Eversource's Grid of the Future Study Methodology & Preliminary Results

Joint MC/RC Meeting

July 1st, 2020

Economic modeling and analysis performed by London Economics International on behalf of Eversource

Eversource's Grid of the Future Study analyzes the impact of decarbonization policy on the electric grid

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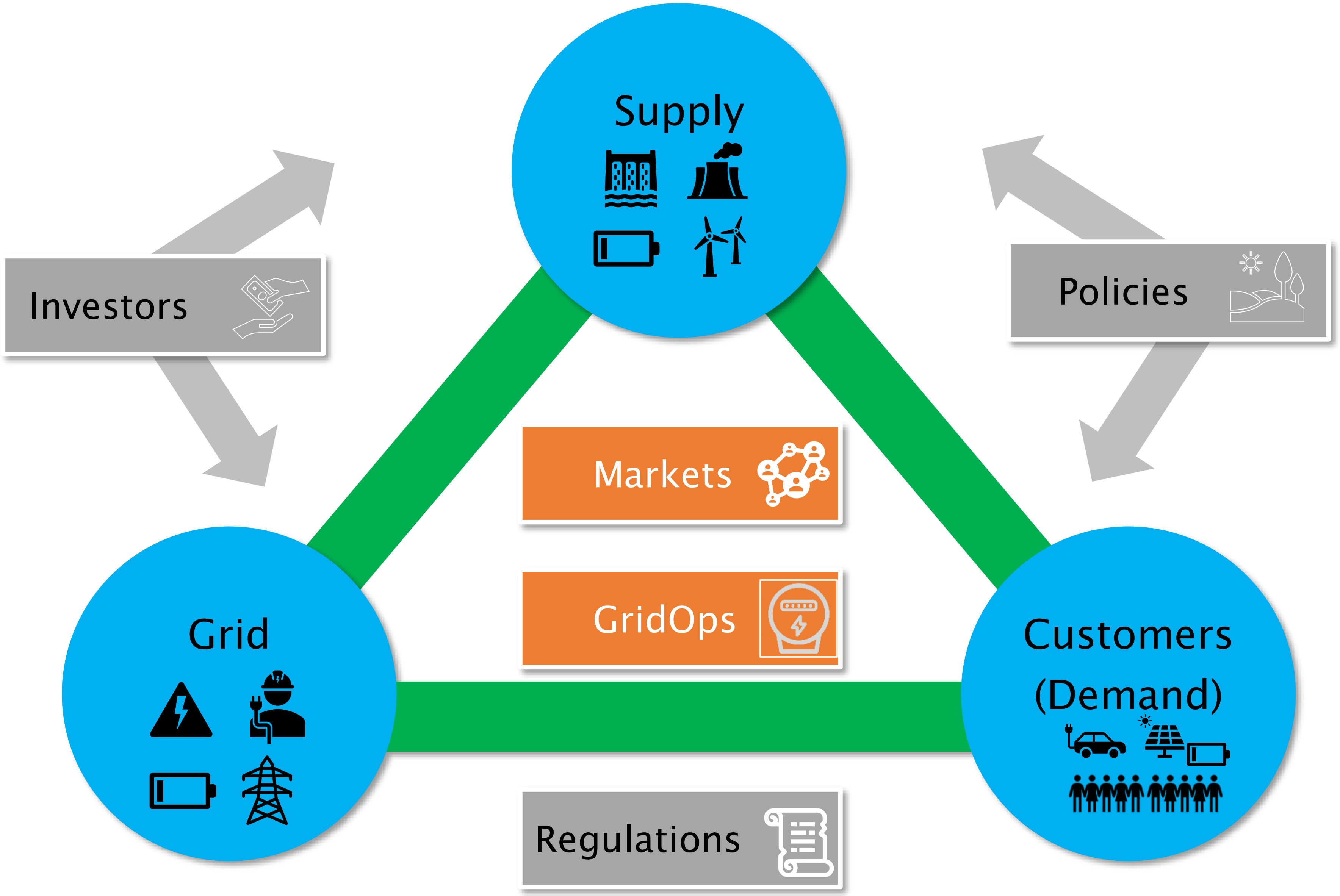

Goal of the Study

- Quantify electric system changes needed to meet regional carbon emission reduction targets

Eversource's Role

- Strategies and actions to enable a clean energy future reliably and cost effectively
- System planning and operational needs
- Resource adequacy and system attributes needed in the future
- Enable Transmission and Market policies.

Study Approach

- London Economics performed comprehensive industry research and hourly economic simulations for the next three decades to identify specific changes to the electric grid necessary to support decarbonization policies

An economy-wide CO_2 emissions reduction would result in major changes to the electricity eco-system

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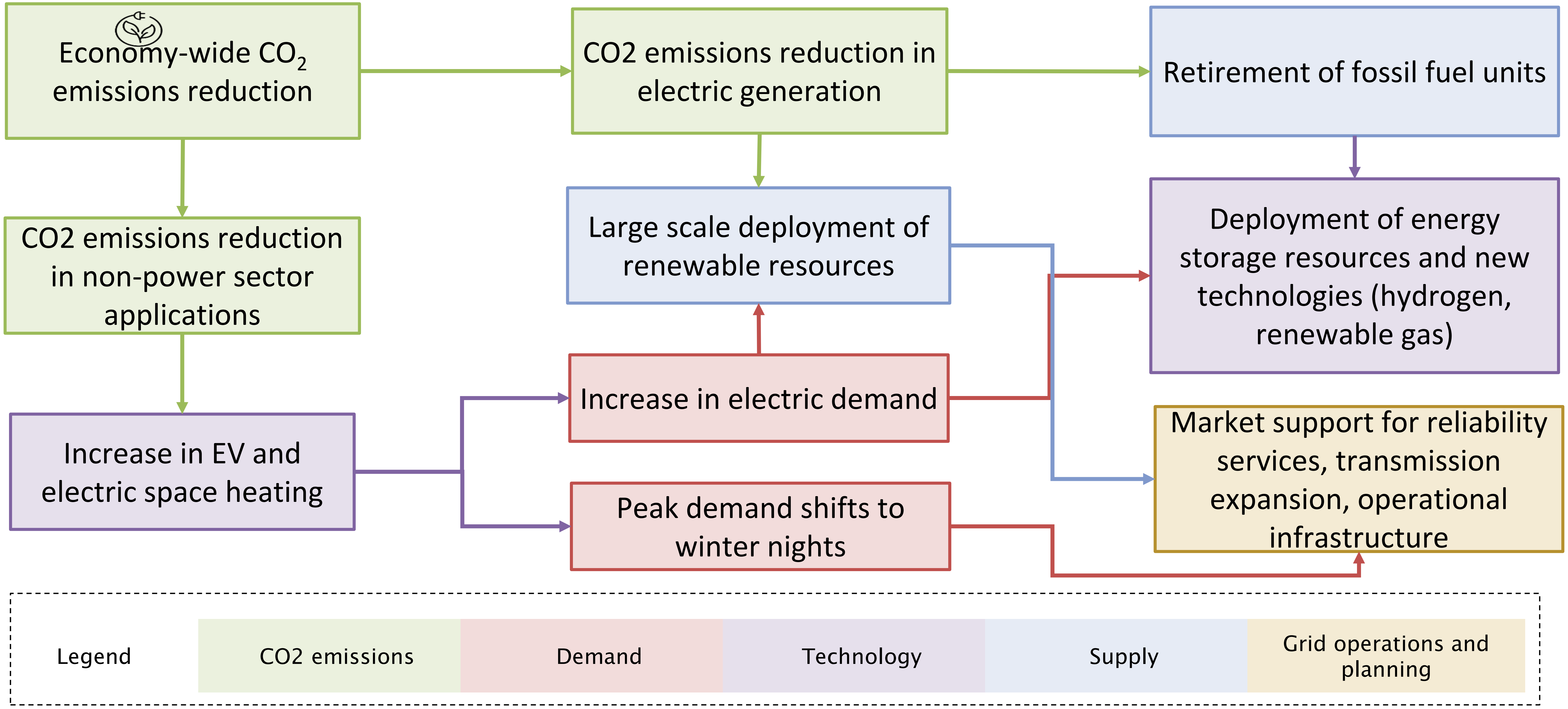


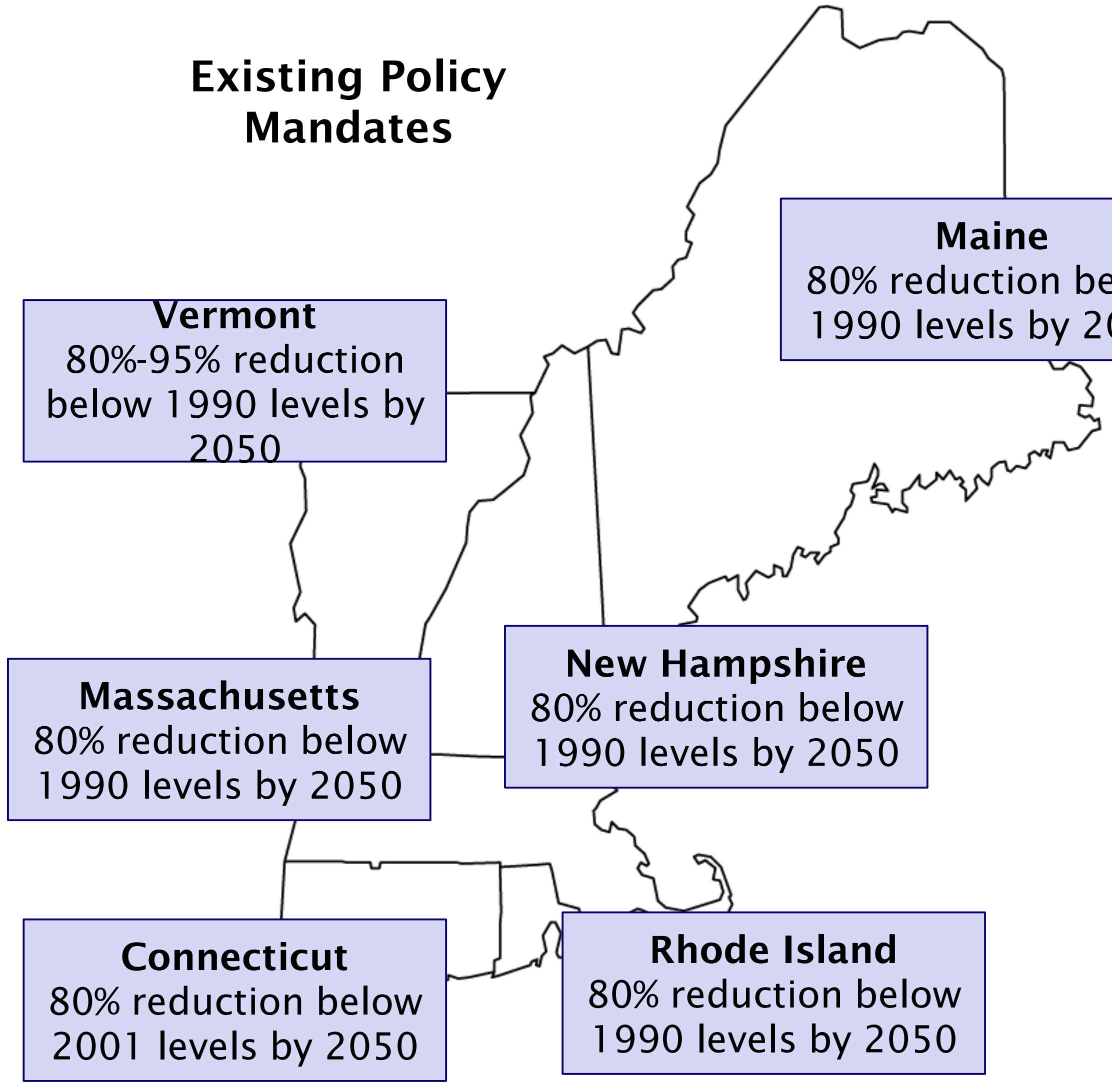
Study scenarios align with current decarbonization policies

Eversource Grid of the Future Scenarios

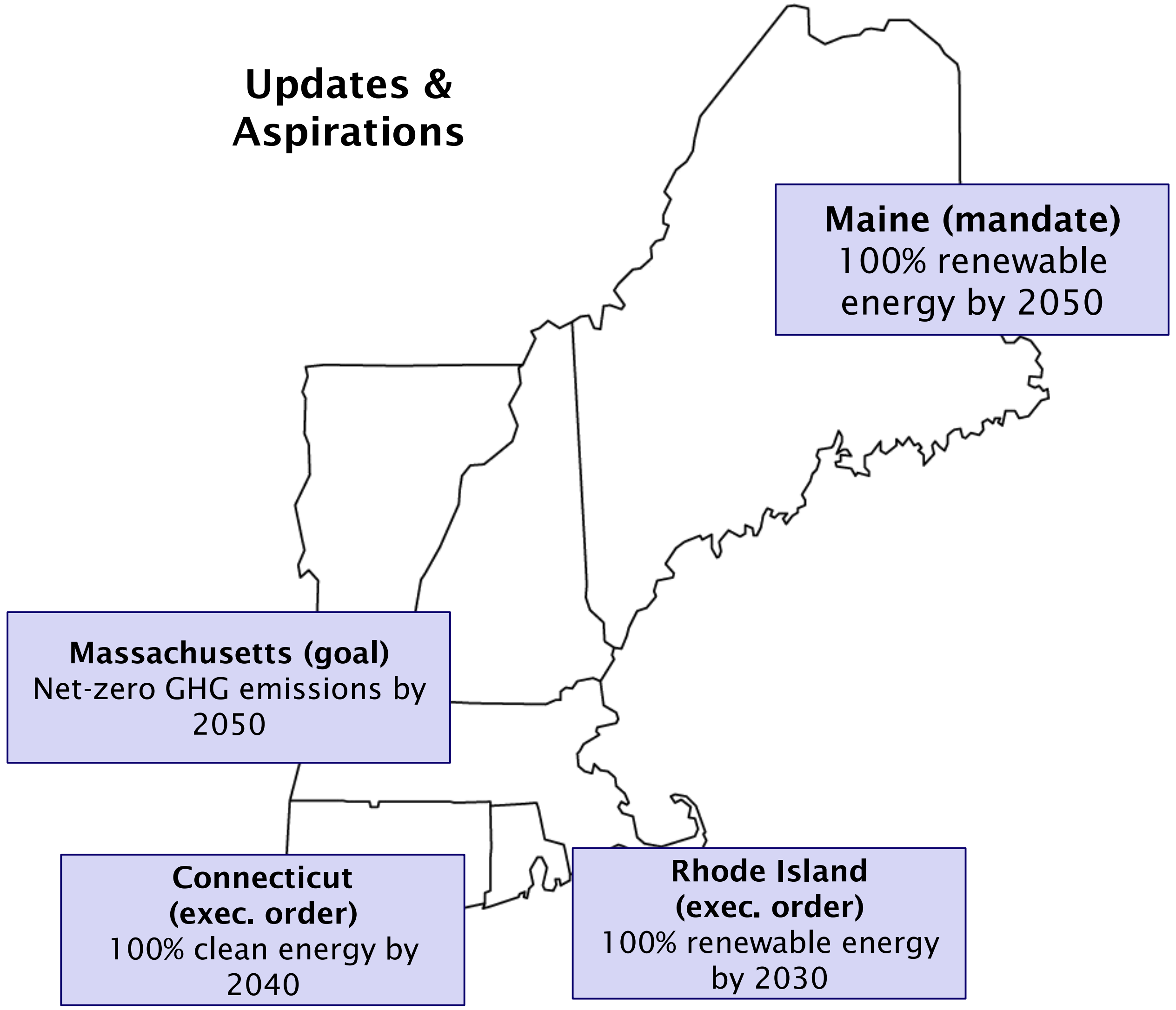
Existing Decarbonization Mandates
(80% reduction below target levels by 2050)

Aggressive Decarbonization to capture potential future policy
(95% reduction below target levels by 2040)

Existing Policy Mandates



Updates & Aspirations



The Grid of the Future Study was intentionally designed to understand changes in all sectors of the economy and their impact on the Electric Grid

Traditional studies to date have focused mostly on individual sectors

Electric sector only accounts for ~14% of the carbon footprint of New England

Main carbon emissions source in New England is transportation, and we assume transportation sector would decarbonize by converting the passenger fleet to EV

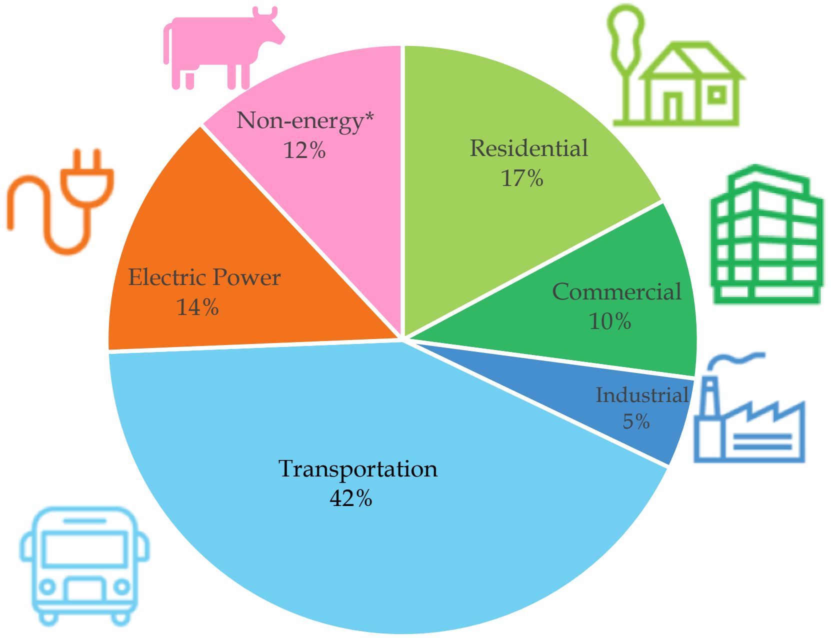
EVs account for 48% of emission reduction from 2020 to 2030 and 2030 to 2040

Decarbonizing other sectors of the economy will result in both higher demand for electricity and changes in demand dynamics

Current energy consumption is still heavily fossil fuel-reliant

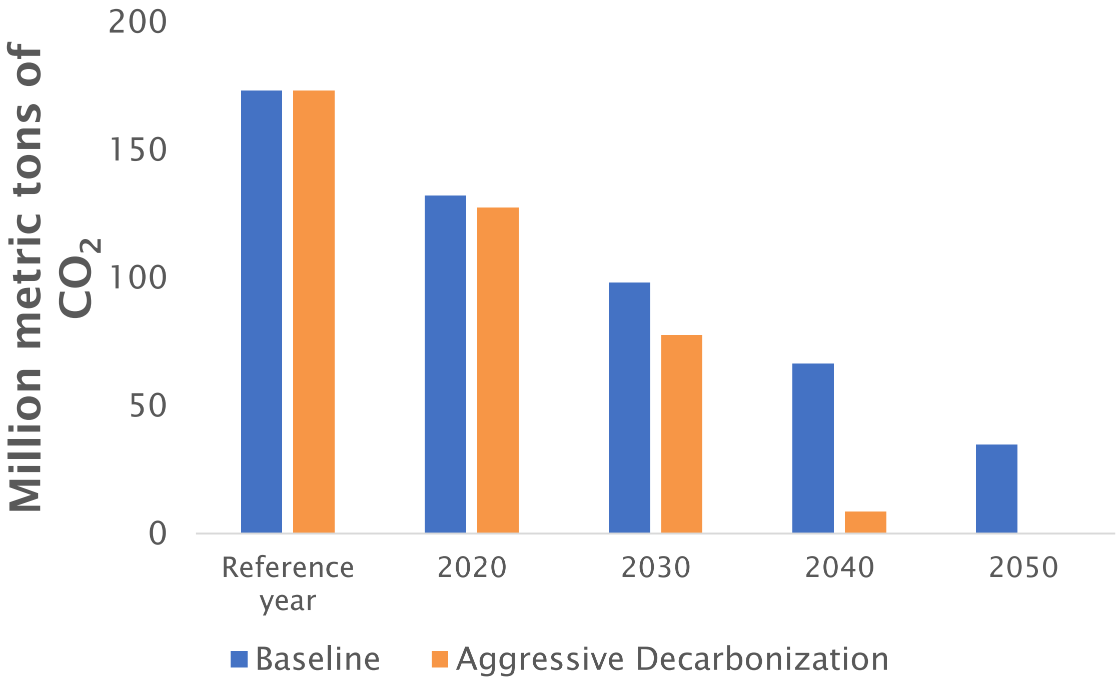
Major changes in supply mix and the grid are required to meet future objectives

Share of CO2 emission in New England (2017)

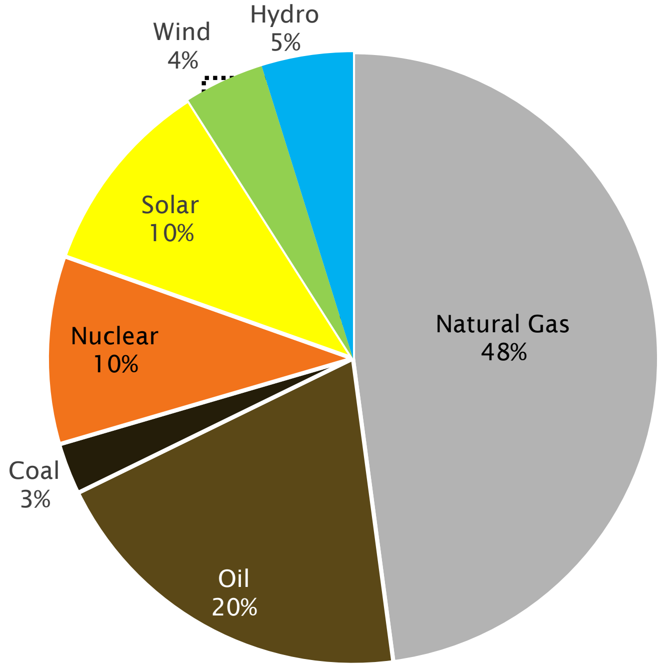


Source: EIA State Carbon Dioxide Emission Data and each state's GHG Inventory for non-energy emission

CO_2 Emissions reduction targets

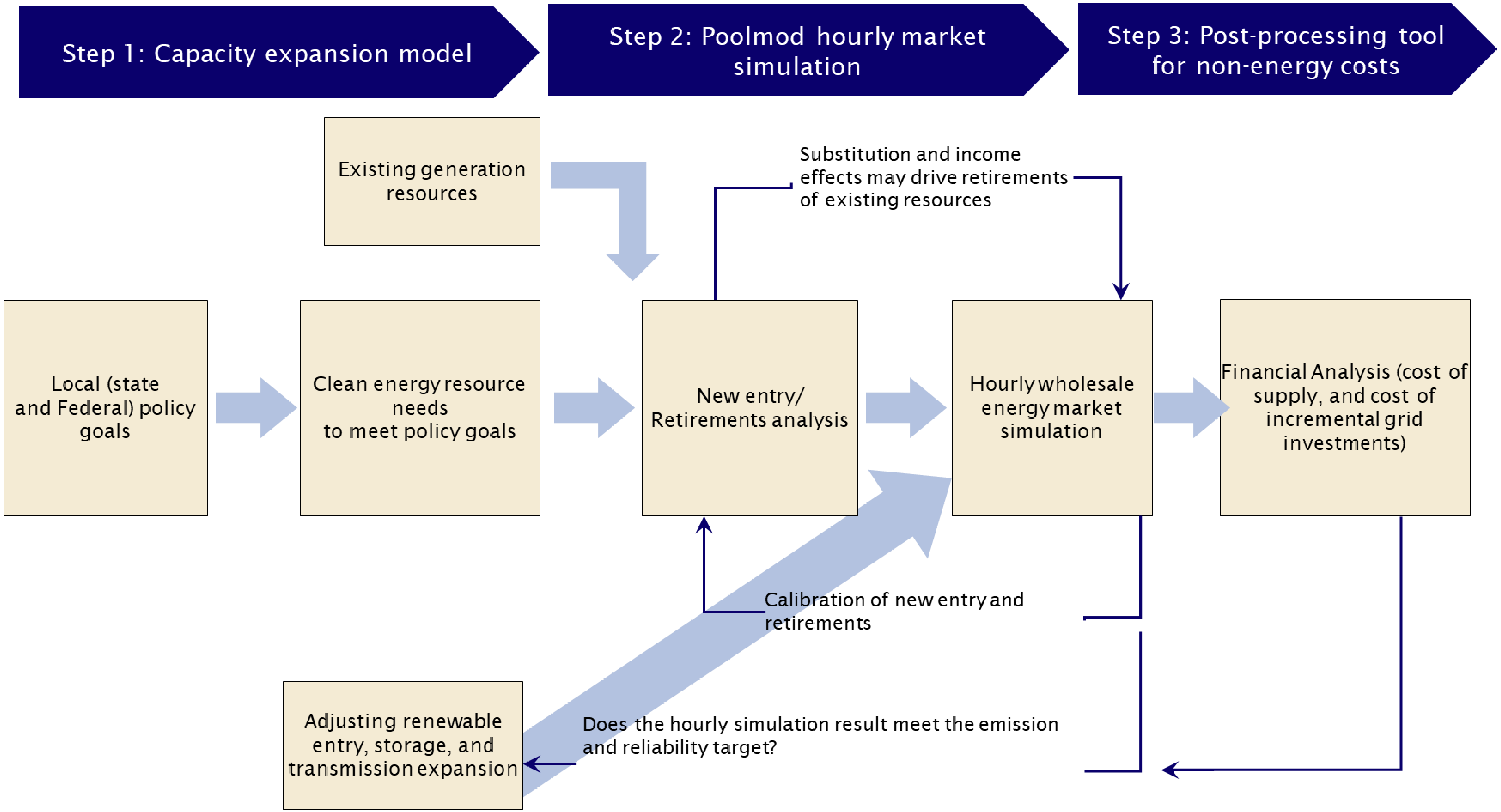


Installed capacity mix in New England (2019)



Source: ISO-NE Regional Energy Outlook 2020, LEI analysis

Three-step process deployed to simulate how carbon policy will impact energy system dynamics in New England



Study results identify significant demand changes in New England

- Net demand (TWh) will increase over the next three decades despite significant reductions from EE and BTM PV
  - By 2040, electricity demand from EVs would amount to 18 TWh (13% of net load) under the 80% by 2050 scenario
  - By 2040, electricity demand from ASHPs would amounts to 7 TWh (5% of net load) under the 80% by 2050 scenario

- Daily and seasonal demand dynamics will shift significantly due to electrification and more distributed technologies
  - System peak shifts from mid-day summer to mid-night winter
  - Intra-day ramping increases dramatically
  - System dynamics increasingly sensitive to flexible/responsive demand

All scenarios require significant changes in supply by 2040 to reliably meet carbon targets

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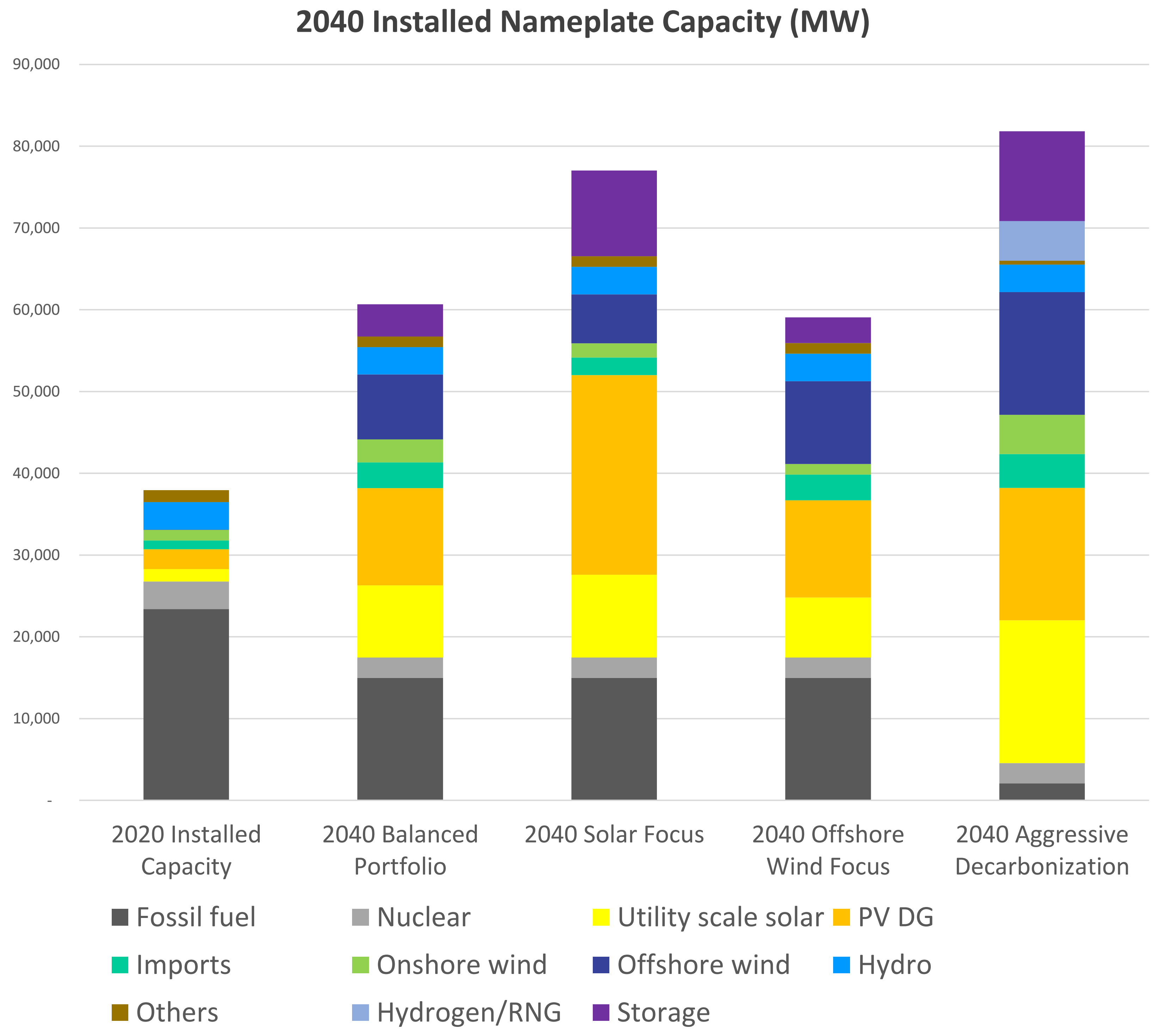
- New England would require 58 – 71 GW of installed generation capacity and 3 – 10 GW of storage capacity by 2040, depending on supply mix and carbon targets
- Continued operation of some Gas generation is necessary for reliability in all scenarios, but gas-fired generation has to be limited in order to meet emissions targets
- Aggressive decarbonization goals will likely require some new form of dispatchable low-emission generation (e.g. long-duration storage, RNG, etc.)
- Given the scale of new investment needed, energy market revenues alone are not sufficient – by 2040, the "missing money" is more than double the current size of the capacity market

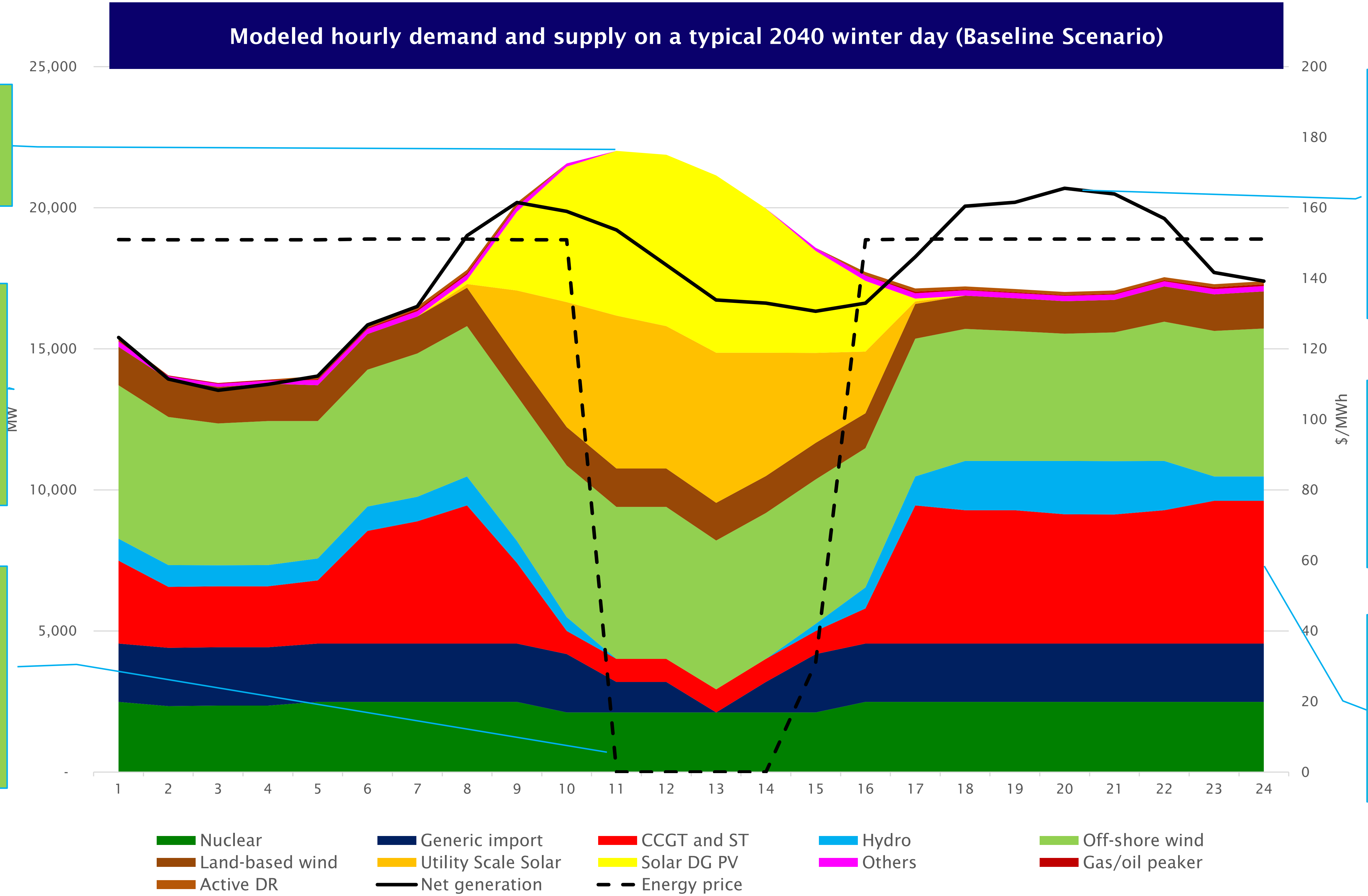


Hourly simulations shows daily excess solar generation by 2040 and value of battery storage in balancing demand and supply

Solar is no longer coincident with peak demand

Storage charges during mid-day when net demand is low (therefore total supply is higher than net demand in these hours)

Energy prices go to zero (or negative if negative bidding is allowed) during mid-day when there is excess solar generation



Net peak demand moves to night-time, mainly driven by EV charging after typical commute hours, and PV generation during mid-day

Storage discharges during late afternoon / evening when net demand is high

Dispatchable resources such as CCGT, ST, Hydro are needed to balance load