7th Annual
Maine Natural Gas Conference

Power Generation

Moderator: Sarah Tracy, Pierce Atwood LLP

Panelists:

- Paul Hibbard, Analysis Group
- Emily Green, Conservation Law Foundation
- Robert Neustaedter, Repsol
- Chris Sherman, Cogentrix Energy

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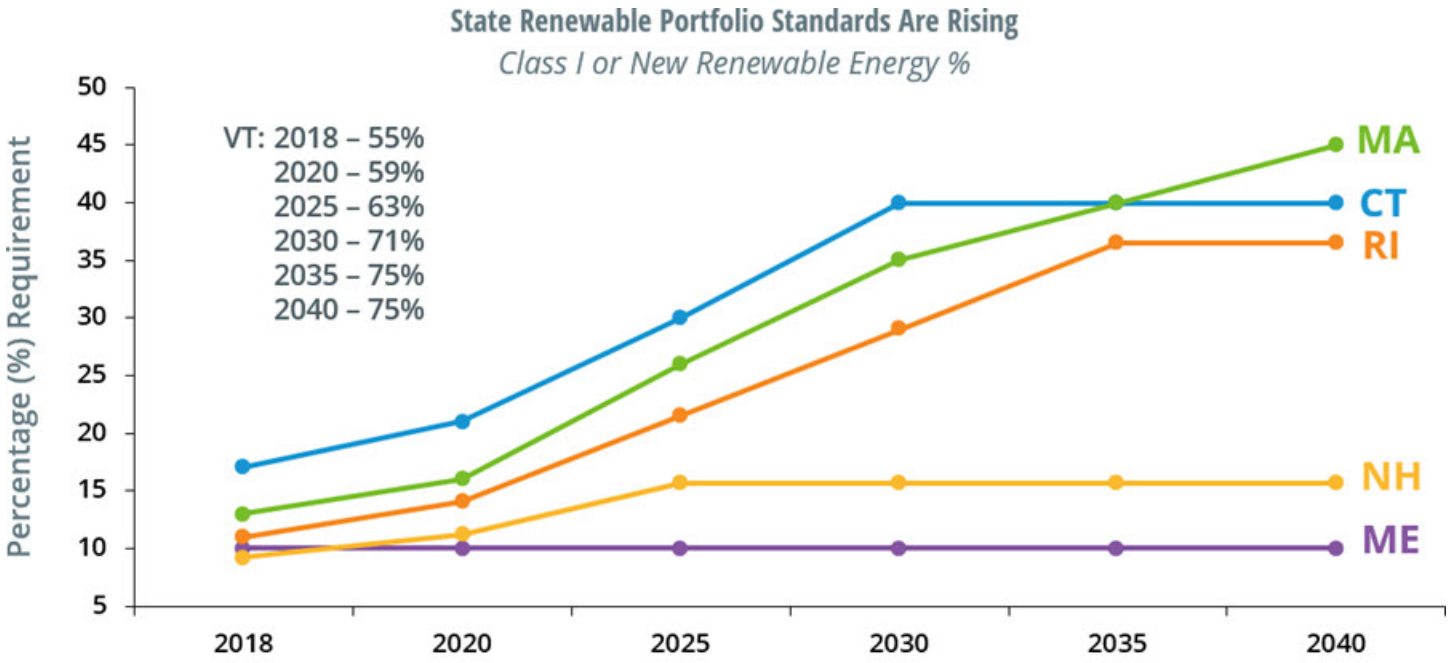
October 3, 2019

The Role of Natural Gas in New England Power Generation:

Setting the Stage

Sarah B. Tracy, Pierce Atwood LLP

Rising State Renewable Portfolio Standards

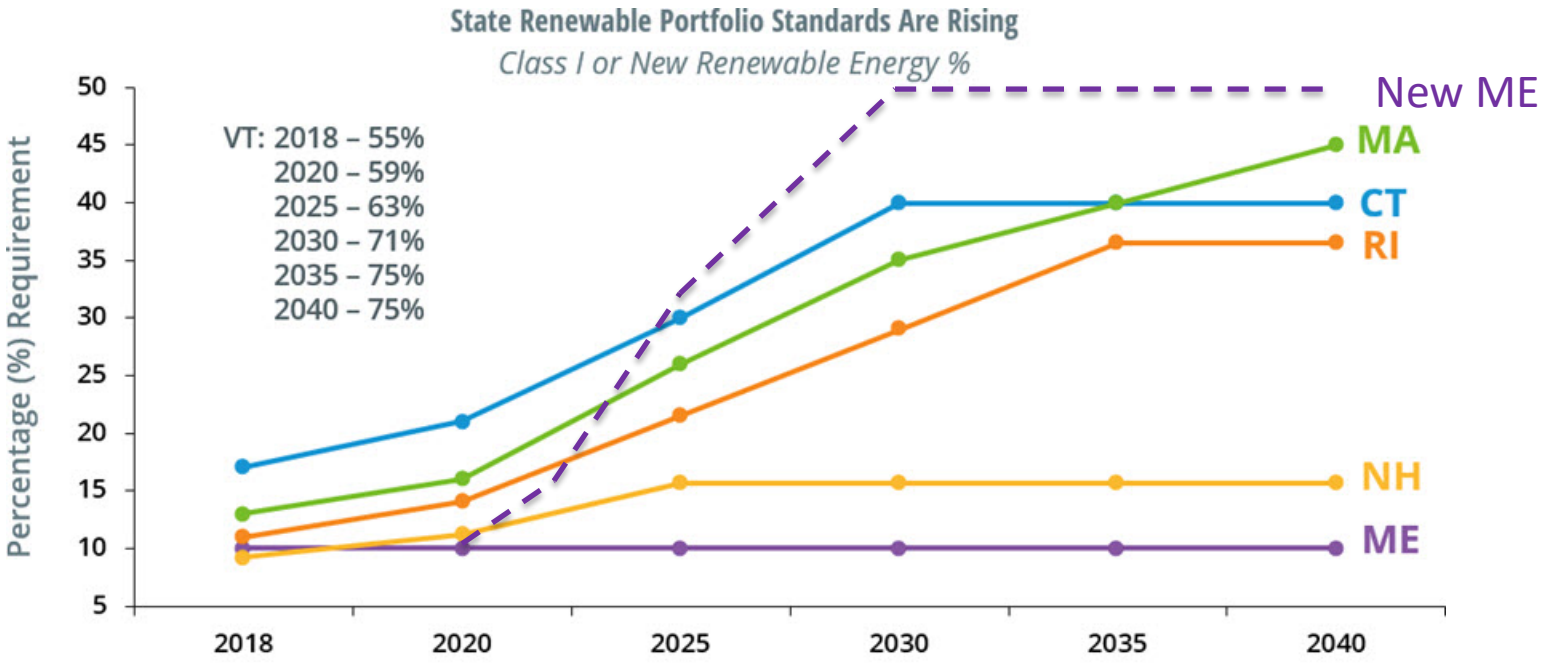


Notes: State RPS requirements promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Connecticut's Class I RPS requirement plateaus at 40% in 2030. Maine's Class I RPS requirement plateaued at 10% in 2017 and is set to expire in 2022 (but has been held constant for illustrative purposes). Massachusetts' Class I RPS requirement increases by 2% each year between 2020 and 2030, reverting back to 1% each year thereafter, with no stated expiration date. New Hampshire's percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006). New Hampshire's Class I and Class II RPS requirements plateau at 15.7% in 2025. Rhode Island's requirement for 'new' renewable energy plateaus at 36.5% in 2035. Vermont's 'total renewable energy' requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.

Source: ISO New England

Source: ISO-NE Resource Mix, https://www.iso-ne.com/about/key-stats/resource-mix/

Rising State Renewable Portfolio Standards



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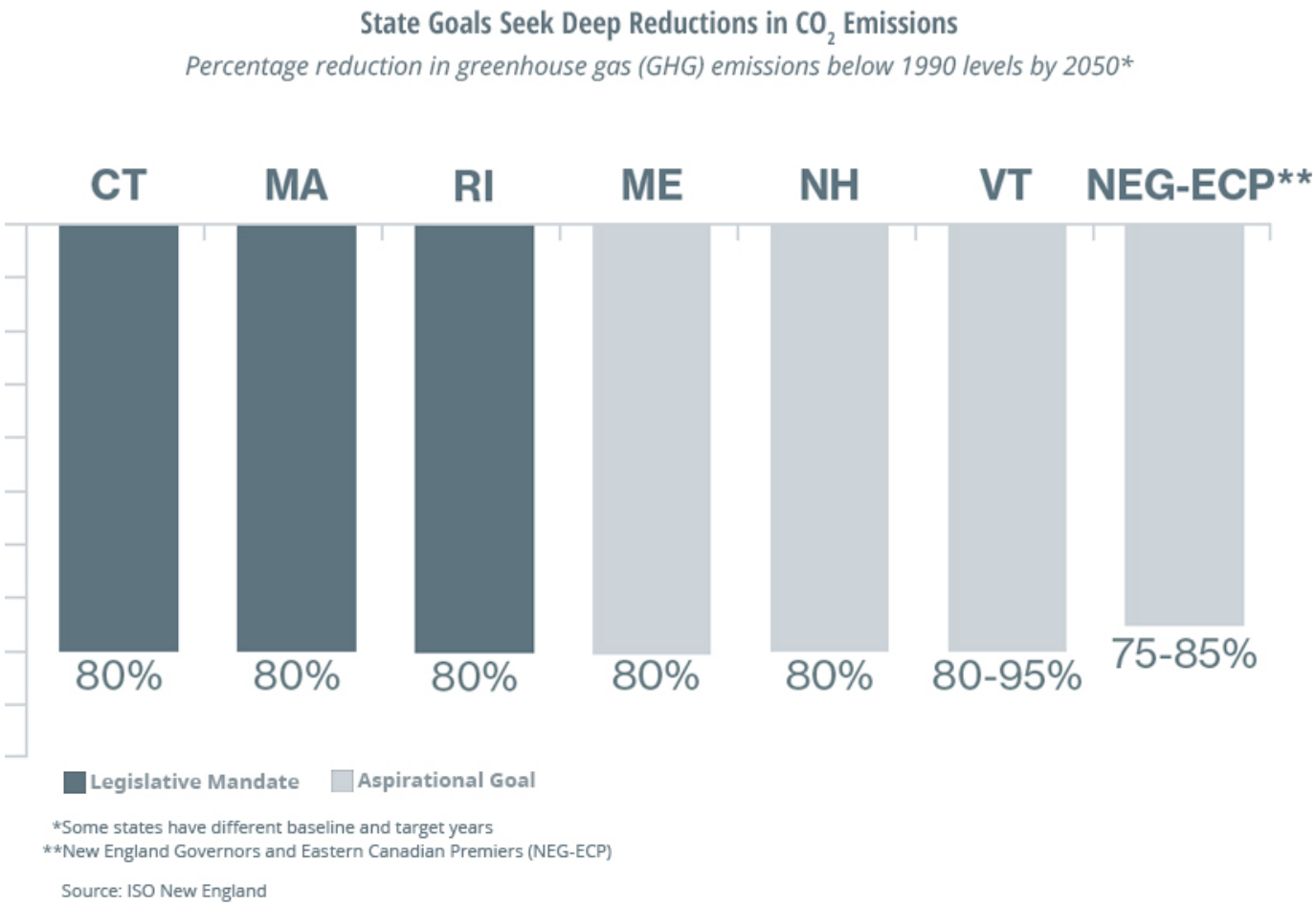
Source: ISO New England

Source: ISO-NE Resource Mix, https://www.iso-ne.com/about/key-stats/resource-mix/ (as modified by Sarah Tracy to reflect new Maine Class IA RPS requirements enacted pursuant to 35-A M.R.S. §3210 (eff. Sept. 19, 2019)).

State CO2 Emissions Reductions Policies



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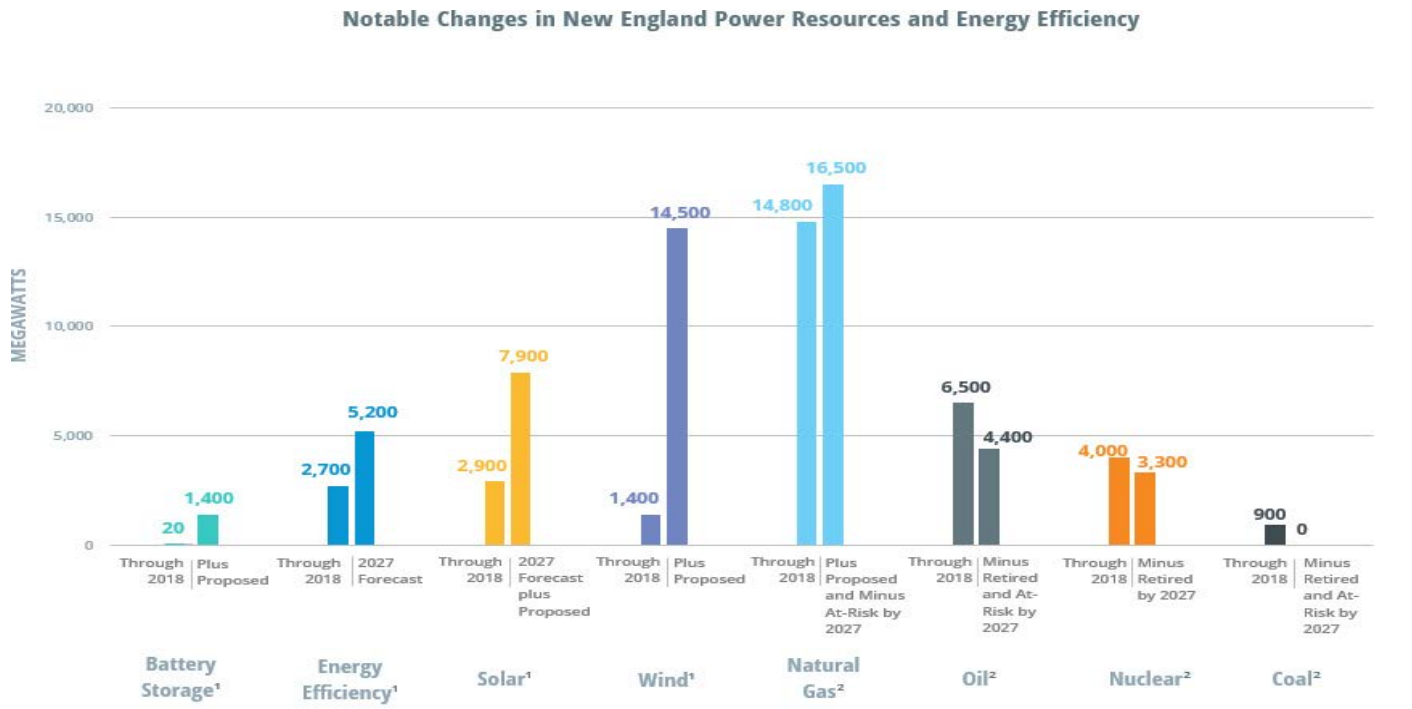
New England Power Resources



Notes: Numbers are rounded. Not all proposed new projects are built; historically, almost 70% of proposed new megawatts in the ISO Generator Interconnection Queue have ultimately withdrawn.

¹ Nameplate capacity. Battery storage includes existing and proposed grid-connected resources; some wind and solar projects also include batteries. Solar includes existing and proposed grid-connected resources, as well as existing and forecasted BTM resources. EE includes resources in the capacity market, as well as forecasted future capacity.

² Nameplate capacity for proposed projects; summer seasonal claimed capability for existing units based on primary fuel type. Some oil units can also burn natural gas and vice versa. The 2027 at-risk values are hypothetical, reflecting retirement delist bids, plus the possible loss of nearly 3,000 MW of generation.

Source:
ISO New England, ISO-NE Generator Interconnection Queue (January 2019), 2018 CELT Report, Final 2018 ISO-NE Solar PV Forecast, Final Energy-Efficiency Forecast Report for 2022 to 2027, Seasonal Claimed Capability Monthly Report (January 2019), Status of Non-Price Retirement Requests and Retirement Delist Bids (August 2018), 2022-2023 CCP Post Forward Capacity Auction Release of Information, and 2016 Economic Studies Phase I Assumptions (2016)

Source: ISO-NE Resource Mix, https://www.iso-ne.com/about/key-stats/resource-mix/

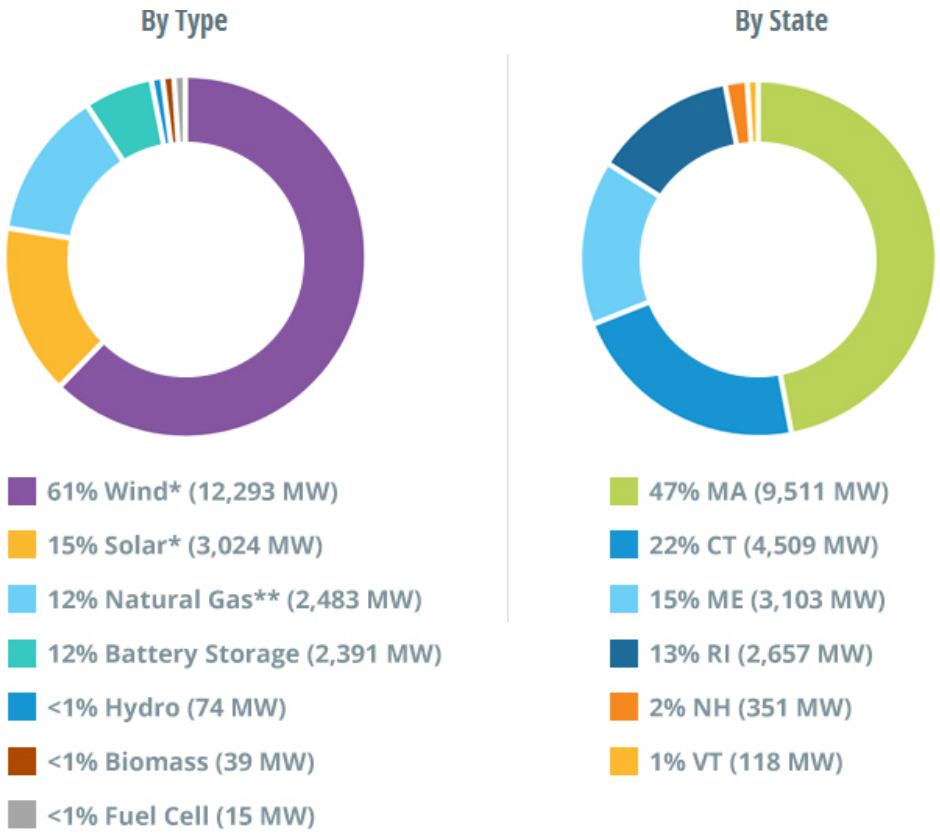
State Procurement of Clean Energy

State(s)	RFP	Resources	Amount Procured	Winning Bids
MA, CT, RI	2015 Multi-State Clean Energy RFP	Solar, Wind	390+ MW	Numerous wind and solar bid winners
MA	2017 Section 83D Clean Energy RFP	Imported Canadian Hydro	1,200 MW	New England Clean Energy Connect
MA, RI	2017 Section 83C Offshore Wind RFP	Offshore Wind	800 MW (MA) 400 MW (RI)	Vineyard Wind (MA) Revolution Wind (RI)
CT	2018 Renewable Energy RFP	Offshore Wind, Fuel cells, Anaerobic Dig.	200 MW OSW 52 MW Fuel Cells 1.6 MW Anaerobic	Revolution Wind 4 CT Fuel Cell Projects 1 CT Anaerobic Project
CT	2018 Zero-Carbon Resources RFP	Nuclear, Hydro, Class I, Storage	1,000 MW Nuclear 100 MW OSW 165 MW Solar	CT Millstone Nuclear Project Revolution Wind 9 Solar Projects (CT and N.E.)
RI	2018 Renewable Energy FRP	Solar, Wind, Biomass, etc.	400 MW solicited	26 bids, June 2019 conditional selection, under negotiation
MA	2019 Section 83C II Offshore Wind RFP	Offshore Wind	Up to 800 MW solicited	Bids submitted Aug. 2019; selection expected Nov. 2019
CT	2019 Offshore Wind RFP	Offshore Wind	Up to 2000 MW solicited	Bids due Sept. 30, 2019; selection expected Nov. 2019

Source: ISO-NE 2019 Regional Energy Outlook at p. 21 and additional research by Sarah Tracy from public sources

Proposed Generation in New England

20,300 MW Proposed in the ISO-NE Generator Interconnection Queue as of June 2019



*Some wind and solar projects include battery storage.

**Some natural-gas projects include dual-fuel units (typically oil).

Source: ISO Generator Interconnection Queue (June 2019; project megawatts have been rounded)

Source: ISO-NE Resource Mix, https://www.iso-ne.com/about/key-stats/resource-mix/

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Natural Gas in Power Generation:

Role Going Forward

Paul J. Hibbard

2019 Maine Natural Gas Conference
October 3, 2019

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The Transition

- State GHG requirements and objectives
  - Require reductions from all sectors
  - Electrification may be least cost solution for other sectors (transportation, heating)
  - Electricity in an outsized role
- Technological change
  - Decline in costs for wind, solar, offshore wind
- State procurements taking over
  - Markets not producing resources wanted by states
  - Questions regarding alternate paths to resource adequacy
- Inevitable asset retirements
  - Dual drivers of market pressure and state emission requirements
- Pathways matter – esp. from reliability and consumer perspectives

- *How does all this affect the role of natural gas in power generation?*

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Resource Options and Scenario Analysis

- Natural Gas is now the residual source for power generation
- "Competition"
  - Two nuclear units – Seabrook, Millstone – for a decade or more, ***no additions***
  - Two coal units – Merrimack, Schiller – for 0 to 5 (?) years: ***no additions***
  - A handful of oil (only) units; old gas or gas/oil units – 0 to 10 (?) years: ***no additions***
  - Onshore wind, distributed solar – continued growth due to economics, policy
  - Offshore wind, hydro procurements – major additions 5 to 10 years through policy
  - Maybe just a few storage projects here and there (unless there is a cost/technology breakthrough)
- What's left to the market?
  - Only natural gas, CCs and (increasingly) CTs
  - Is this market share declining or not? What assets/infrastructure are still needed?
- Wildcard: can not meet the states' climate requirements and goals without electrification of heating, transportation (at least)
- So let's take a look - future snapshot (somewhere 5-10 years out)
  - 2018 hourly load and generation, no growth
  - Pilgrim out; coal and oil out
  - 5 – 10 GW renewables (wind/solar/hydro); maybe a bit of storage
  - Remainder: natural gas must fill the gap

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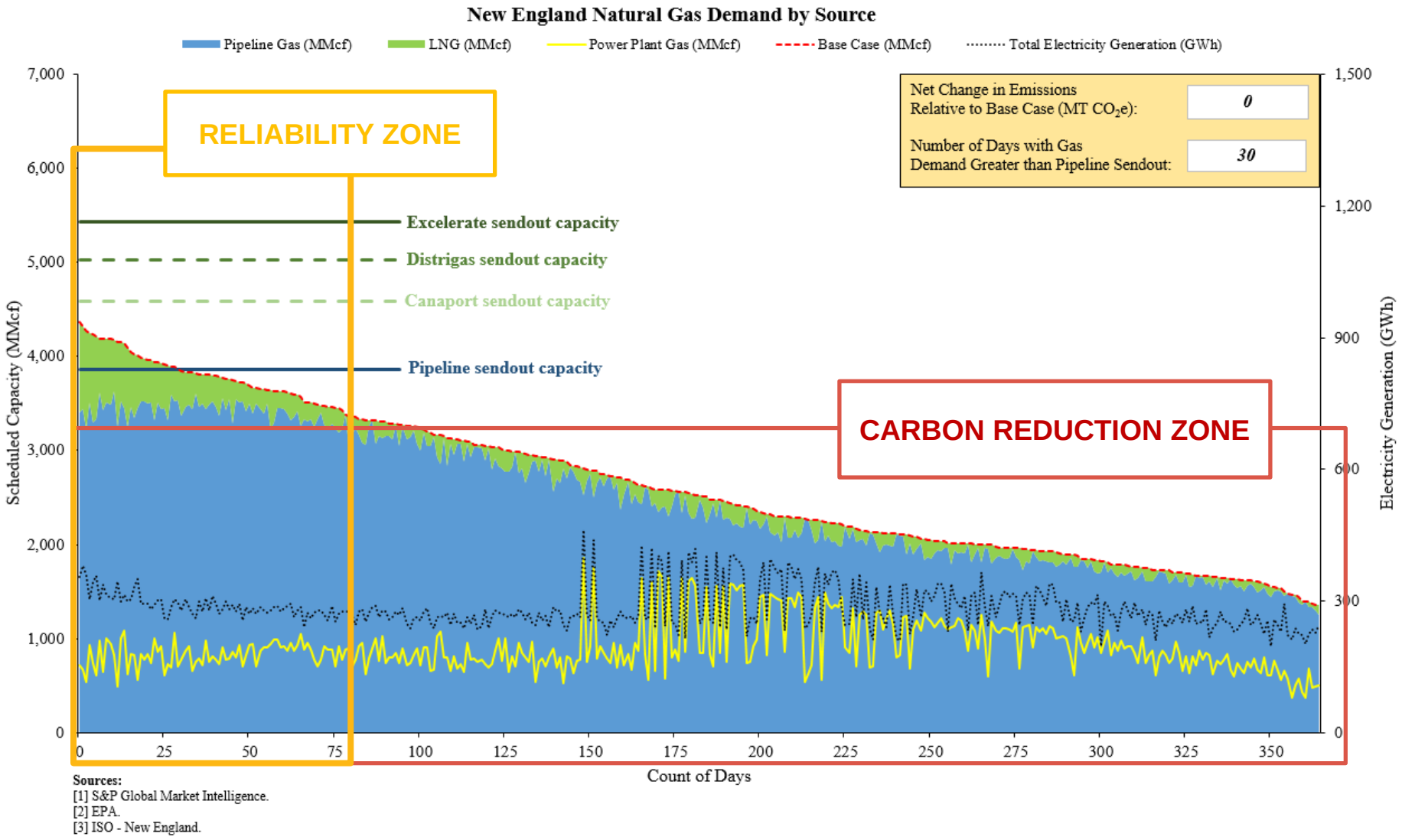
Starting Point: 2018 Natural Gas Load Duration Curve



Sources:
[1] S&P Global Market Intelligence.
[2] EPA.
[3] ISO - New England.

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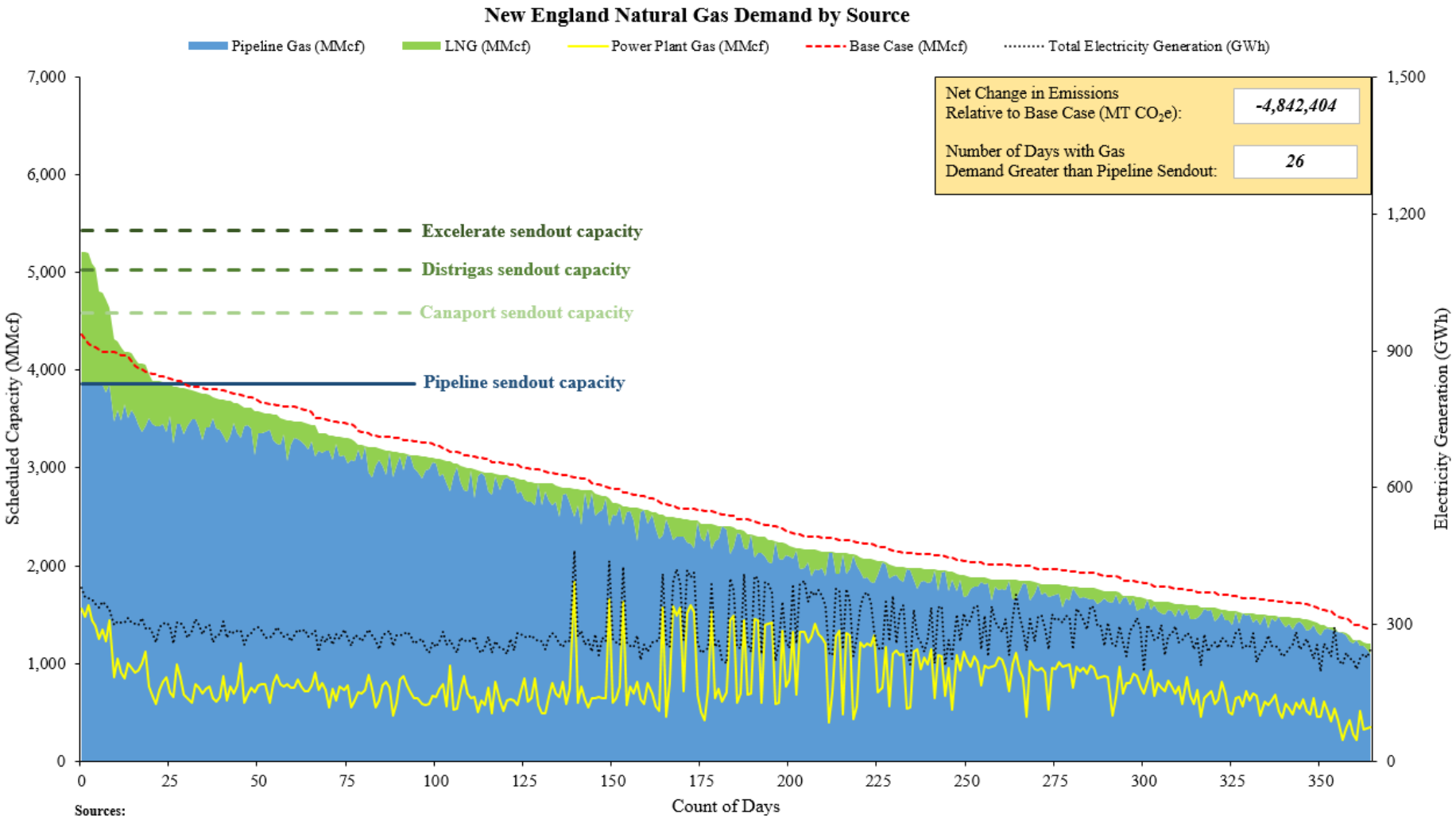
Pilgrim, Coal, and Oil Out; 5,000 MW Hydro, Wind, Solar Added



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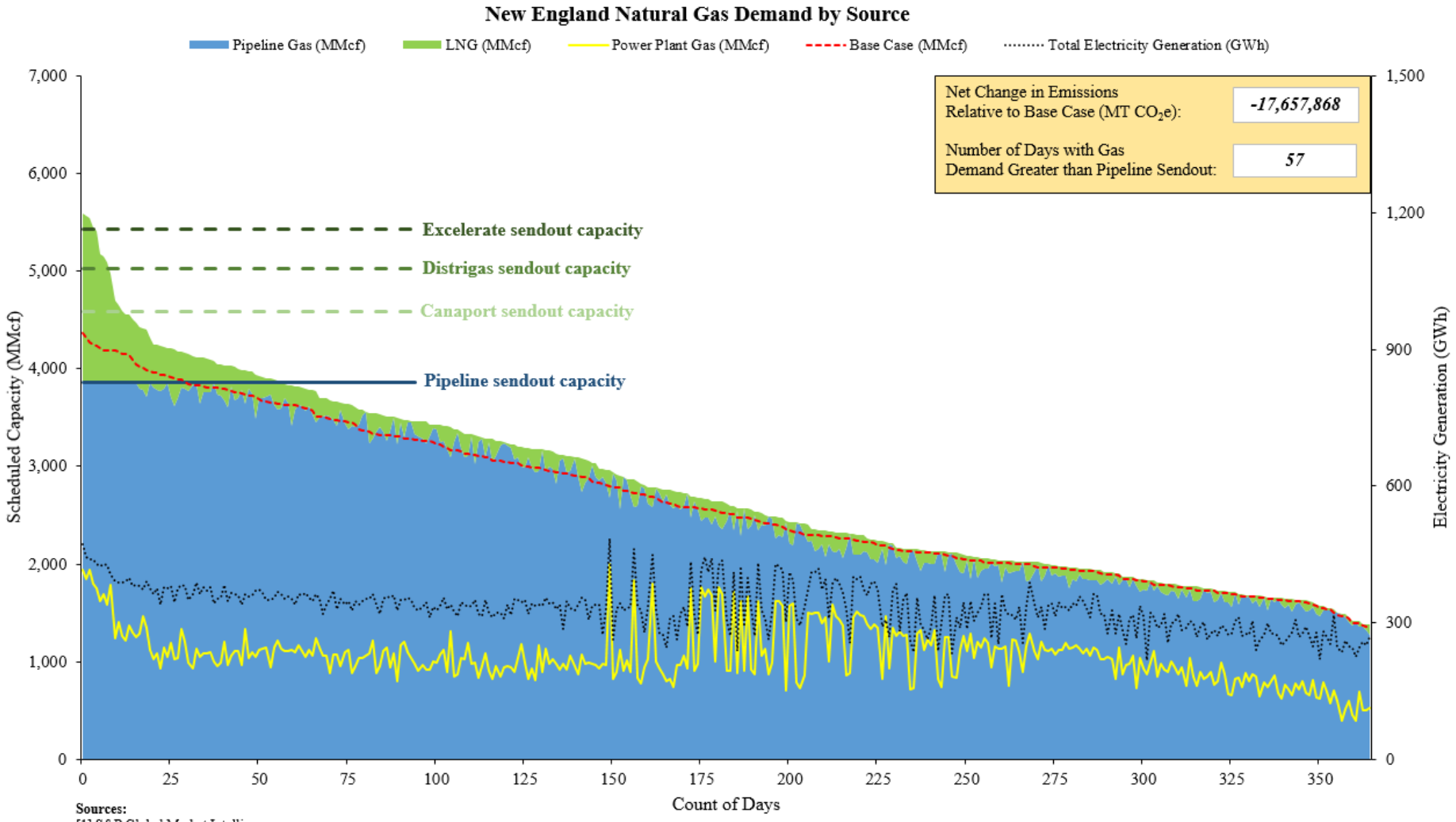
Pilgrim, Coal, and Oil Out; 5,000 MW Hydro, Wind, Solar Added 25% Electrification (Heating, Cars)



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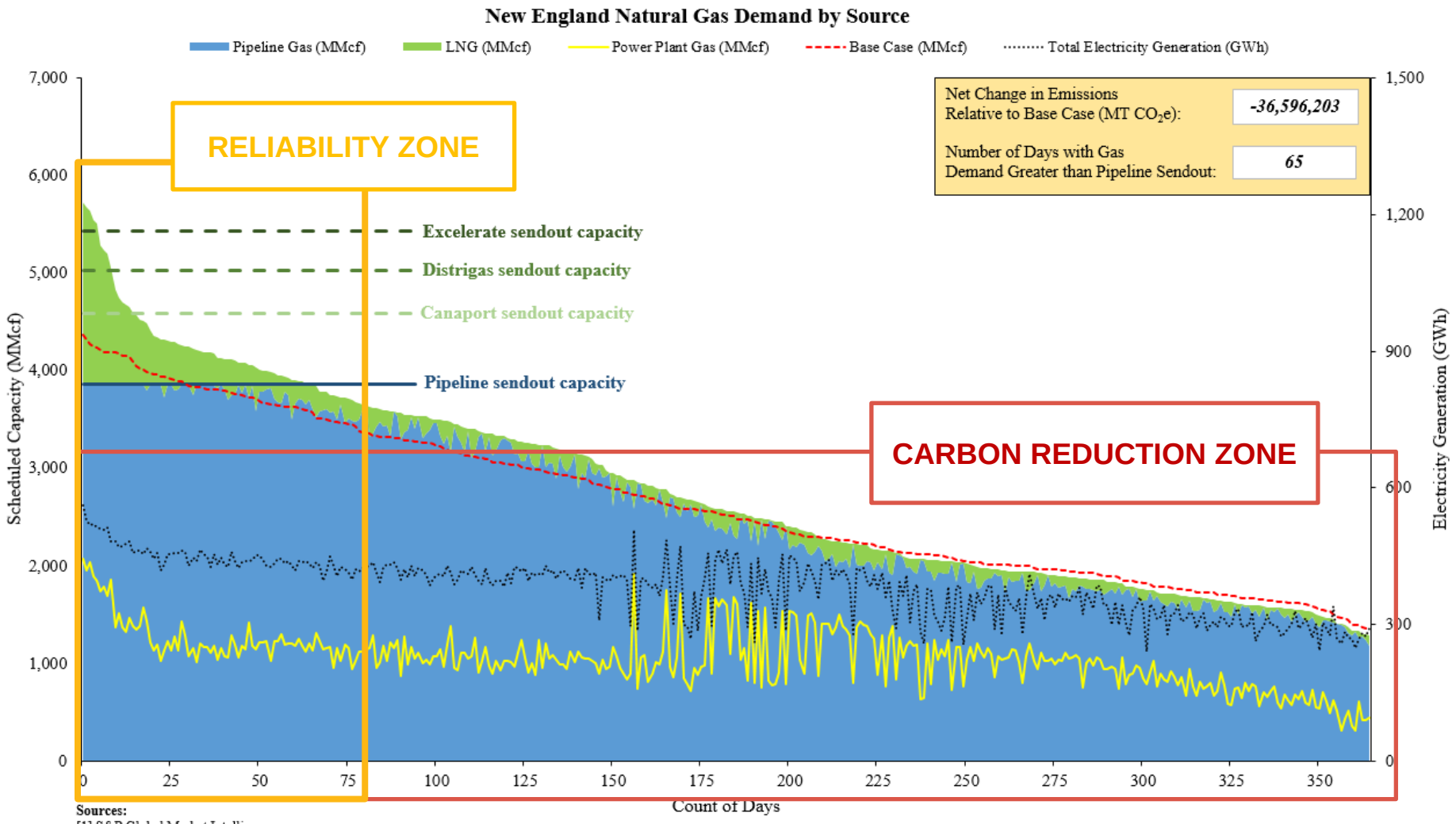

Sources:
[1] S&P Global Market Intelligence.
[2] EPA.
[3] ISO - New England.

Carbon Reductions vs. Peak Winter Needs

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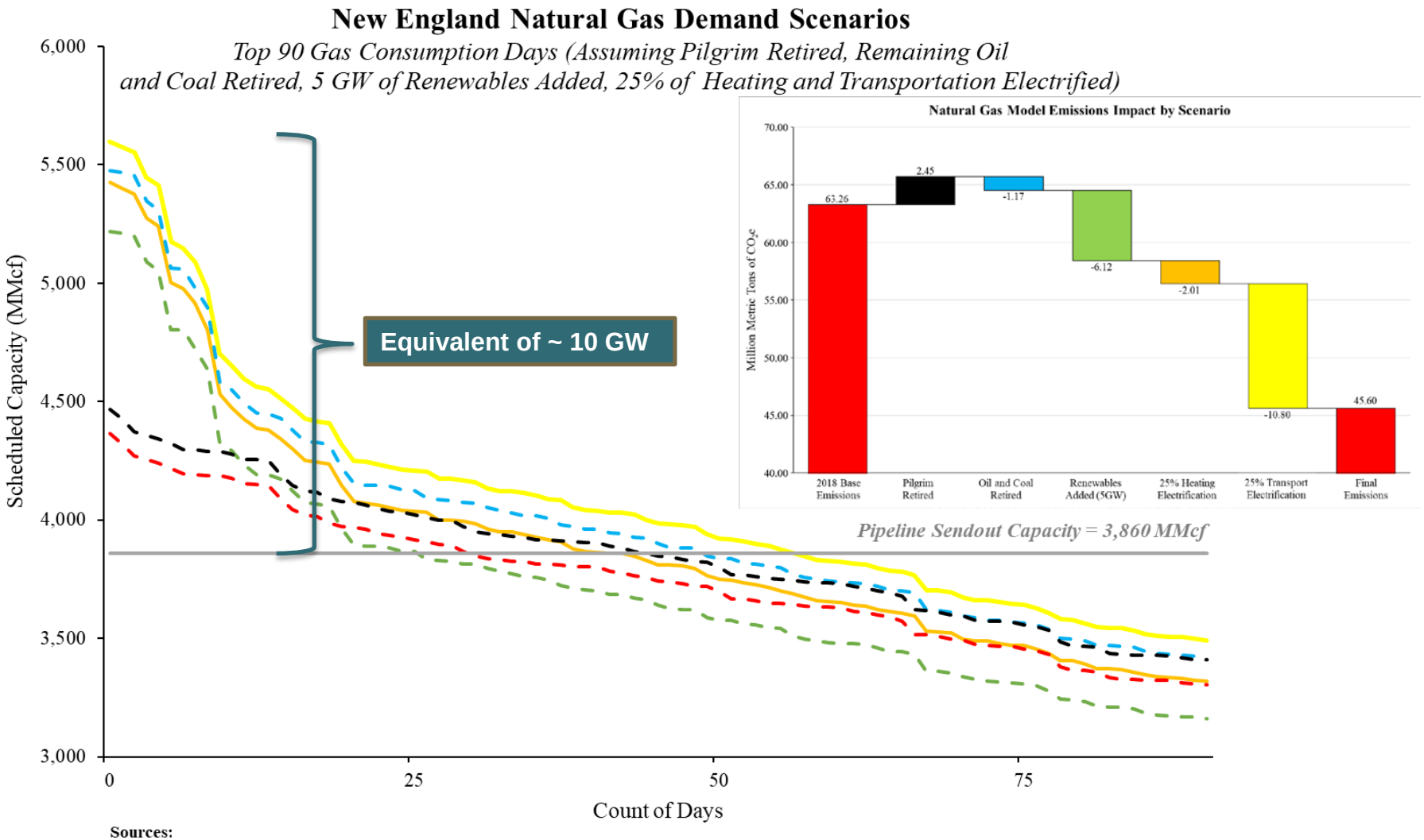

Sources:
[1] S&P Global Market Intelligence.
[2] EPA/EIA.
[3] ISO - New England.

Punchline

- Add 10,000 MW of zero-carbon renewables
- Electrify transportation, heating to achieve state GHG requirements
- Reduce GHG by on the order of 40 million metric tons
- Still heavily dependent on natural gas in the power sector
  - To balance the market, meet annual consumption requirements
  - To support operations with vastly greater net load variability
- Natural gas infrastructure remains vital for winter heating and power system reliability
  - Existing pipeline capacity still maxed out
  - Coldest winter demand exceeds pipeline plus *all* LNG capacity
  - Some LNG needed for between 50 and 75 days per winter

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Questions

- What alternatives are missing?
  - Storage – will it ever be economic enough to be ubiquitous?
  - Additional hydro from Canada?
  - Greater growth in distributed resources, efficiency, demand response
  - Alternative GHG reductions from other sectors
- How do we maintain the infrastructure currently vital for reliability while making sufficient progress towards climate requirements?
  - Window for pipeline infrastructure has all but passed
  - LNG capacity on the fence; reliability contributions are not valued in markets (and never will be)
- Are there market or other mechanisms to find the most efficient path for the transition
  - More aggressive RGGI cap requirements?
  - Carbon pricing (in dispatch; across all sectors?)
  - State resource planning?
- How does the region guide the transition away from fossil fuels
  - To ensure the right infrastructure remains in place to manage power system operations, meet heating and electricity needs through 2050
  - To minimize consumer costs
  - To encourage innovation

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