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A Step Through the Looking Glass

Outlook for Decarbonization in the Northeast

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August 2021

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Topics

- Background: the climate challenge
- How states are reacting
- Pathways
- Implications for the electric system, natural gas, and policy

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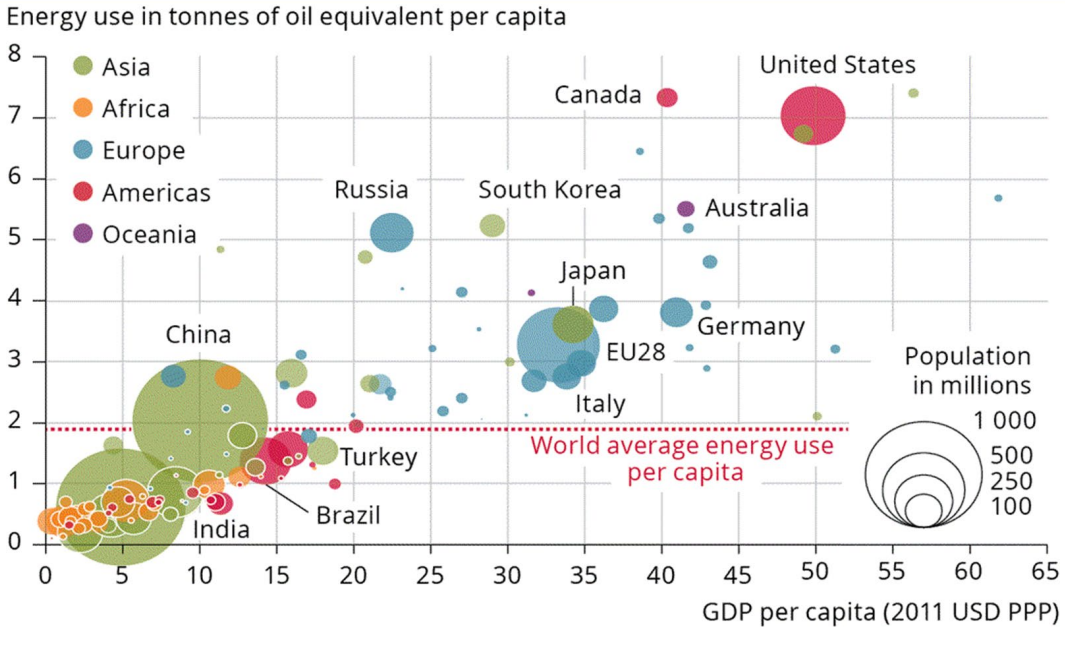
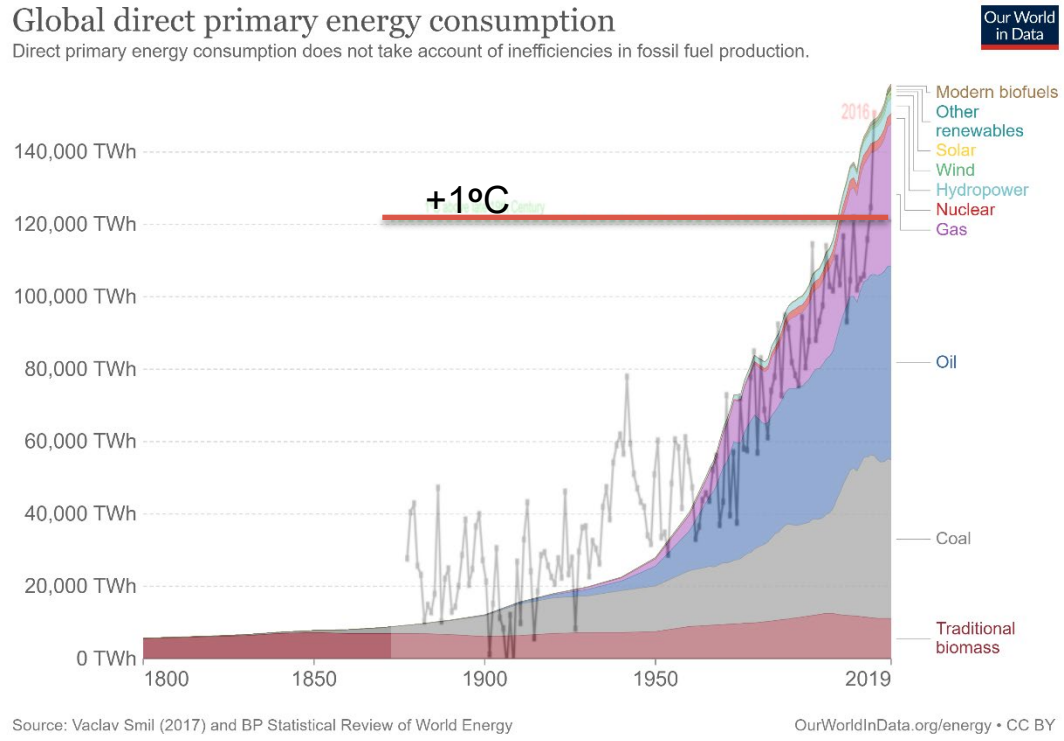
A Difficult Context

- Strong links
  - Well being = wealth = energy
    - The link between energy, the economy, and human well being is absolute
  - Energy = fossil fuels
    - Always has, still does, everywhere
  - Fossil fuels = GHGs = potentially disastrous social and economic impacts
    - States (and now the federal government?) recognize the risks and urgency
- Policymakers are taking action
  - Laws & mandates, not goals or targets
  - Economy wide
  - Banking on rapid technological advancements
    - Solar/wind, storage, transmission, H, RNG…





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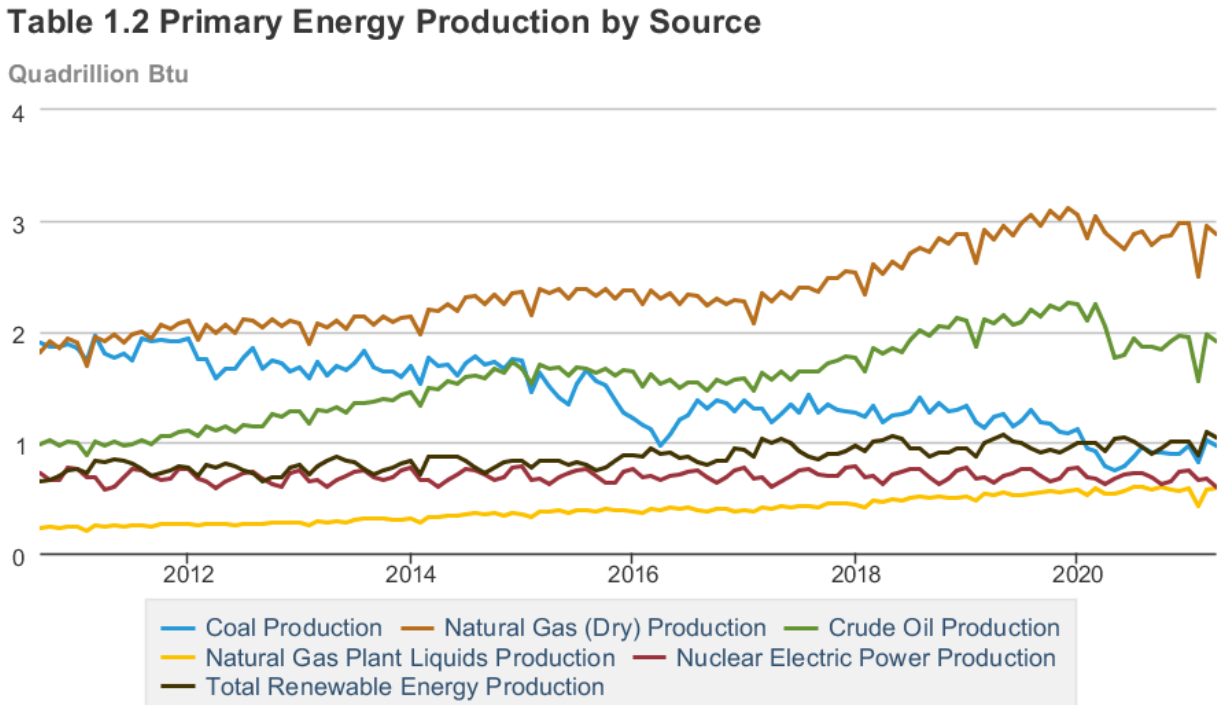
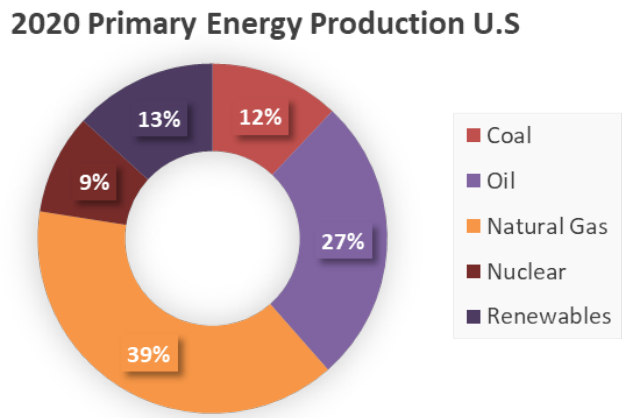
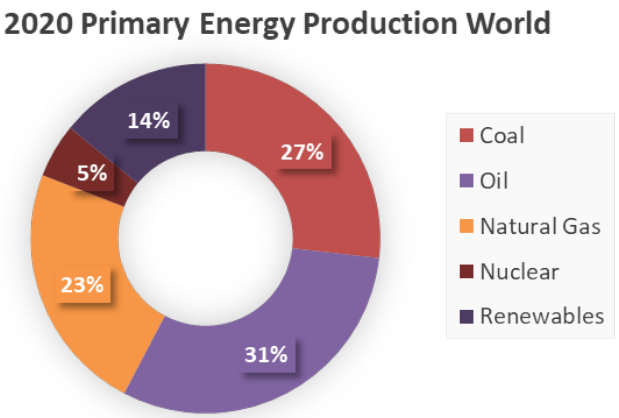
Primary Energy

- What drives states' targets?
  - Scientific consensus (IPCC)
    - Stay in the 1.5-2°C range to avoid catastrophic social, economic, and environmental outcomes
    - Doing this requires achieving *net zero* CO_2 by mid-century
- Despite progress, a long way to go
  - Fossil fuels dominates energy use, in the world, in the US, and in the Northeast
  - Past ten years has made matters worse
- This will not be easy
  - Transition timelines are inconceivable relative to historical change in the energy sector
  - The technological solutions for full decarbonization are not readily apparent
- Don't expect policy retreat
  - The science will not change for the better
  - Rapidly evolving policy will drive major asset decisions over the next 1-2 decades







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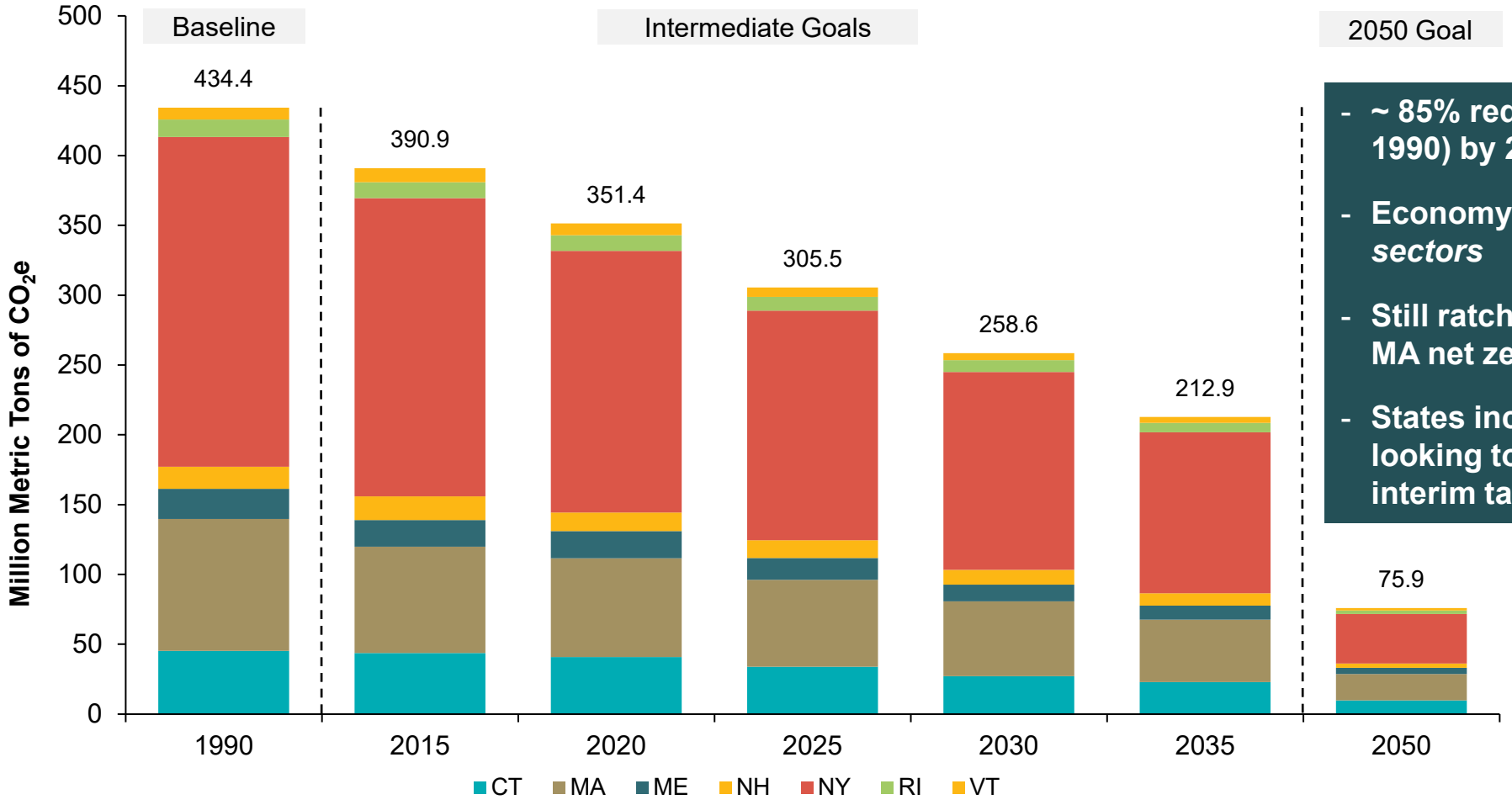
State Goals for Decarbonization to 2050

- Ultimate goals, estimated interim levels



- ~ 85% reductions (from 1990) by 2050
- Economy-wide; *all sectors*
- Still ratcheting down – MA net zero by 2050
- States increasingly looking to binding interim targets

Sources: CT DEEP, MA DEP, ME DEP, NH DES, NY DEC, RI DEM, VT DEC.

The (Futile) Soapbox

- Ideal: price GHG emissions (carbon price or cap/trade), let the market sort it out, at the lowest cost
- *The obvious conundrum:* carbon pricing at levels needed to meet mandates is not likely to become the primary basis for meeting Northeast state climate targets
  - Politically suspect; "tax"
  - The numbers would have to be high, for it to work
  - Supportive policymakers, legislators, governors remain too few
  - Opposed by key groups and industries, including those that benefit from entrenched policies
- The only things *more obvious*:
  - This is crazy
  - Because of this, consumers and businesses will pay *substantially* more to meet emission reduction requirements
  - Because of this, states will continue to administer a wide-ranging "toolbelt" of complicated policy programs, with associated costs and inefficiencies

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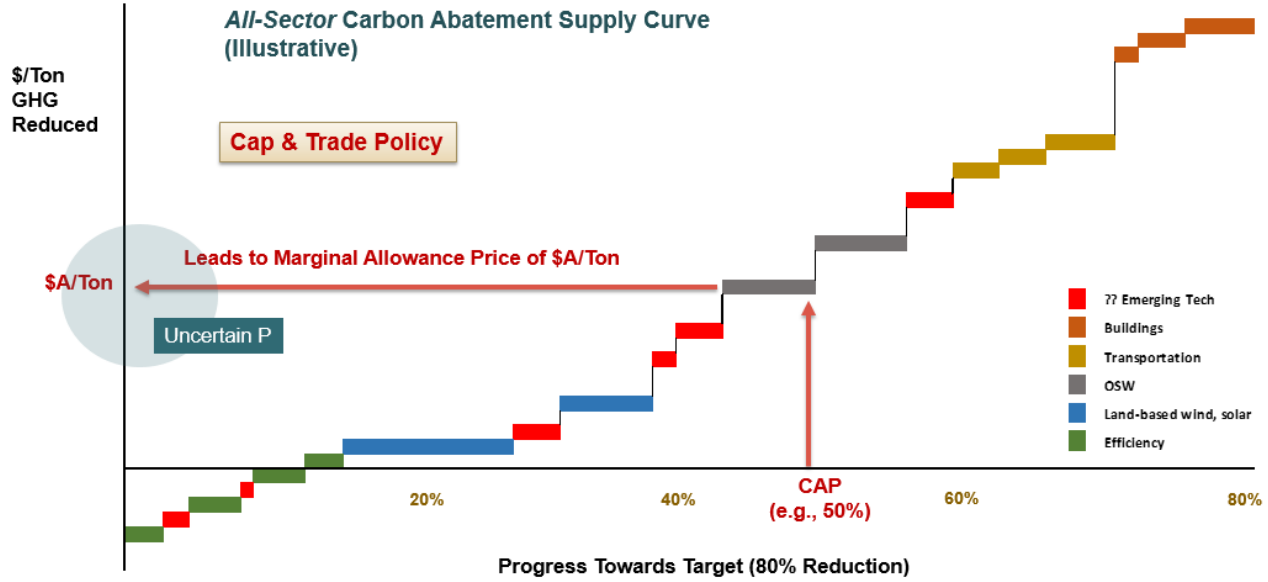
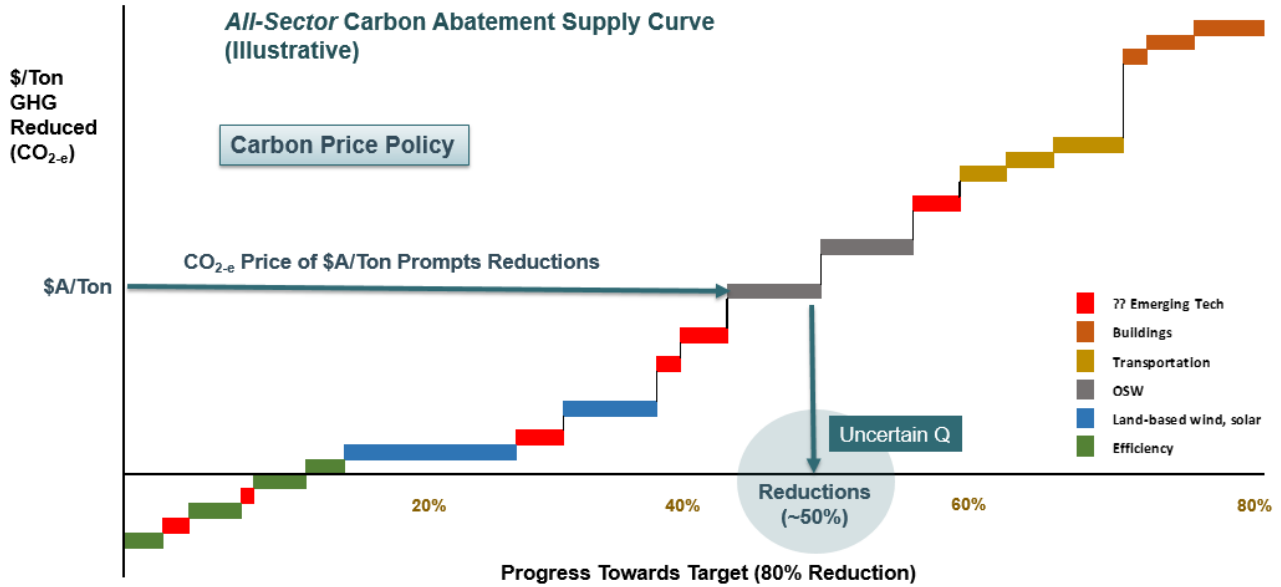
Carbon Pricing: What is it?

- *Tax or fee* on GHG "emissions," based on CO_2 equivalence ($CO_{2\text{-}e}$)

  or..
- *Cost of an allowance* under an emission cap, with allowance trading
- Assess based on emissions and/or carbon content of fuel (assuming complete combustion)
- Periodically review program results, adjust price or cap, ala RGGI
  - *Concerns over uncertain Q or uncertain P are overstated, unwarranted, easily remedied*
- Exceedingly simple mechanics and administration





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Carbon Pricing Benefits

- Seamless integration with power system markets and operation

- **None** of the following would be needed (partial list):
  - *Tax incentives for renewables, EVs, and their equity implications*
  - *Fuel or infrastructure bans*
  - *Net metering tariffs, with their regressive tendencies*
  - *"Green" or "renewable" retail electricity products, or their questionable validity*
  - *RPS/CES, with periodic changes and compliance administration*
  - *Long-term contract procurements, proceedings, litigation, or their imposition of investment risk on captive ratepayers*
  - *Arguments over transmission cost allocation for "policy" projects*
  - *Contorted band aids on wholesale capacity markets which are incompatible with state policy*
  - *EE investment requirements, council deliberations, EE plans, M&V, commission review*

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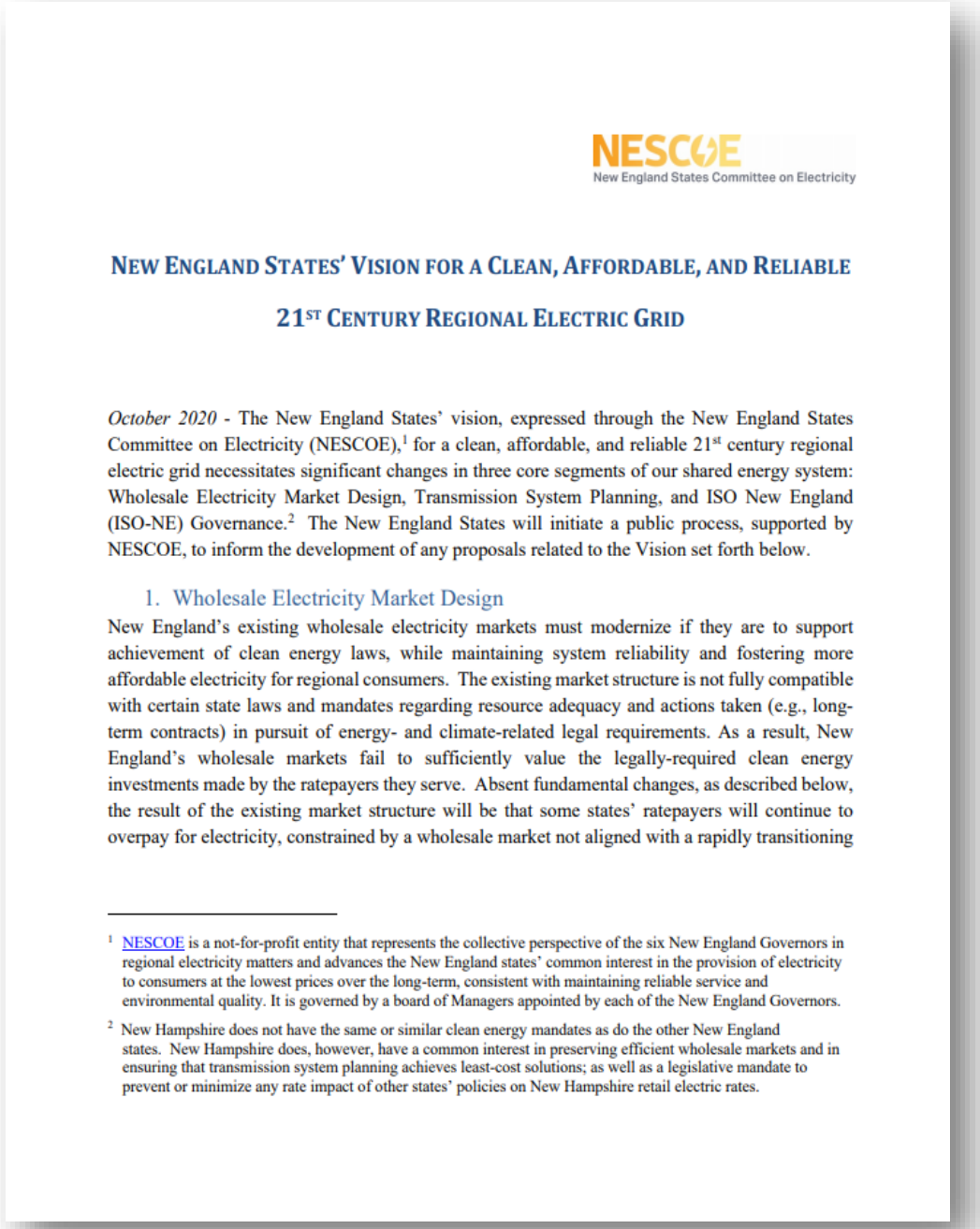
The Electricity Markets Problem

- Favored pathway
  - Significant electrification of building and transportation sectors
  - Accelerated decarbonization of the electric sector
- Market structures do not support #2
  - Do not properly capture value of certain resources to meeting state policy objectives
  - States have responded in ways that threaten markets
  - States will abandon markets before they abandon policy
- Failure to harness markets will be a costly mistake in the decarbonization effort
  - CO_2 pricing – at the right level – would help resolve this problem



NESCOE
New England States Committee on Electricity

NEW ENGLAND STATES' VISION FOR A CLEAN, AFFORDABLE, AND RELIABLE 21ST CENTURY REGIONAL ELECTRIC GRID

October 2020 - The New England States' vision, expressed through the New England States Committee on Electricity (NESCOE),[1] for a clean, affordable, and reliable 21st century regional electric grid necessitates significant changes in three core segments of our shared energy system: Wholesale Electricity Market Design, Transmission System Planning, and ISO New England (ISO-NE) Governance.[2] The New England States will initiate a public process, supported by NESCOE, to inform the development of any proposals related to the Vision set forth below.

1. Wholesale Electricity Market Design

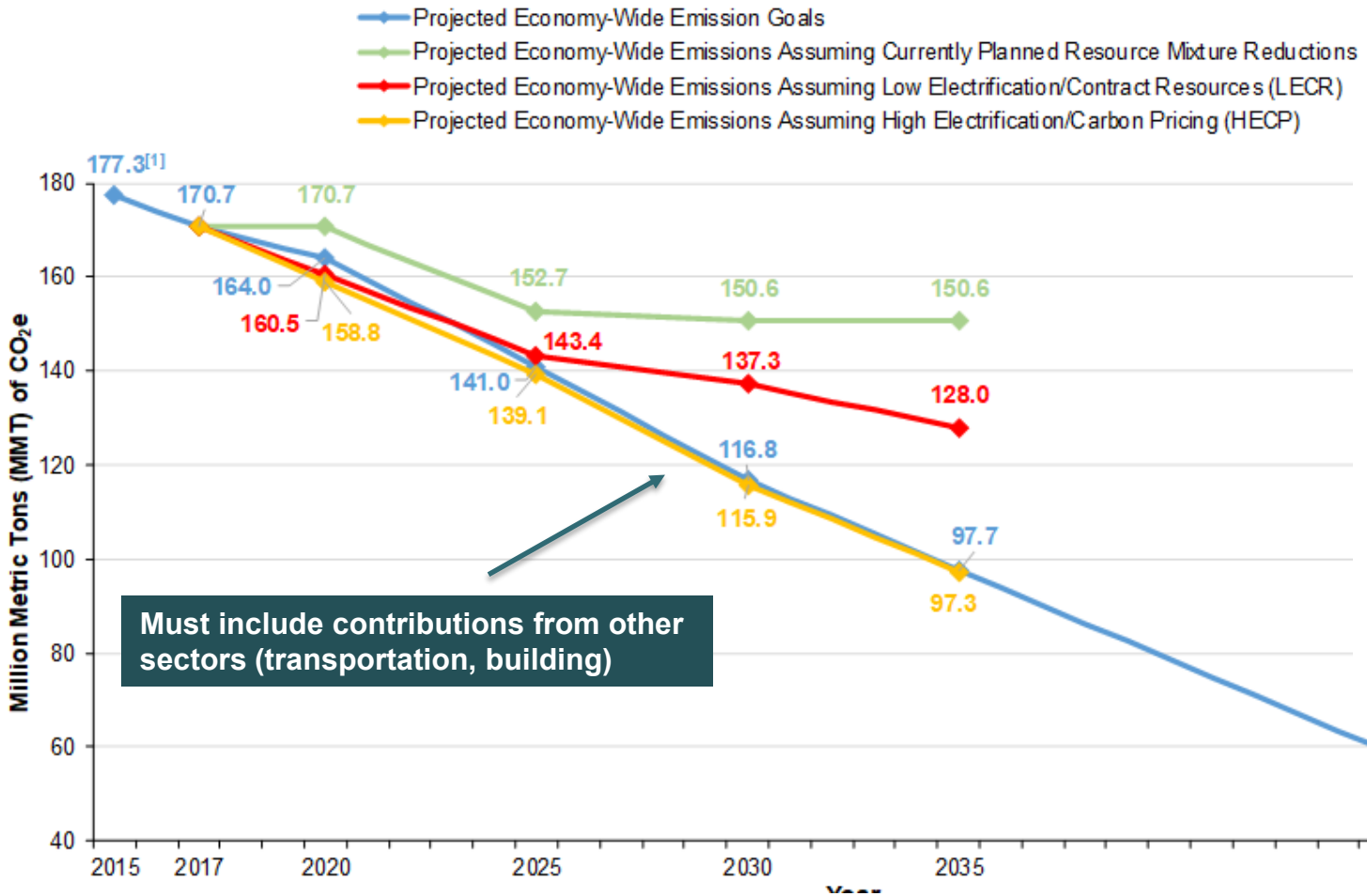
New England's existing wholesale electricity markets must modernize if they are to support achievement of clean energy laws, while maintaining system reliability and fostering more affordable electricity for regional consumers. The existing market structure is not fully compatible with certain state laws and mandates regarding resource adequacy and actions taken (e.g., long-term contracts) in pursuit of energy- and climate-related legal requirements. As a result, New England's wholesale markets fail to sufficiently value the legally-required clean energy investments made by the ratepayers they serve. Absent fundamental changes, as described below, the result of the existing market structure will be that some states' ratepayers will continue to overpay for electricity, constrained by a wholesale market not aligned with a rapidly transitioning

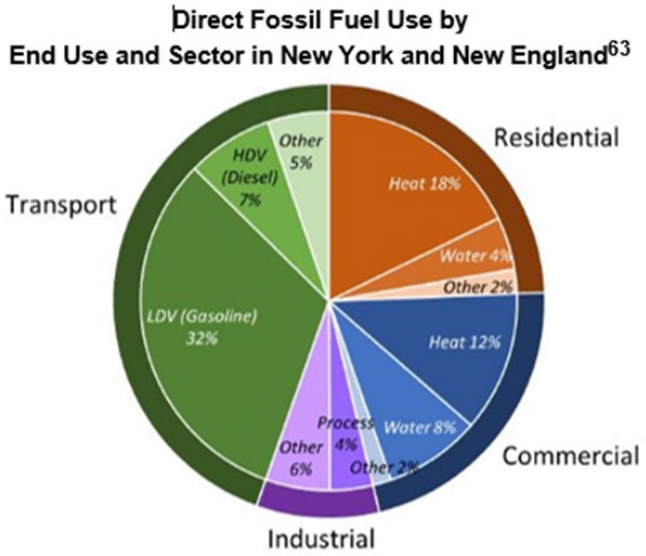
[1] NESCOE is a not-for-profit entity that represents the collective perspective of the six New England Governors in regional electricity matters and advances the New England states' common interest in the provision of electricity to consumers at the lowest prices over the long-term, consistent with maintaining reliable service and environmental quality. It is governed by a board of Managers appointed by each of the New England Governors.

[2] New Hampshire does not have the same or similar clean energy mandates as do the other New England states. New Hampshire does, however, have a common interest in preserving efficient wholesale markets and in ensuring that transmission system planning achieves least-cost solutions; as well as a legislative mandate to prevent or minimize any rate impact of other states' policies on New Hampshire retail electric rates.

Policy Focus: Electrification + Decarbonization

New England Emission Reduction Standards Compared with Emission Reductions from Renewable Resource Additions and Increased Electrification





Sources: Analysis Group study (Cavicchi, Hibbard)

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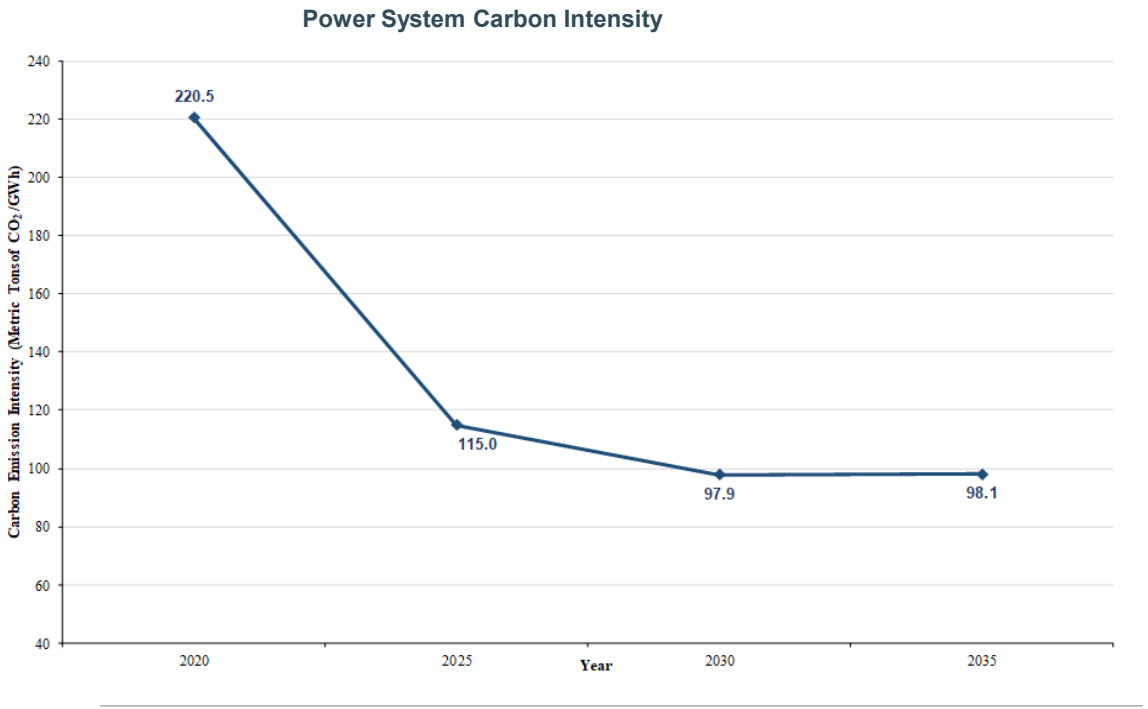
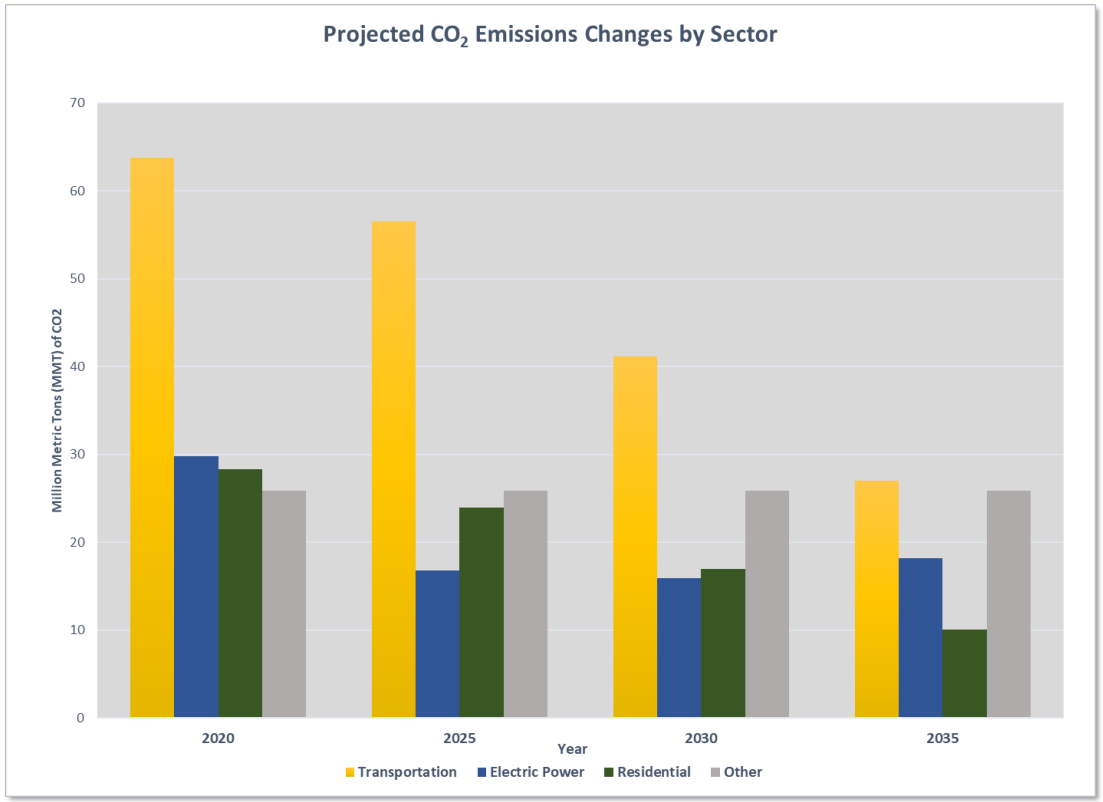
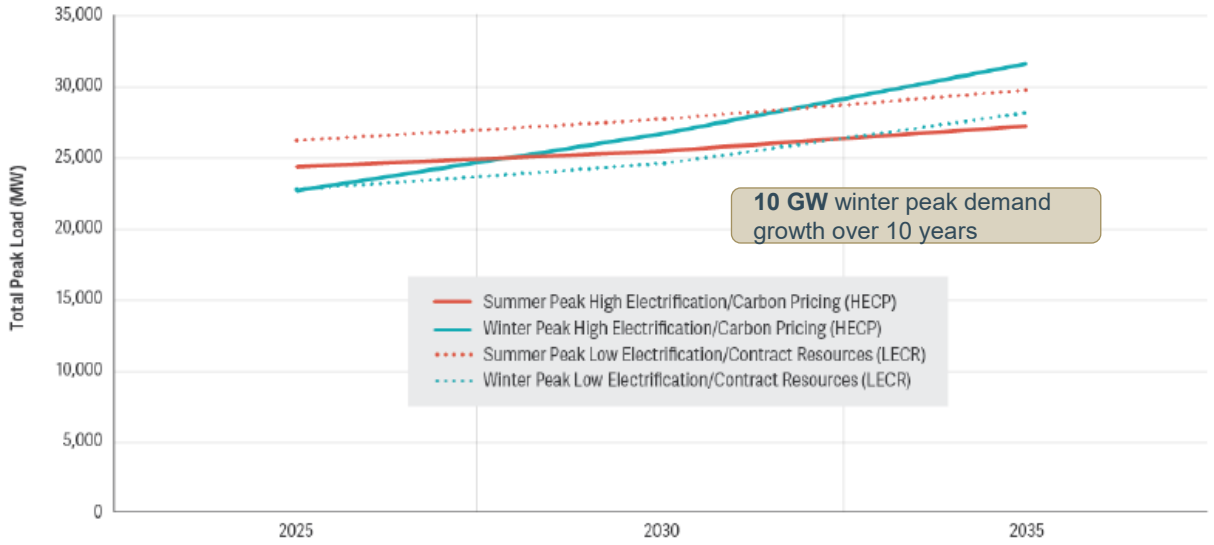
Electric Sector as GHG Sponge

- Flat emissions with declining carbon intensity (lb/MWh), absorbing GHG reductions in transportation, building sectors
- Carbon price growing from $25/ton to $70/ton could be sufficient







Sources: Analysis Group study (Cavicchi, Hibbard)

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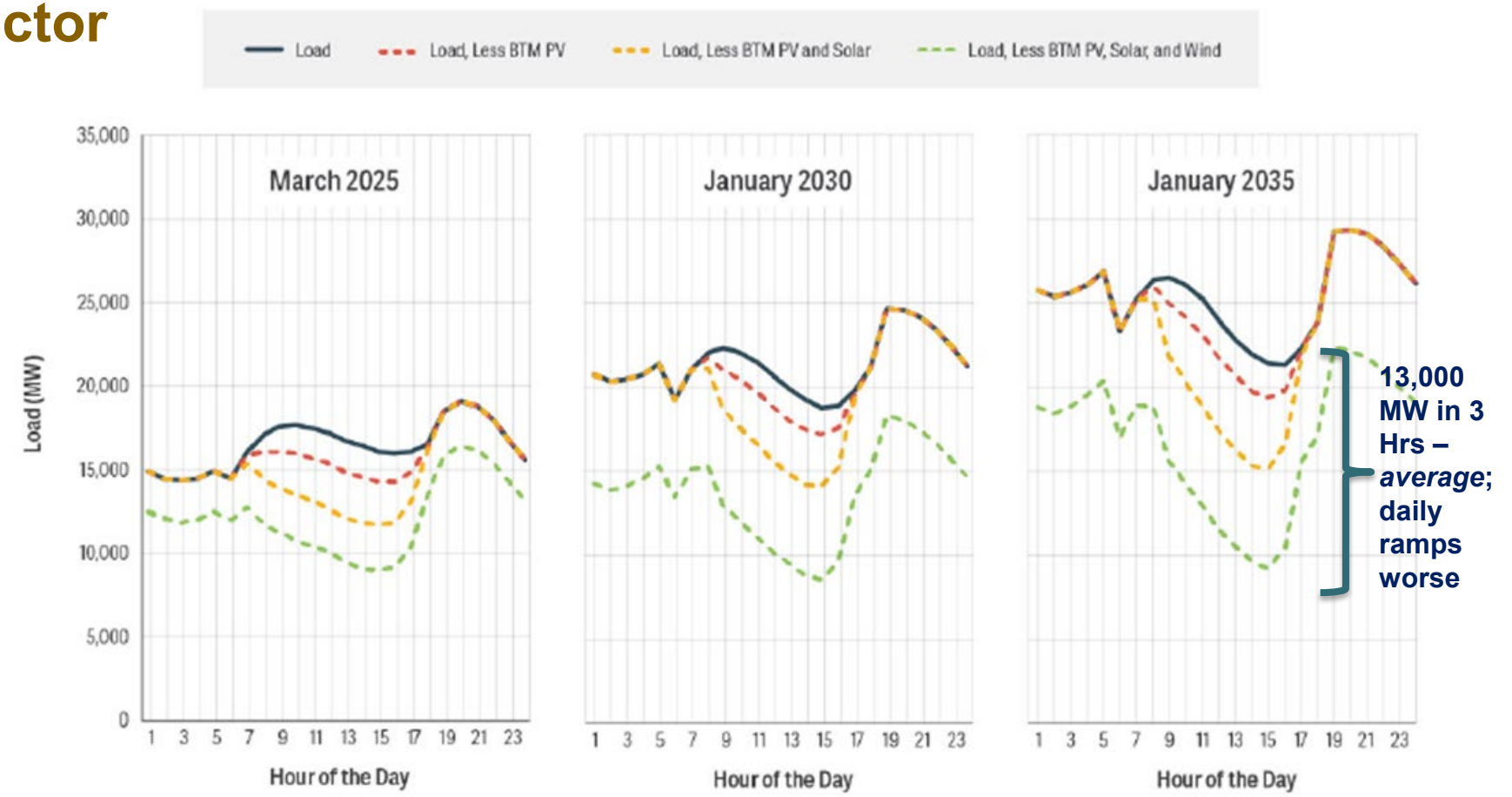
Impact on Electric Sector

- EV most significant GHG reductions (when do folks charge?)
- Heating benefits flow from oil, propane, wood conversions (*not so much* natural gas)
- Peak quickly shifts to winter
- Major load ramp challenges emerge within a decade
- Gas generation remains vitally important absent economically viable alternative

Figure 2: Average Ramp-Ups for the Month that the Peak Ramp Occurs
High Electrification – Winter Season

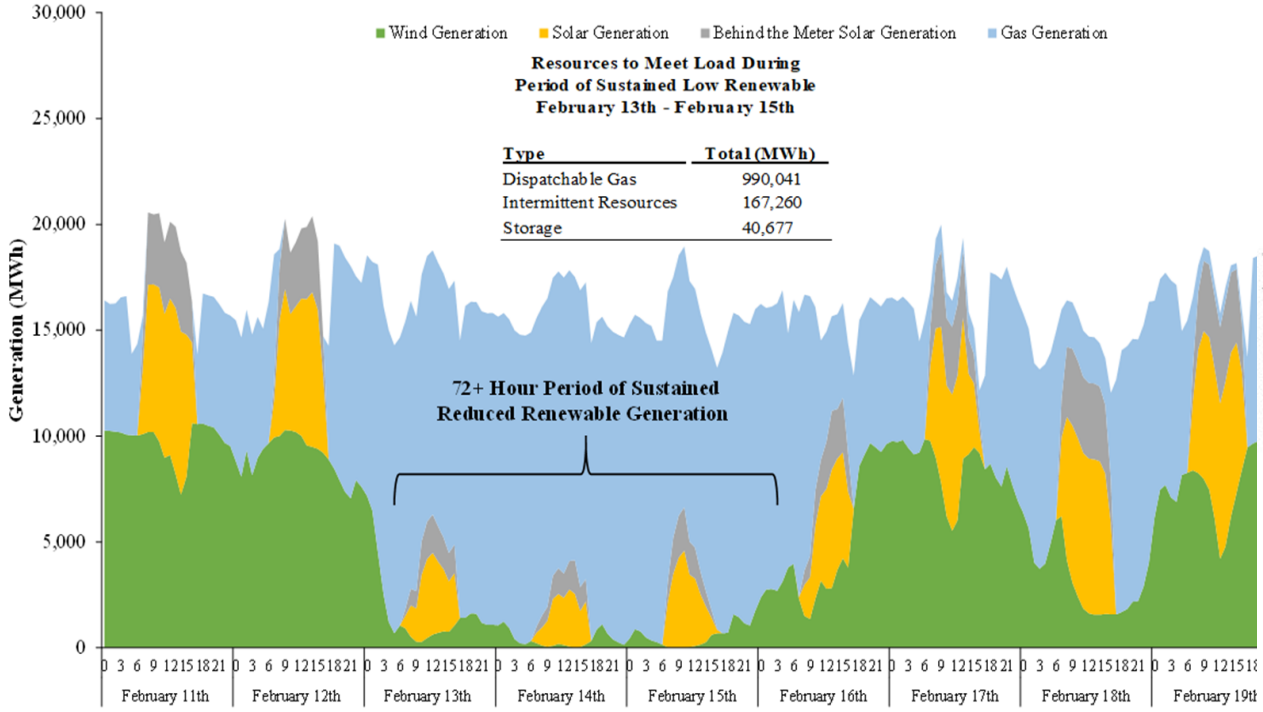


Power System Operational Challenges

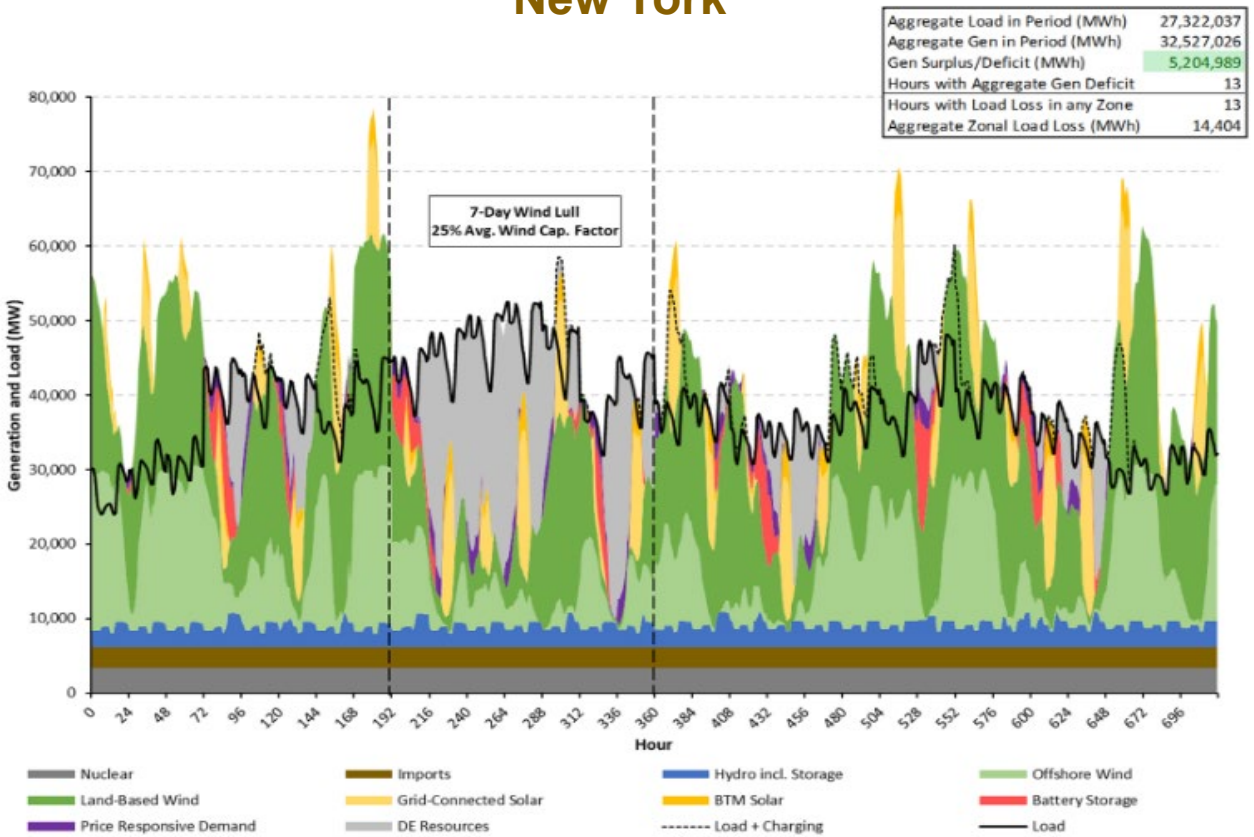
Analysis Group studies of rapid expansion of variable resources in New England and New York

In both cases, multiple extended periods of low solar/wind output, when even extensive storage capacity insufficient to meet reliability needs

New England



New York



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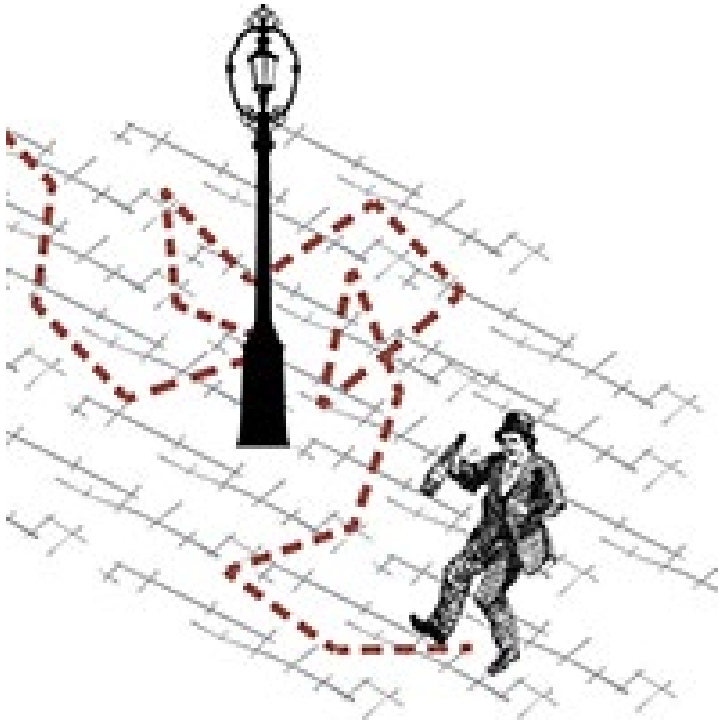
Implications for Energy Infrastructure (esp. Natural Gas) in the Northeast

- Avoid the temptation to "just say no" - carefully assess the role of natural gas in the transition
  - An economically-prioritized path to decarbonization would likely lean on the important transitional role of natural gas
    - In supporting electrification of the transportation and other sectors
    - In sustaining power system reliability and "having the back" of rapid renewable integration
    - In mitigating the cost of a rapid transition while technologies evolve to capture the later – and undoubtedly more difficult – phases of decarbonization
  - Certain factors can guide policy approach
    - Zero-carbon resources, technologies, practices must grow rapidly
    - There will be an important residual energy supply need for 1-2 decades (at least)
    - From a combined climate/economic impact perspective, there is a rationale for prioritizing electrification policies and investments to
      (1) new applications before existing, and
      (2) oil/propane/wood/baseboard electric heating *before* gas

Wrap Up



- The destination is known (…more or less)
  - 2040 – 2050
  - GHG emissions ~ 80% - 100% less than now
  - Across all sectors of the economy
  - Will require actions/technologies not currently in play

- A random walk to compliance is not an option
  - States are being proactive, evaluating LT pathways
  - Challenge: *increasingly* difficult to forecast beyond 5-10 years
    - Emerging technologies in all sectors (H, RNG, storage, OSW, EVs, heat pumps…)
    - Accelerating changes in cost factors, operational capabilities; breakthroughs possible
  - Resource-specific policies and investments today will soon look outdated
  - There are real reliability challenges as the electric sector absorbs other sector demands
  - All will be affected by the transition – consumers, businesses, shareholders
  - The price tag of inefficient policy will be extremely large; full carbon pricing is the way to go

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