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New England's Evolving Grid

AEE New England Energy Outlook Forum

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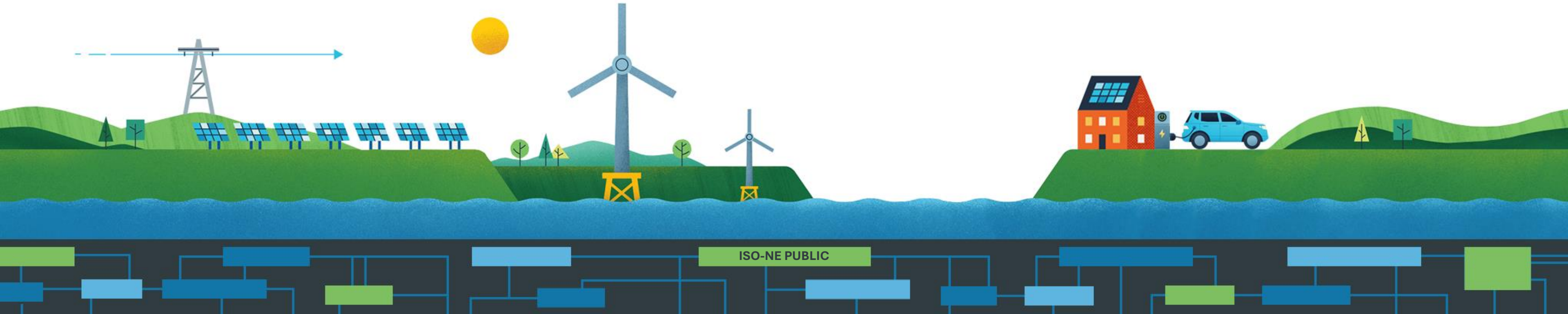
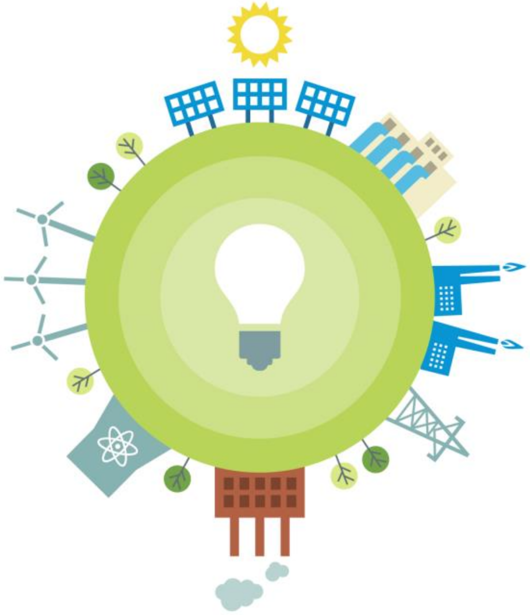


Today's Presentation

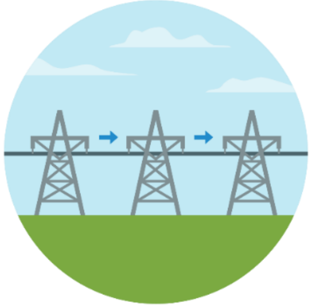
1. Introduction
2. Building Upon Past Knowledge
3. Key Findings
4. Conclusion



ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

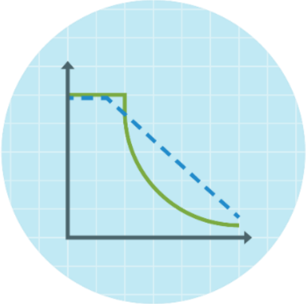
Grid Operation

Coordinate and direct the flow of electricity over the region's high-voltage transmission system



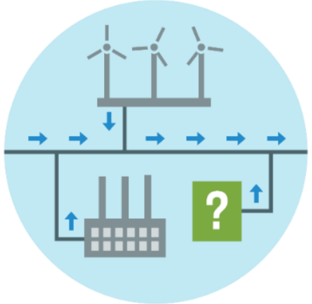
Market Administration

Design, run, and oversee the markets where wholesale electricity is bought and sold



Power System Planning

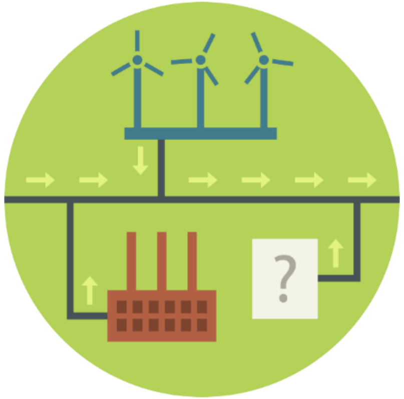
Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years



Things We Don't Do

- Handle retail electricity
- Own power grid infrastructure
- Have a stake in companies that own grid infrastructure
- Have jurisdiction over fuel infrastructure
- Have control over siting decisions
- Plan the resource mix

ISO New England Manages Regional Power System Planning to Meet Future Electricity Needs



- Manage regional power system planning in accordance with mandatory reliability standards
- Administer requests for interconnection of generation and regional transmission system access
- Conduct transmission system needs assessments
- Plan regional transmission system to provide regional network service
- Develop Regional System Plan (RSP) with a ten-year planning horizon
- Perform longer-term transmission planning

ISO-NE Is a Summer-Peaking System

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, with peaks on such days averaging roughly 25,600 MW since 2000
- Region's all-time summer peak demand was **28,130 MW** on **Aug. 2, 2006**

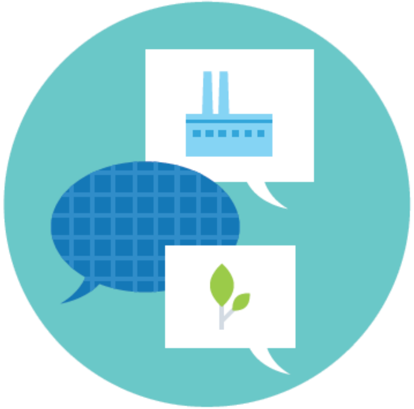
The region is expected to shift back to a **winter-peaking system** with the electrification of heating demand

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

BUILDING UPON PRIOR KNOWLEDGE

Economic Studies Background

- Previously, ISO New England performed stakeholder requested Economic Studies to analyze future potential power systems
- Following recent changes to the Economic Study process' Tariff provisions, the ISO now performs three repeated scenarios along with a potential Stakeholder-Requested Scenario*
- The Economic Planning for a Clean Energy Transition Study (EPCET) was a dry run of the new Economic Study process
  - The 2024 Economic Study was the first Economic Study conducted under this new structure
- Previous Economic Studies can be found on the ISO-NE Economic Studies webpage



* A self-funded stakeholder request option is also available

Objective of the Economic Study Process

- Provide information to stakeholders to help them evaluate the economic and environmental impacts of New England state policies, federal policies, and various resource technologies on satisfying future resource needs
- Identify potential system efficiency issues on the New England transmission system (specifically the Pool Transmission Facilities portion) and, where appropriate, explore competitive solutions to address any identified congestion above the set dollar threshold
- Economic Studies are not plans to build certain resources
- More details on the Economic Study process can be found in the Economic Studies Technical Guide

Economic Studies Modeling

Production Cost Modeling

- Replicates the hourly economic dispatch of the New England power system
- Provides data on emissions, prices, production cost to generators, cost to load, fuel consumption, generation and curtailment, system congestion, and generator revenues

Capacity Expansion Modeling

- Longer-term view of the evolution of the New England power system over time
- Usually paired with production cost models to provide more detailed data on individual years

Economic Study Reference Scenarios

Benchmark Scenario

Prior Year

Model the previous calendar year and compare it to historical performance to assess model fidelity and improve future scenario accuracy

System Efficiency Needs Scenario*

10 Years Out

Model a future year (10-year planning horizon) based on the ISO's existing planning criteria to identify system efficiency issues that could meet the threshold of a System Efficiency Needs Assessment and move on to the competitive solution process for System Efficiency Transmission Upgrades needs

Policy Scenario

Beyond 10 Years

Model future years (10+ year planning horizon) based on satisfying New England region and other energy policies and goals

Stakeholder-Requested Scenario

?

Stakeholders may request analysis with a region-wide scope that is not covered by the other three scenarios; or they may request additional "sensitivity" analysis on these three scenarios

** System Efficiency Needs Scenario results are not included as part of the 2024 Economic Study Report and can be found on the Economic Study page of the ISO website*

Building Upon EPCET

Reduced Decarbonization

EPCET assumed that states' net-zero by 2050 target would mean a 100% decarbonized electric grid which would require vast buildouts of solar, wind, and battery resources (very costly and unrealistic)

- 2024 Economic Study re-interpreted net-zero to be a 75-85% decarbonized grid assuming carbon offsetting technology will be implemented

Flexible Demand

EPCET started exploring the benefits of flexible load by modelling discretionary loads using hydrogen electrolyzers which can be turned on/off to reduce peak demand and/or absorb oversupply

- 2024 Economic Study expanded the scope of flexible load to shift baseload and electric vehicle (EV) load within each day

Sampling Days

EPCET capacity expansion built resources using randomly sampled days

- 2024 Economic Study tested locked in representative sample days to allow for a more correlated buildout of resources at varying electrification rates

New Technologies

EPCET's Policy Scenario expansion candidates only include fixed-tilt monofacial PV, offshore wind (OSW), land-based wind (LBW), 4-hr/8-hr batteries (BESS)

- 2024 Economic Study explored addition of bi-facial tracking PV, small modular nuclear reactors (SMRs), and 100-hr BESS

KEY FINDINGS

Overview of Key Findings

1

Including more dispatchable technologies reduces needed capacity by over 15%

2

Shifting the hours of peak demand in winter reduces costs

3

Emissions reductions beyond 85% of policy goals drive escalating costs

4

Demand growth also increases costs beyond the 2040s

5

Deep decarbonization in 2040s drives increased curtailment of renewables and reduces the economic viability of certain technologies

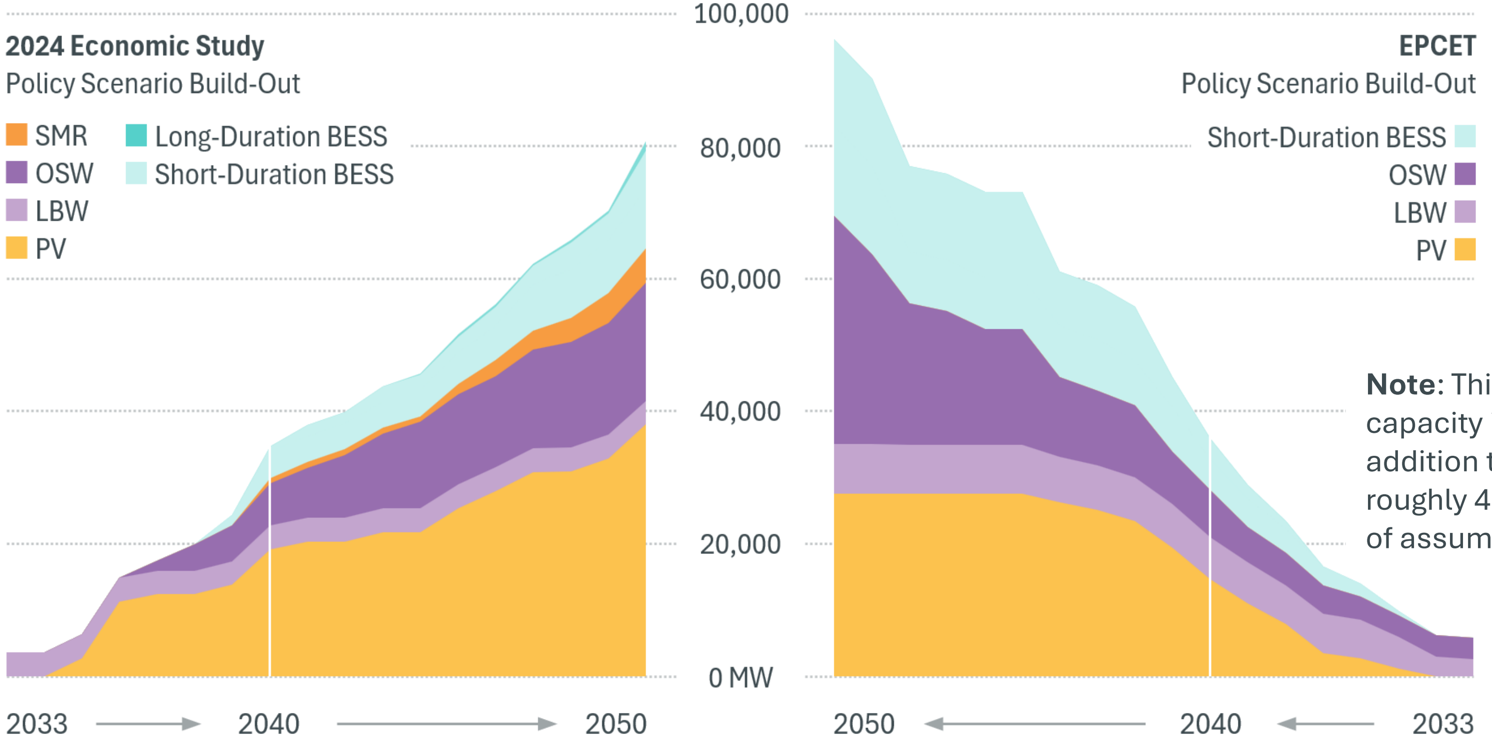
6

Land-based wind is consistently economical from 2033 to 2050, while PV supports early decarbonization

See report for full description of findings and results

Including More Dispatchable Technologies Reduces Needed Capacity by More Than 15%

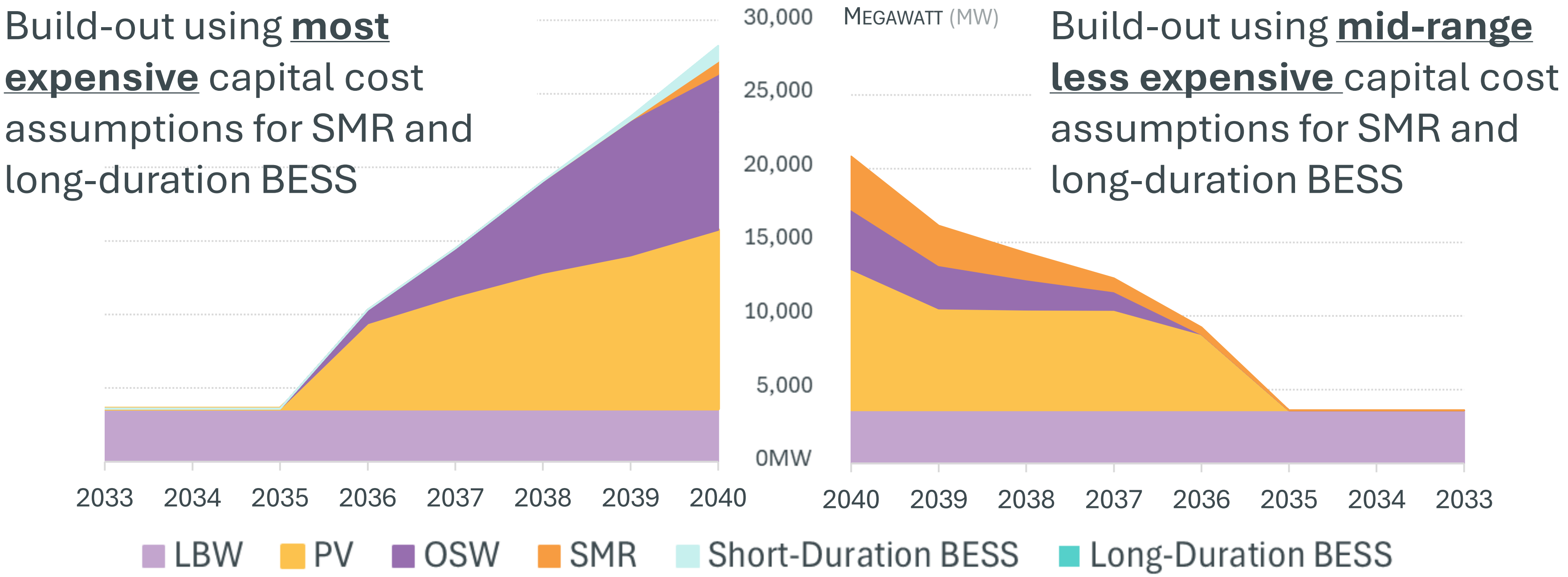
Key Finding 1



Note: This new capacity is in addition to the roughly 49,000 MWs of assumed capacity

Including More Dispatchable Technologies Reduces Needed Capacity by More Than 15%, cont.

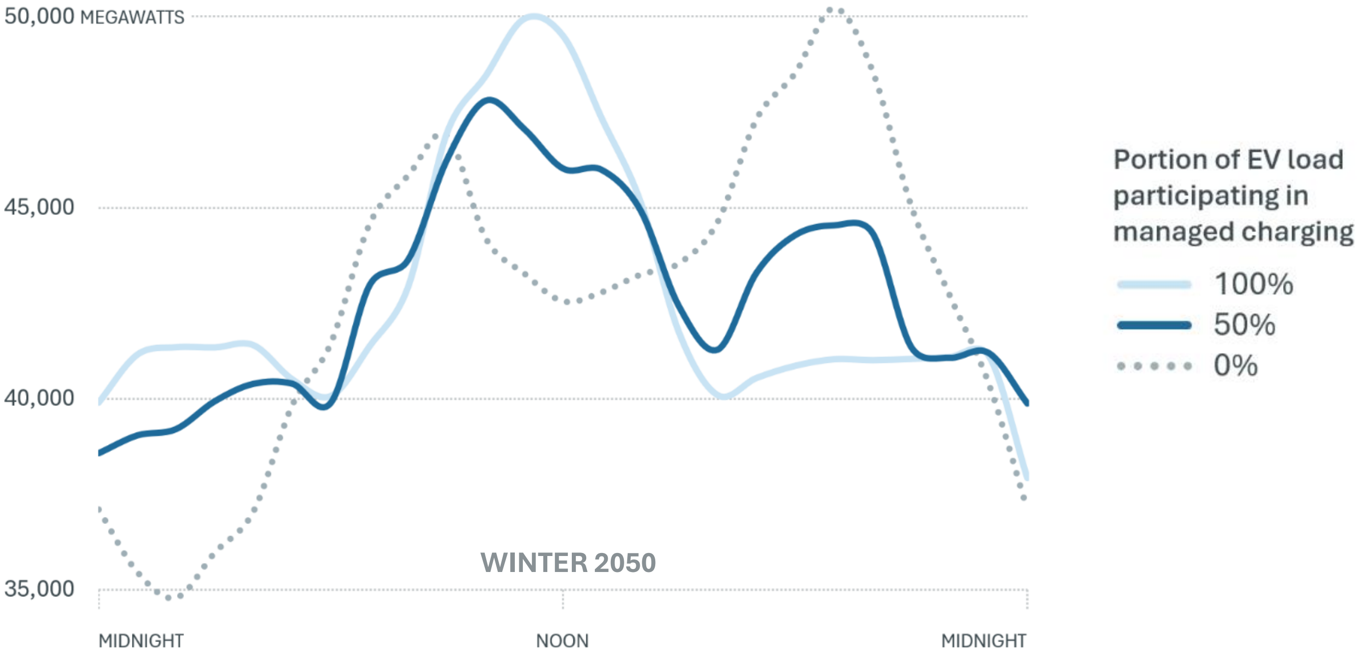
Key Finding 1



Shifting Peaks in Winter Demand Reduces Costs

Key Finding 2

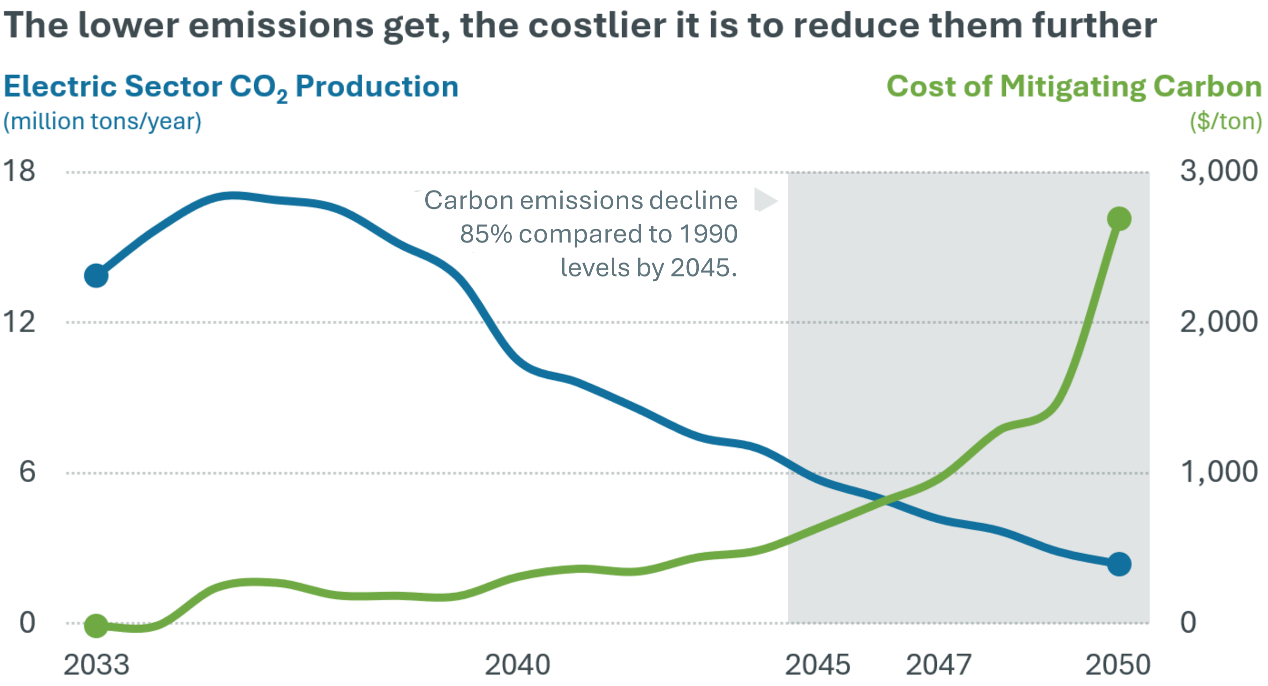
Flexible charging of EVs reduces even peak demand in winter 2050



Note: Chart includes behind the meter (BTM) solar, but does not account for utility scale solar

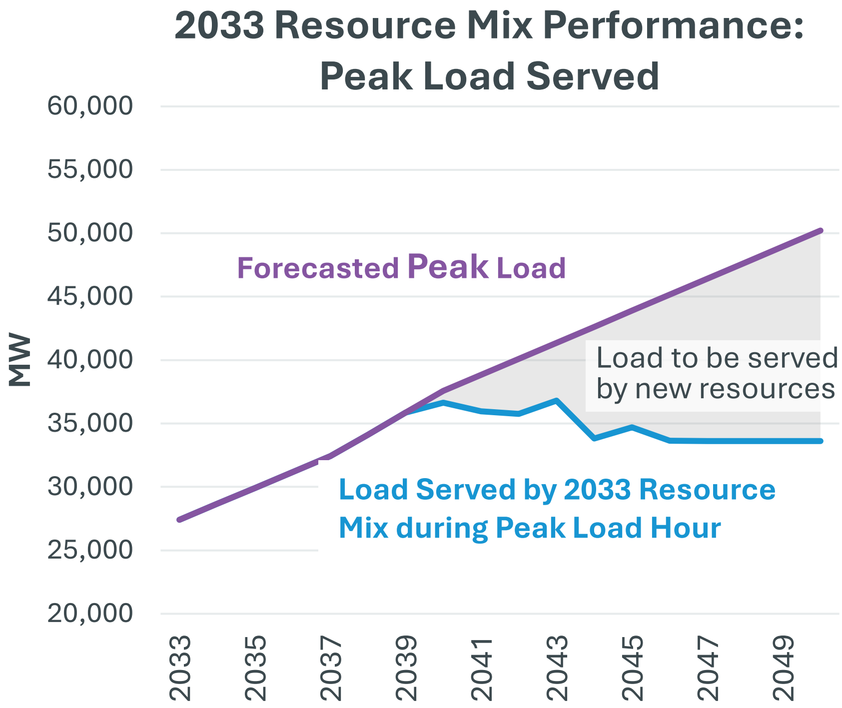
Emissions Reductions Beyond 85% of Policy Goals Drive Escalating Costs

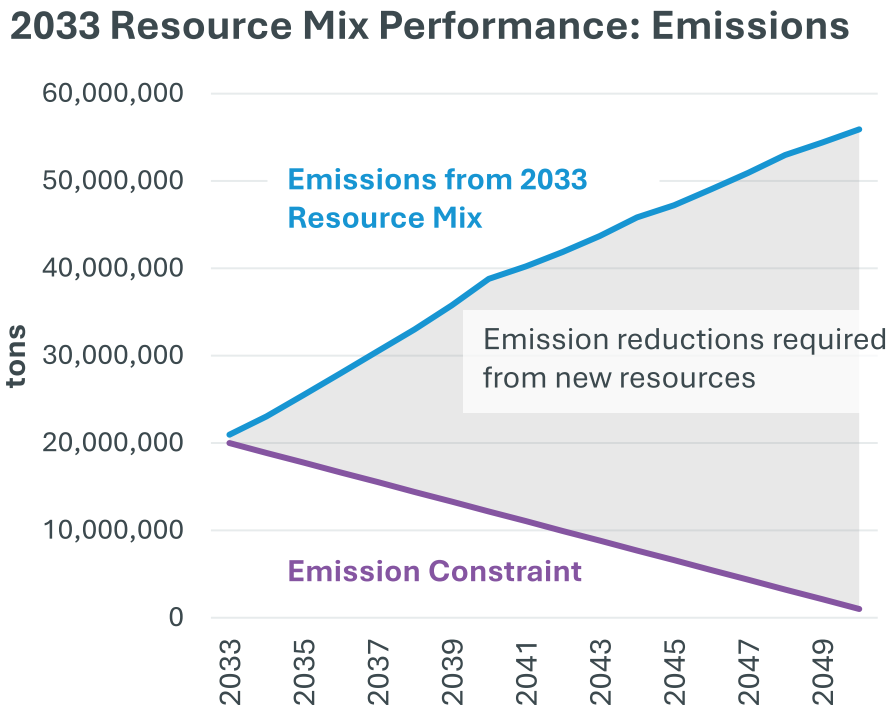
Key Finding 3



Demand Growth Also Increases Costs in the 2040s

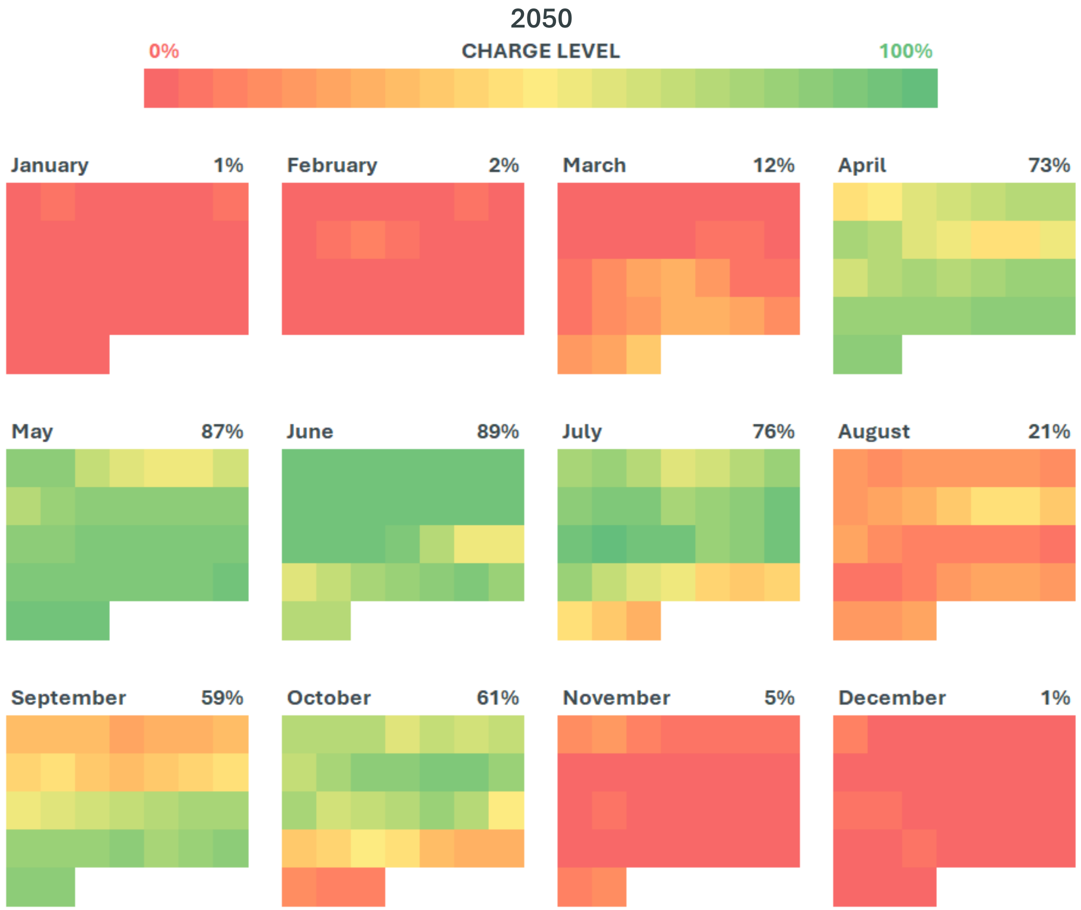
Key Finding 4





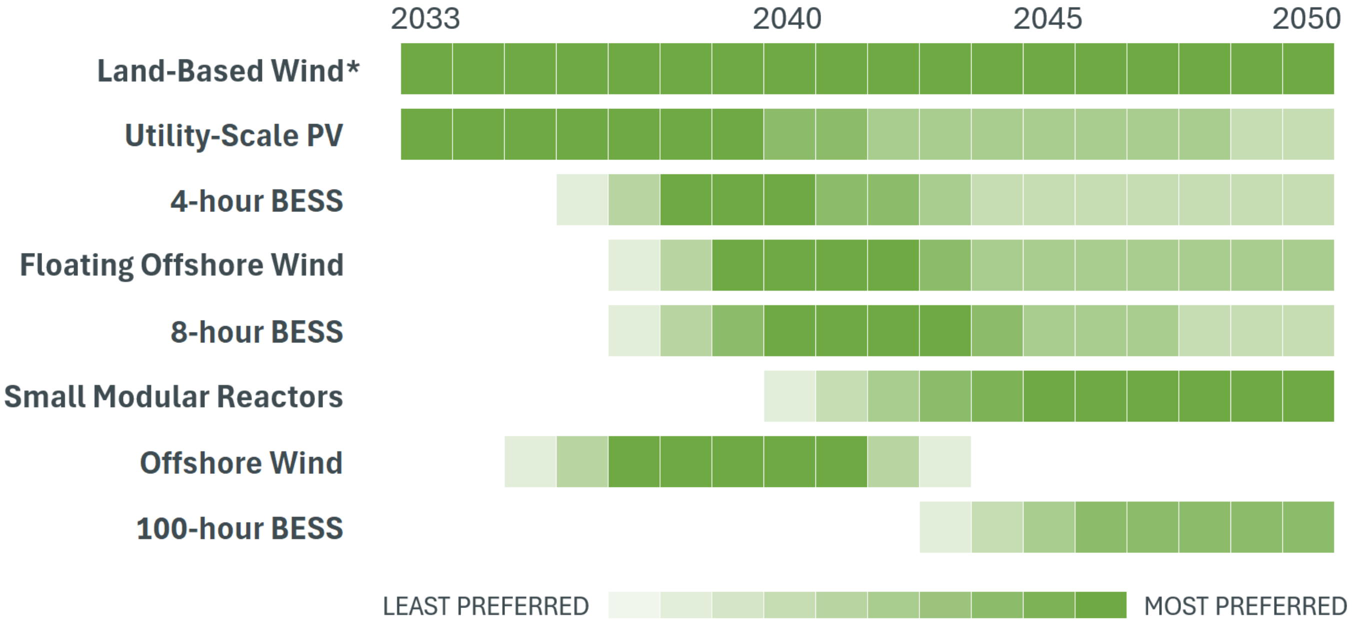
Deep Decarbonization in 2040s Drives Increased Curtailment of Renewables and Reduced Economics of Certain Technologies

Key Finding 5



Land-based Wind is Consistently Economical from 2033 to 2050, While PV Supports Early Decarbonization

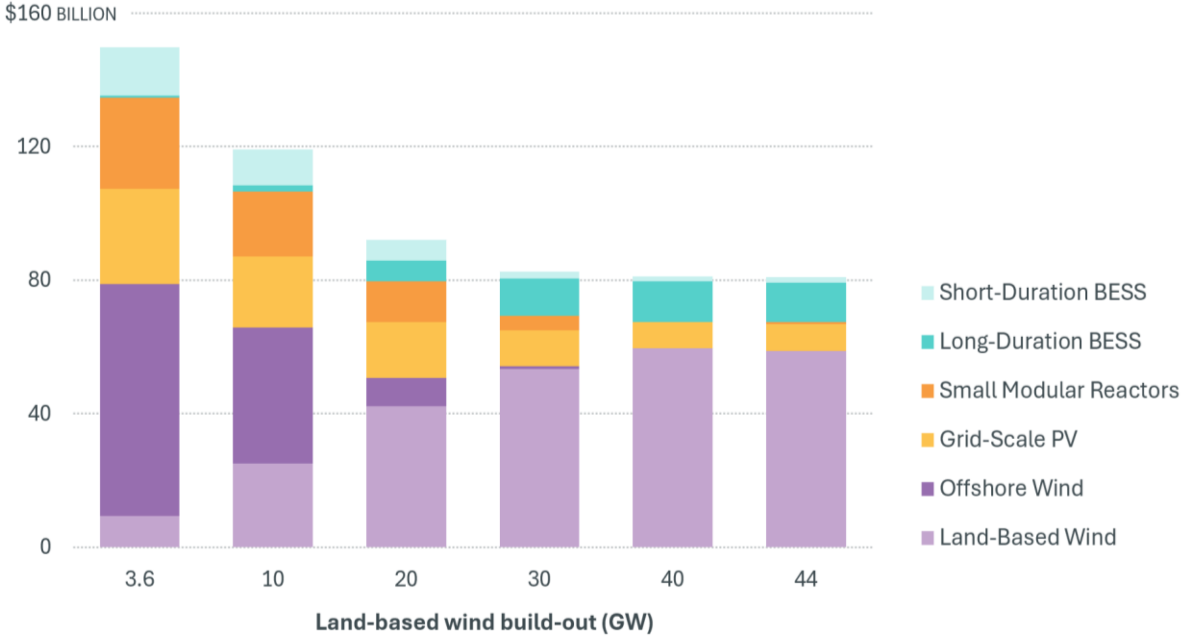
Key Finding 6

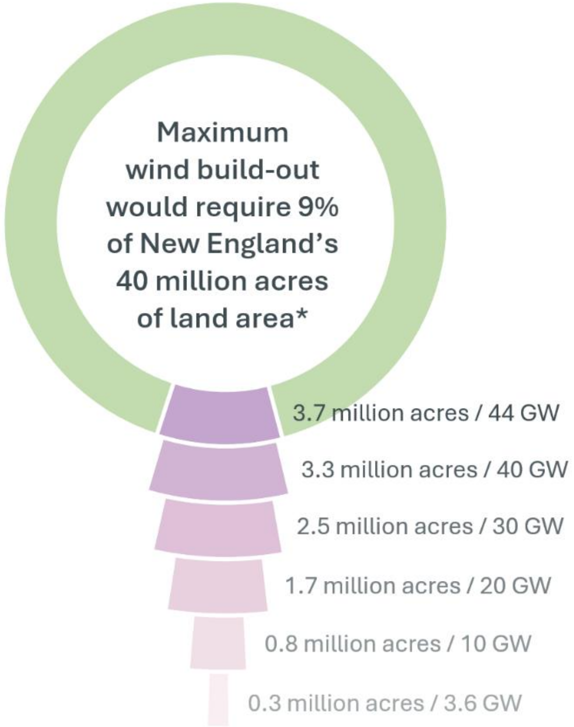


*Land-based wind is the only technology subject to land availability constraints.
This category reflects what the model would build without these constraints.

Land-Based Wind is Consistently Economical from 2033 to 2050, While PV Supports Early Decarbonization, cont.

Key Finding 6





* Assuming 6 MW turbines requiring 500 acres each.

Shifting part of the decarbonization effort away from the electric sector can significantly reduce costs

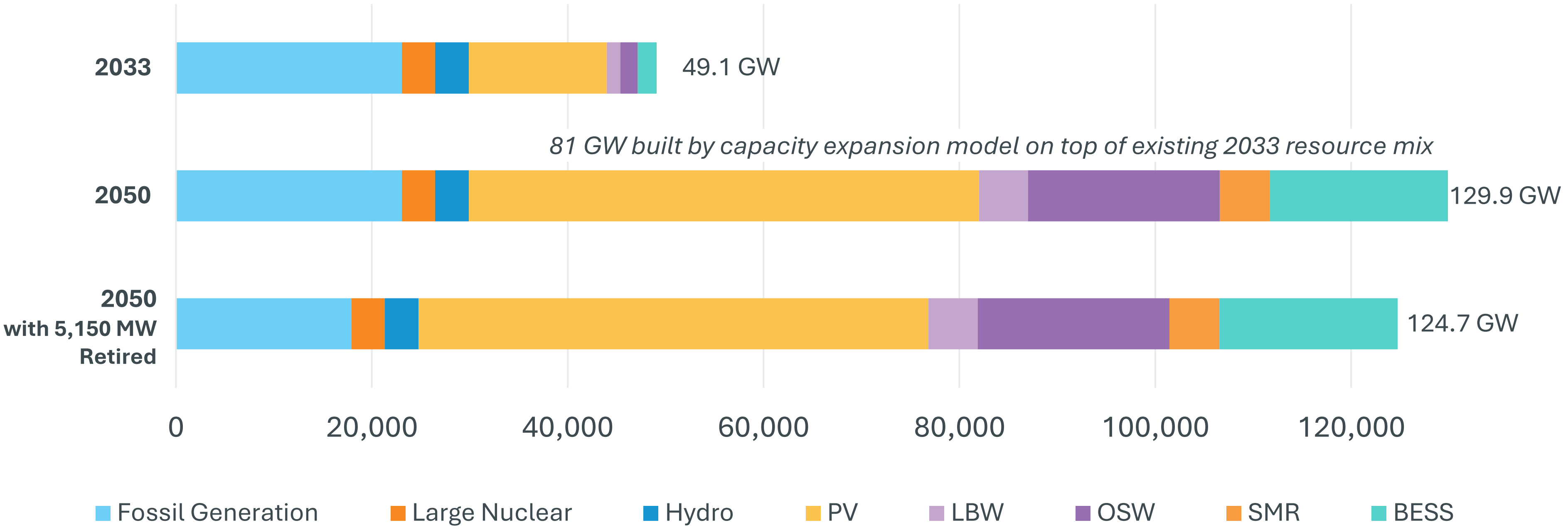
Additional Findings

Scenario	Cost reduction versus Reference*
% electric sector decarbonization *% electrification of transportation and heating sectors*	**%** *cost reduction versus Reference**
***100%** electric sector decarbonization* ***85%** electrification of transportation and heating sectors*	**18%** *cost reduction versus Reference*
***85%** electric sector decarbonization* ***100%** electrification of transportation and heating sectors*	**29%** *cost reduction versus Reference*
***85%** electric sector decarbonization* ***85%** electrification of transportation and heating sectors*	**43%** *cost reduction versus Reference*
***100%** electric sector decarbonization* ***75%** electrification of transportation and heating sectors*	**30%** *cost reduction versus Reference*
***75%** electric sector decarbonization* ***100%** electrification of transportation and heating sectors*	**43%** *cost reduction versus Reference*
***75%** electric sector decarbonization* ***75%** electrification of transportation and heating sectors*	**66%** *cost reduction versus Reference*

**Reference case assumes 100% electric sector decarbonization and 100% electrification of transportation and heating sectors*

System Will Continue to Rely on Existing Fleet for Reliability

Additional Findings



LOOKING FORWARD

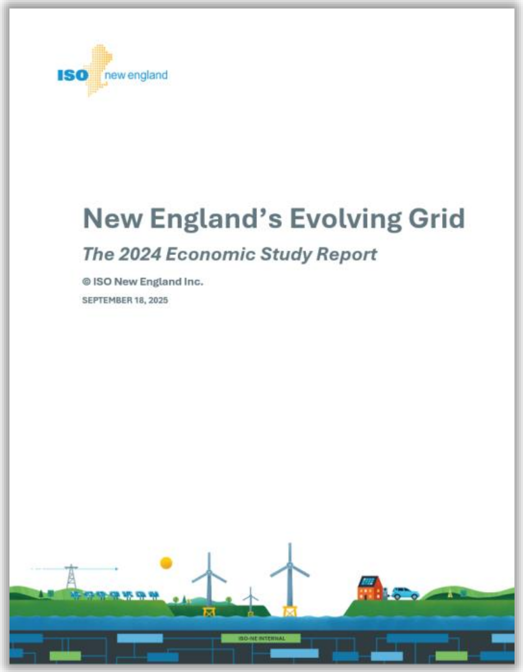
Conclusion and Next Steps

- The 2024 Economic Study is **one of the broadest power system analyses the ISO has conducted to date**, with over 2,500 simulations across nearly 40 scenarios
  - The results show that **early, least-cost emissions reductions and a diverse set of technologies** can maintain reliability at scale
  - **Insights on flexible demand, renewable integration, and system planning** are relevant well beyond New England
- The work **builds on EPCET results**, creating continuity in the analysis and helping to track trends in the region's decarbonization pathways
- Findings will **guide policymakers, planners, and stakeholders** in evaluating tradeoffs and practical strategies, while also informing the 2026 Economic Study as it explores new trajectories for the regional grid

Questions

Dig Deeper

2024 Economic Study materials can be found on [the ISO Economic Studies webpage]



ISO new england

New England's Evolving Grid

The 2024 Economic Study Report

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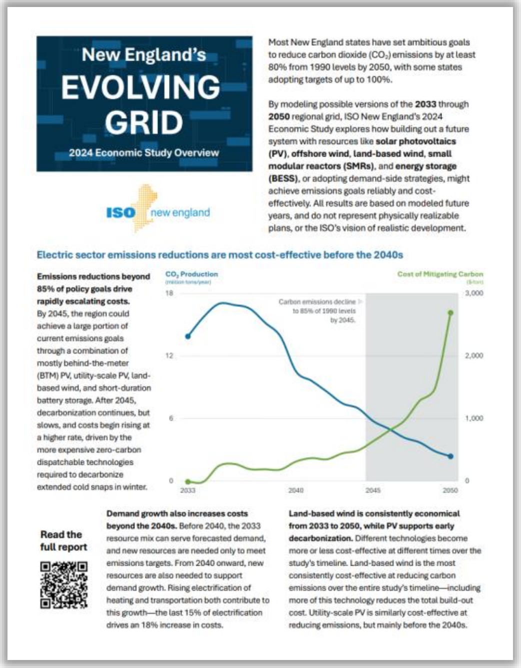
New England's Evolving Grid: The 2024 Economic Study Report



New England's EVOLVING GRID

2024 Economic Study Overview

ISO new england

Most New England states have set ambitious goals to reduce carbon dioxide (CO_2) emissions by at least 80% from 1990 levels by 2050, with some states adopting targets of up to 100%.

By modeling possible versions of the **2033** through **2050** regional grid, ISO New England's 2024 Economic Study explores how building out a future system with resources like **solar photovoltaics (PV)**, **offshore wind**, **land-based wind**, **small modular reactors (SMRs)**, and **energy storage (BESS)**, or adopting demand-side strategies, might achieve emissions goals reliably and cost-effectively. All results are based on modeled future years, and do not represent physically realizable plans, or the ISO's vision of realistic development.

Electric sector emissions reductions are most cost-effective before the 2040s

Emissions reductions beyond 85% of policy goals drive rapidly escalating costs. By 2045, the region could achieve a large portion of current emissions goals through a combination of mostly behind-the-meter (BTM) PV, utility-scale PV, land-based wind, and short-duration battery storage. After 2045, decarbonization continues, but slows, and costs begin rising at a higher rate, driven by the more expensive zero-carbon dispatchable technologies required to decarbonize extended cold snaps in winter.

Read the full report

Demand growth also increases costs beyond the 2040s. Before 2040, the 2033 resource mix can serve forecasted demand, and new resources are needed only to meet emissions targets. From 2040 onward, new resources are also needed to support demand growth. Rising electrification of heating and transportation both contribute to this growth—the last 15% of electrification drives an 18% increase in costs.

Land-based wind is consistently economical from 2033 to 2050, while PV supports early decarbonization. Different technologies become more or less cost-effective at different times over the study's timeline. Land-based wind is the most consistently cost-effective at reducing carbon emissions over the entire study's timeline—including more of this technology reduces the total build-out cost. Utility-scale PV is similarly cost-effective at reducing emissions, but mainly before the 2040s.

New England's Evolving Grid Fact Sheet

Acronyms

BESS	Battery Energy Storage Systems
BTM PV	Behind the Meter Photovoltaic
CELT	Capacity, Energy, Load, and Transmission Report
EPCET	Economic Planning for the Clean Energy Transition
EV	Electric Vehicle
LBW	Land-based Wind
OSW	Offshore Wind
PV	Photovoltaic
RSP	Regional System Plan
SMR	Small Modular Reactor

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