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The Future of Natural Gas in New England's Electric System?

Who knows. It's complicated…

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Today's baseline: a quick overview

Conditions in NE's power sector, CO_2 emissions, state policy drivers, and the role of natural gas

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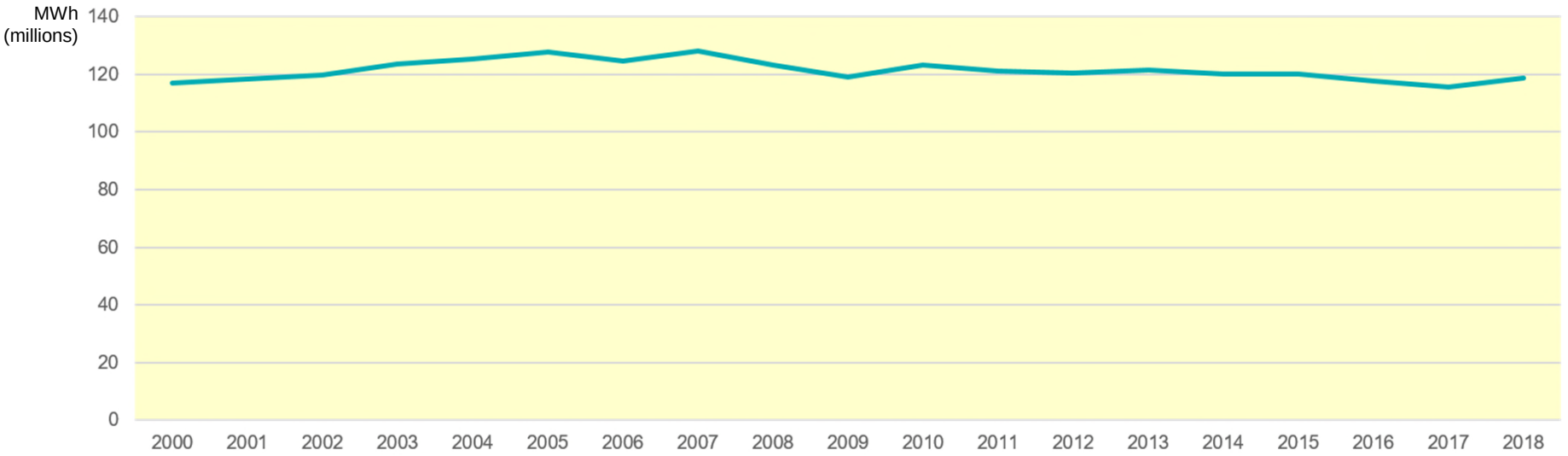
The baseline:

Electric resources: two decades of retail electricity demand in NE

- **The era of flat electricity use**



Source: EIA data

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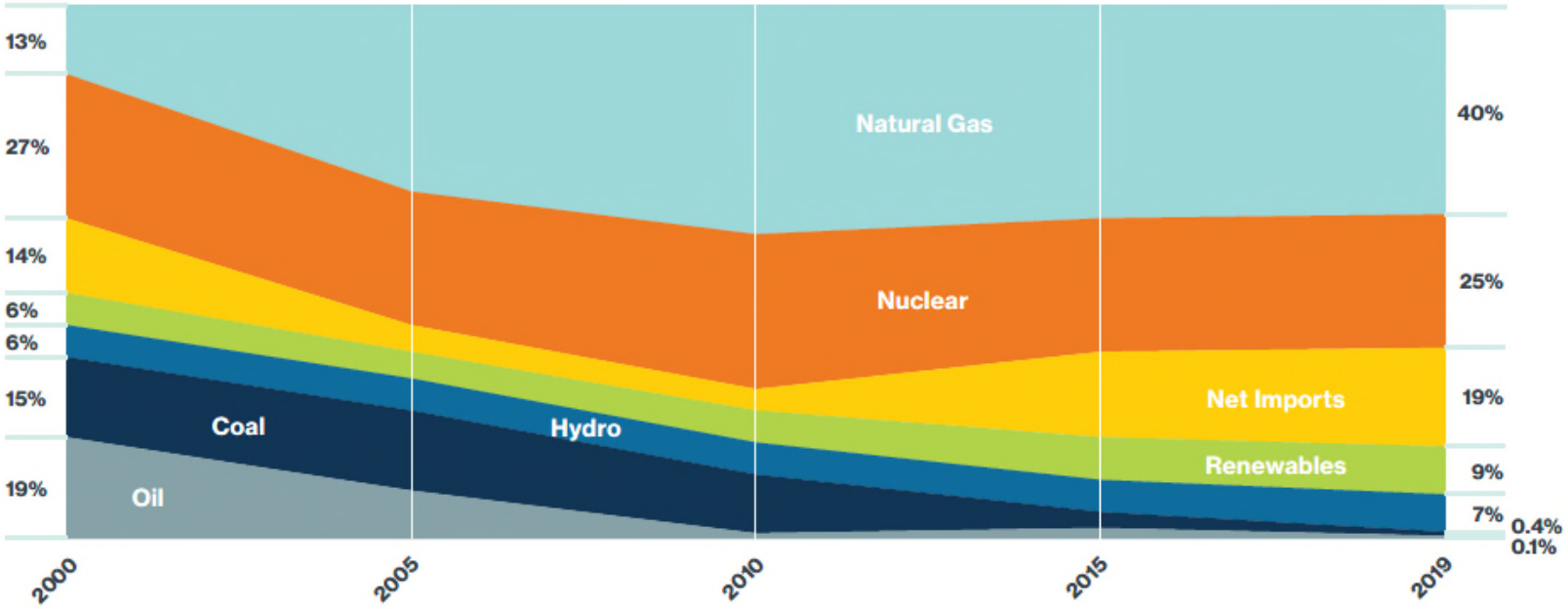
The baseline:

Electric resources: two decades of power production in NE

- **The era of natural gas**



In two decades, coal and oil dropped from 34% of power production to 0.5% of electricity supply.

https://www.iso-ne.com/static-assets/documents/2020/02/2020_reo.pdf

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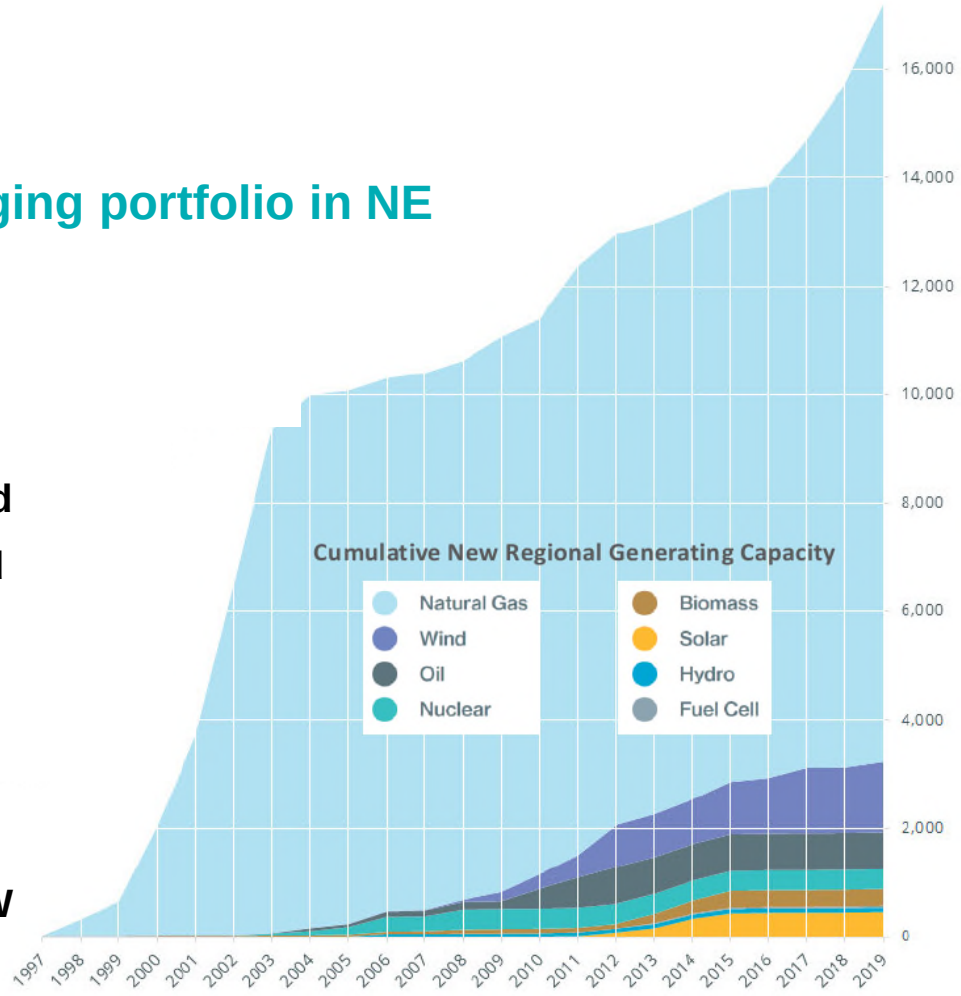
The baseline:

Electric resources: two decades of a changing portfolio in NE

- **The era of natural gas**
  - **2000 total capability = ~ 25,000 MW**
  - **Since then, changes in resources include:**
    - **~ +18,000 MW of power plant capacity added**
    - **~ 8,000 MW of fossil & nuclear plants retired**
    - **~ +3,000 MW of energy efficiency in place**
    - **~ +800 MW of behind-the-meter PV added**
    - **~ +40 MW of new storage added**
  - **2020 total generating capacity = ~ 30,000+ MW**



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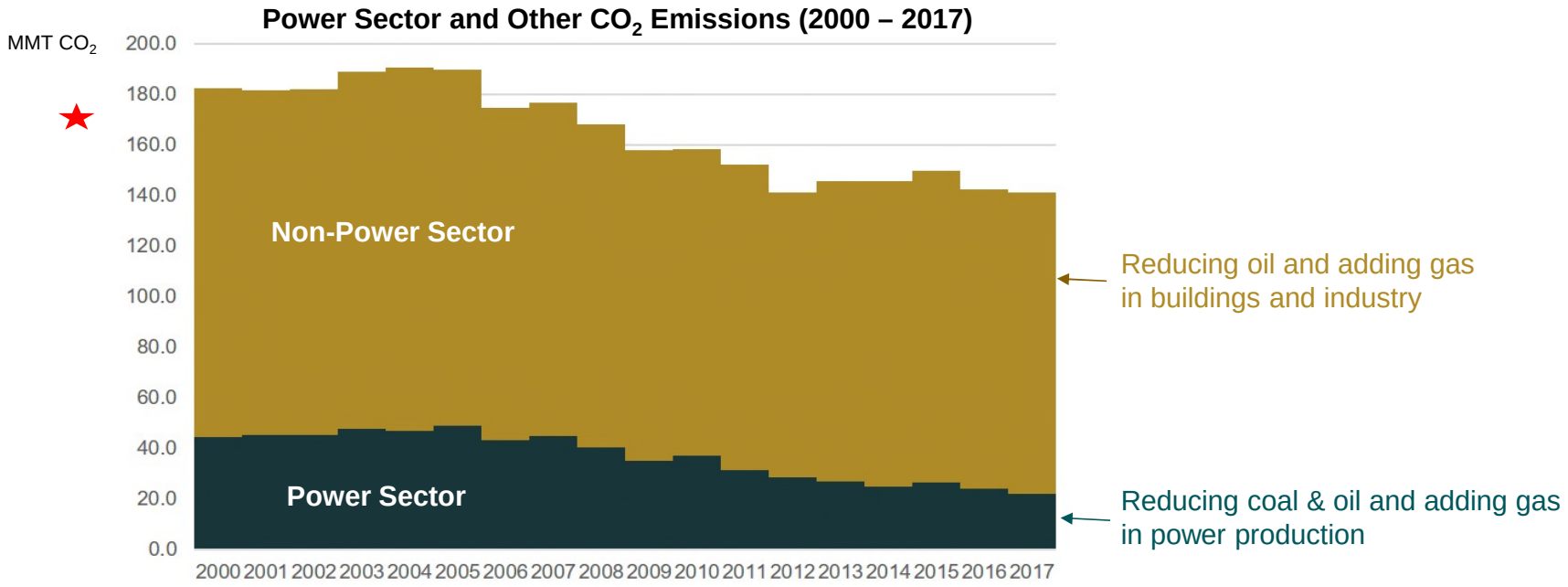
The baseline:

CO_2 emissions: two decades of all energy-related emissions in NE (not just power)



Source: EIA data

★ 1990 NE emissions = 172 MMT. (1990 is the benchmark year for many states' emissions reductions.)

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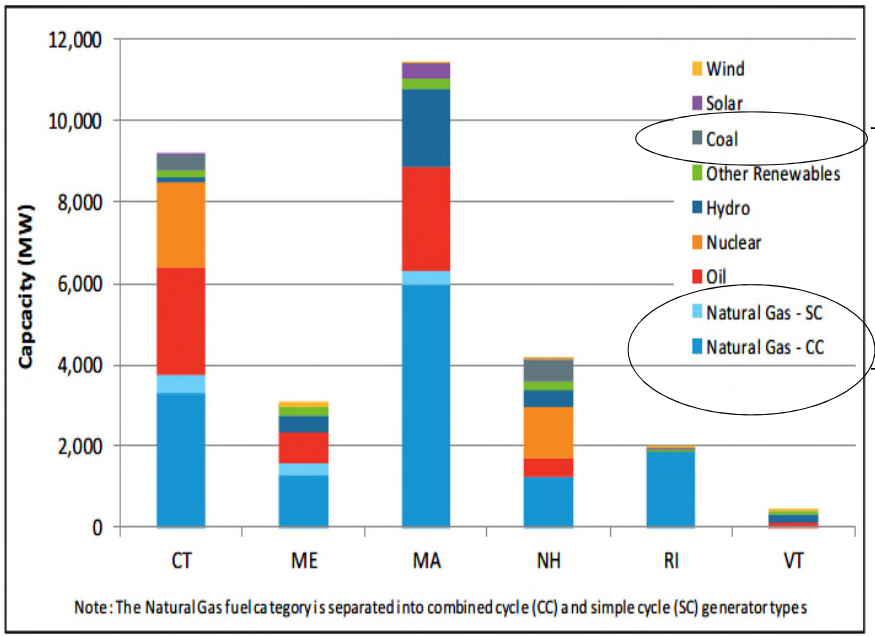
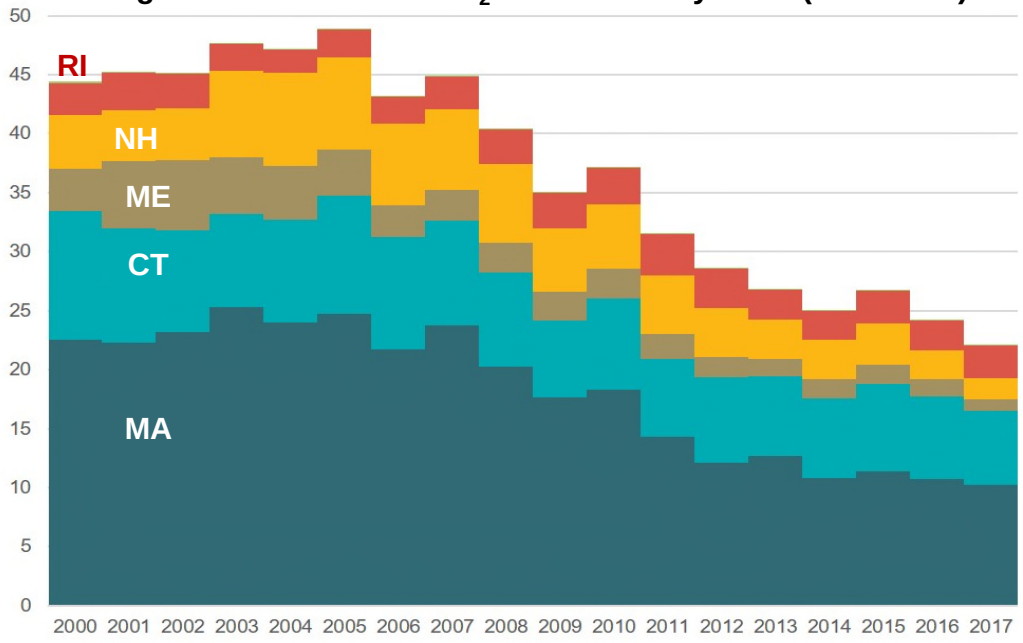
The baseline:

CO_2 emissions: two decades of decline in the power sector, now mainly from gas

New England Generating Capacity by State (2019)



New England Power-Sector CO_2 Emissions* by State (2000-2017)



Sources: CO2 data = EIA; Capacity by state =2018 ISO New England Electric Generator Air Emissions Report.

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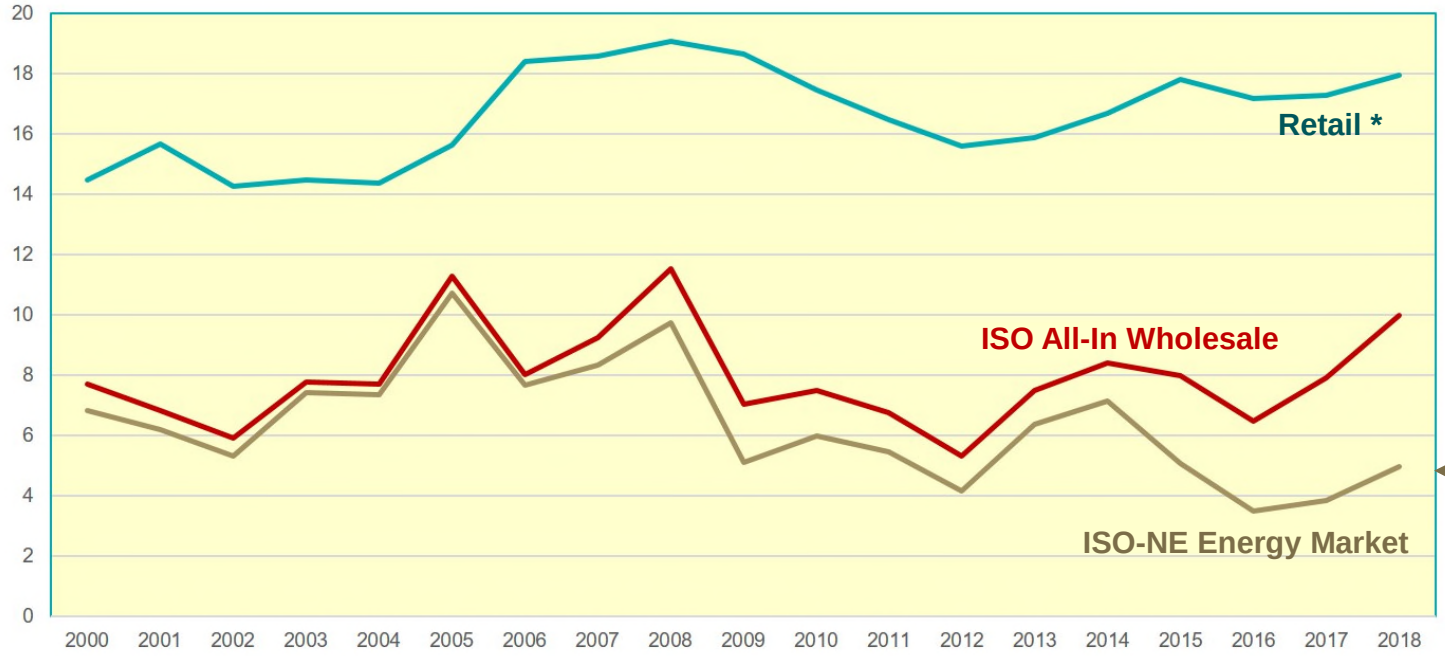
The baseline:

Electricity prices: two decades of taming wholesale and retail electricity prices in NE

Cents/kWh
Real $
(2019 $)



In nominal terms, 2018 retail prices and all-in wholesale were nearly 2x levels in 2000, and energy market prices are near the levels in 2000.

The clear imprint of natural gas.

* Retail prices reflect load-weighted average for all electricity customers in the 6 New England states

Sources: EIA data on average annual retail prices in the NE states; ISO-NE data on average annual

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The baseline:

NE States' climate and clean energy policies: ahead of the curve

- **Energy efficiency**
- **Renewable portfolio standards**
- **Carbon-reduction in the power sector: RGGI**
- **Statutory economy-wide GHG emission-reduction targets**
- **Distributed energy resources**
- **Offshore wind and Canadian hydro contracts**
- **Mixed feelings about existing nuclear plants**
- **And so on…..**

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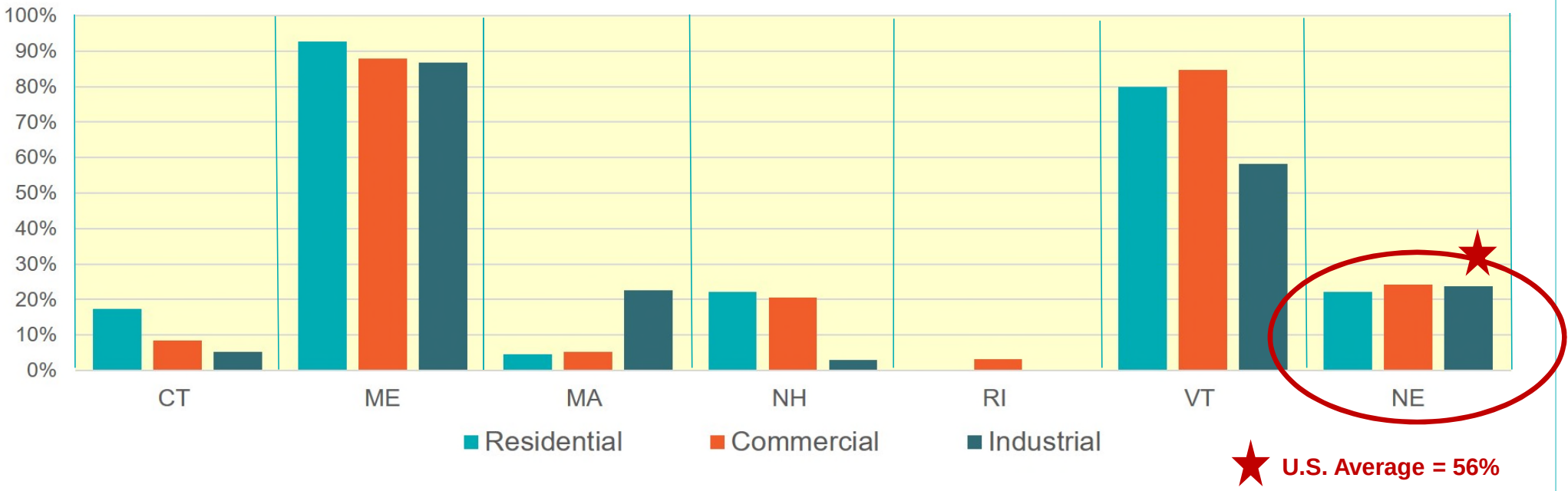
The baseline:

Advanced meters for retail customers: by 2018, behind the curve in 4 NE states

Percent of Retail Customers with Advanced Metering by State and in NE (2018)



★ U.S. Average = 56%

Sources: EIA data on advanced retail meters.

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The baseline:

The state of play in NE's electric industry and market

- **Changes over the past two decades have been huge, including:**
  - **Implementation of the ISO-NE market, with core industry restructuring.**
  - **Billions of investment in generation, transmission, distribution, distributed resources.**
  - **Adoption of state policies driving entry of renewables / zero-carbon energy.**
  - **Significant transitions in the region's resource portfolio even with flat demand.**
  - **Emergency of an electric system intimately tied to natural gas.**
  - **Real reductions in wholesale electric energy market prices.**

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My expectations and assumptions about NE's electric future

The important yet challenging role of natural gas

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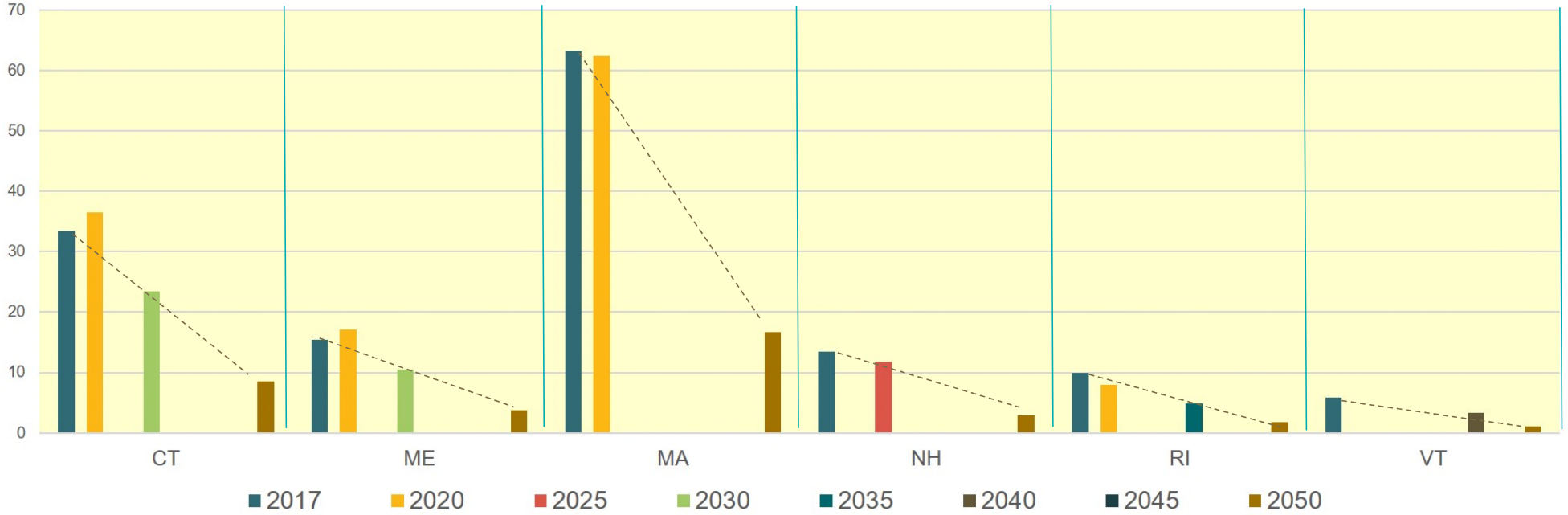
The future: expectations

State climate laws/goals call for transformation of the region's energy systems

NE's Actual (2017) Energy-Related CO_2 Emissions* by State and GHG-Emissions Reduction Goals by State (through 2050)



* Note that the 2017 numbers are CO_2 emissions, while the goals are in GHG emissions. The emissions-reduction targets shown in this figure are specific to each state's benchmark year and the timing of future emissions reductions goals.

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The future: expectations and assumptions

Changes in the past 20-30 years pale in comparison to what's ahead in NE

- **The region will need to pick up the pace:**

Changes in each NE state's economy-wide energy-related CO_2 reductions		
	Past 27 years (1990-2017)	Further reductions needed in the next 30 years (2020-2050)
CT	- 18%	74%
ME	- 19%	75%
MA	- 24%	74%
NH	- 9%	78%
RI	+ 13%	82%
VT	+ 6%	81%

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The future: expectations and assumptions

Changes in the past 20-30 years pale in comparison to what's ahead in NE

- **The region will need to pick up the pace:**
  - **Faster, deeper additions of zero-carbon supply**
  - **More entry of varied storage technologies**
  - **Much more animation on the demand side**
  - **Much deeper energy efficiency**

Changes in each NE state's economy-wide energy-related CO_2 reductions		
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The future: expectations and assumptions

Changes in the past 20-30 years pale in comparison to what's ahead in NE

- **The region will need to pick up the pace on all of those things *while also* ensuring that the electric system meets multiple other fundamental social/economic objectives:**
  - **Safe, reliable, resilient power supply**
  - **Growing services and delivery options for customers**
  - **Access to affordable energy for those customers with few choices**
  - **Viable business models for service providers**

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The future: expectations and assumptions

Tomorrow's electric system will be different but in as-yet unknown ways (1)

- **Electrification of buildings and transportation**: It will not be cheap in the near term, so markets alone are not likely to drive change fast enough.
- **Carbon pricing:** Without a much-stronger price in the electric market and in other sectors, it will be harder to switch to electricity and to lower CO_2 emissions.
- **NE's electric system:** It could be much bigger (1.5x? 2.0x? Other x?) with electrification.
- **Resource economics:** Increasing % of the market will have high capital costs and low variable costs.
- **ISO-NE's organized capacity market:** Questionable sustainability as the system continues to change.

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The future: expectations and assumptions

Tomorrow's electric system will be different but in as-yet unknown ways (2)

- **The region's 3 remaining nuclear plants:** Currently provide 2/3 of carbon-free generation.
- **Their licenses expire: In** 2035, 2045, and 2050.
- **Zero-carbon resources:** Need to add ones with high capacity factors.
- **The NE electric system peak:** Over time, shifts to the winter with higher electric heating loads, when there is diminished output from some carbon-free resources.
- **Demand response:** Without more adoption of AMI and change in retail rate designs, customers will under-perform in providing flexible resources, and more generating capacity and storage will be needed.

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The future of natural gas in NE's electric system:

Who knows; it's complicated…. (1)

- **Siting**: Not likely to be easier to site new pipeline capacity and gas-fired plants in NE in the future.
- **Gas delivery infrastructure:** Will need to be maintained as long as there are gas users on the system.
- **Gas distribution costs:** Could rise for gas customers as loads shift to electricity.
- **Renewable natural gas:** Although the economics and markets for renewable natural gas are uncertain, under the right conditions (e.g., price on carbon in energy markets, economic value for provision of flexible generation services), RNG could play a role in keeping gas in the mix while lowering GHG emissions.

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The future of natural gas in NE's electric system:

Who knows; it's complicated…. (2)

- **Gas for winter power generation:** Some delivery capacity could be freed up as gas-heating loads switch to electricity.
- **Need for gas-fired power plants:** Until there is much more storage (especially long-duration) and dispatchable zero-carbon resources, gas plants will be needed for energy back-up and balancing.
- **Performance of gas plants:** Declining capacity factors over time.
- **Financial viability of gas plants:** Low capacity factors, low energy market prices and uncertain capacity-market arrangements will make it hard for plants to remain open over time.
- **Mechanisms to support gas plants on the system:** As the system relies increasingly on non-dispatchable resources, there will likely be need for new financial mechanisms to retain such gas capacity as insurance – which will be very controversial in the context of climate-related politics.

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The future of natural gas in NE's electric system:

Who knows; it's complicated; and part of the puzzle

- **Figuring out how to decarbonize the region's energy systems are like assembling a 2500-piece jigsaw puzzle.**
- **There's a timer ticking on completing the puzzle without**
- **The pieces of the puzzle are in the hands of countless players.**
- **It's not clear how the whole regional puzzle comes together fast enough and without dropping key pieces on the floor.**
- **Winning the game calls for greater coordination and cooperation.**
- **And it'll be a beautiful picture.**

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