensive clean energy resources) typically requires long-term commitments; prompting states to backstop new energy supply through PPAs
  - The reliability objective is left to FERC/NERC/ISO

Summary of Frictions and Structural Challenges, cont.

- **Unrealized potential of retail demand response to provide load flexibility**
  - Would require reforming retail rate structures and deployment of automation and smart metering at the retail level
- **Frictions that impede supply side response:**
  - Siting challenges for all types of energy projects
  - Restrictions on the types of resources that can be developed
  - Supply chain uncertainties that hamper responsiveness and increase costs
  - Industry wide skill shortage to rapidly scale power system

SUMMARY ISO NEW ENGLAND WORK PLAN

Markets Anchor Project

Capacity Auction Reforms (CAR)

- To ensure system reliability and affordability as New England's electricity demand and power resource mix undergoes a significant transformation, CAR:
  - Transitions the capacity market from a three-year forward auction to a prompt auction that runs shortly before the capacity commitment period (CCP)
  - Restructures the CCP from annual to seasonal commitment periods
  - Reshapes capacity market accreditation to more accurately reflect resource adequacy contributions from an evolving resource mix, from season to season
- Design and implementation of the changes will span 2025-2027
  - The current Forward Capacity Market has secured capacity commitments through May 2028 (CCP 18)

Markets Anchor Project and Notable Initiatives

- **Day-Ahead Ancillary Services Initiative (DASI)**
  - The ISO is developing the software and systems changes needed to implement the Day-Ahead Ancillary Services Initiative (DASI), targeted for implementation in Q1 2025
  - Includes a day-ahead operating plan that satisfies both the load forecast and contingency reserve requirements
  - DASI will incorporate two new products into the Day Ahead market:
    - Flexible response services (FRS) *and* Energy imbalance reserves (EIR)
  - The existing Forward Reserve Market will be retired

- **Flexible Response Services (FRS)**
  - The ISO has been evaluating the system's needs for flexible response capabilities to address greater operational uncertainties with an increasingly weather-dependent resource mix; this evaluation will consider new products in the day-ahead and real-time markets as potential market-based solutions to these flexibility needs

Operations Anchor Project

Regional Energy Shortfall Threshold (REST)

- Stakeholders discussions re: updates to the Probabilistic Energy Adequacy Tool (PEAT) are underway
  - ISO expects the model to be fully operational by the end of 2024
- Expected in Q4 2024, the ISO will present its REST proposal for establishing an acceptable threshold of energy shortfall risk during low-probability extreme weather events as identified through PEAT
- The ISO plans to begin performing PEAT/REST assessments seasonally, starting with winter 2025/2026
  - Following, annual assessments with longer look-ahead horizons (to be defined) will be considered to inform risk trends over time
- Results of the first assessment will provide more data on the risk trends to guide the timing and nature of the next phase, which is to evaluate whether the possibility of exceeding the REST requires development of specific regional solutions to mitigate risks

Planning Anchor & Implementation Projects

First Competitive Solicitation for LTTP Solution

- In 2025, the ISO expects to implement an RFP process in anticipation of a request from the states for a competitively-selected transmission solution to address New England's future, clean energy needs in connection with the 2050 Transmission Study
- The RFP process, from initiation through final recommendation, is expected to take approximately 18 months

FERC Order No. 1920: Building for the Future Through Electric Regional Transmission Planning and Cost Allocation

- The ISO is assessing the assimilation of the extensive Final Rule with New England's innovative Longer-Term Transmission Planning (LTTP) framework accepted by FERC in July 2024
- Several entities nationwide have appealed the order at FERC, and now at court

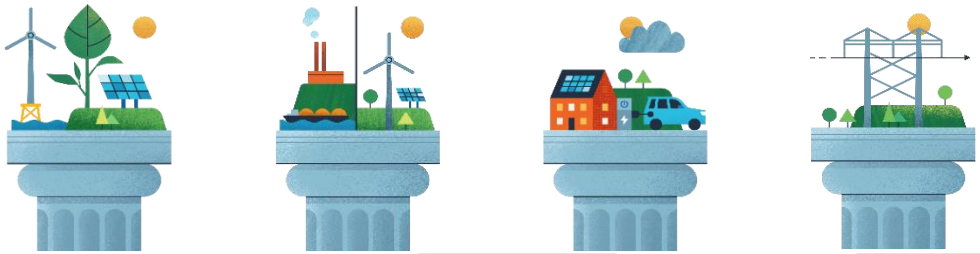
Planning Anchor & Implementation Projects, cont.

Transmission Sizing for the Clean Energy Transition

- The ISO, the New England states, and NEPOOL stakeholders seek to develop an approach to sizing transmission projects for the future to support integration of renewables and higher load levels over the life of the transmission asset
- As indicated in the 2024 AWP, the ISO plans to work with NESCOE and Transmission Owners to establish guidelines for “right-sizing” transmission facilities for the clean-energy transition
  - Guidelines would be applicable to asset condition projects and potentially to transmission developed through other upgrade processes
  - Discussions would address NEPOOL’s priority request for the 2025 AWP to develop methods for distinguishing right-sizing costs from asset condition project costs
- Timing on right-sizing discussions will move forward after the states and TOs complete their asset condition process improvements initiative

Conclusion: ISO is Focused on Developing Solutions to Today's Grid Challenges

- Economic and environmental factors are resulting in generator retirements, while state policies are driving investments in clean and renewable energy
- Retiring and emerging resources exhibit very different characteristics
  - Improved market designs and new reliability standards will be needed to ensure resource and energy adequacy
- New England must balance multiple objectives:
  - Robust wholesale markets to ensure reliability
  - Affordable decarbonization of the regional energy system
- The ISO is developing responsive market designs to accommodate the changing resource mix and conducting longer-term transmission studies to support state policies



Questions