Wholesale Market Re-Design in a Fully Decarbonized New England Grid

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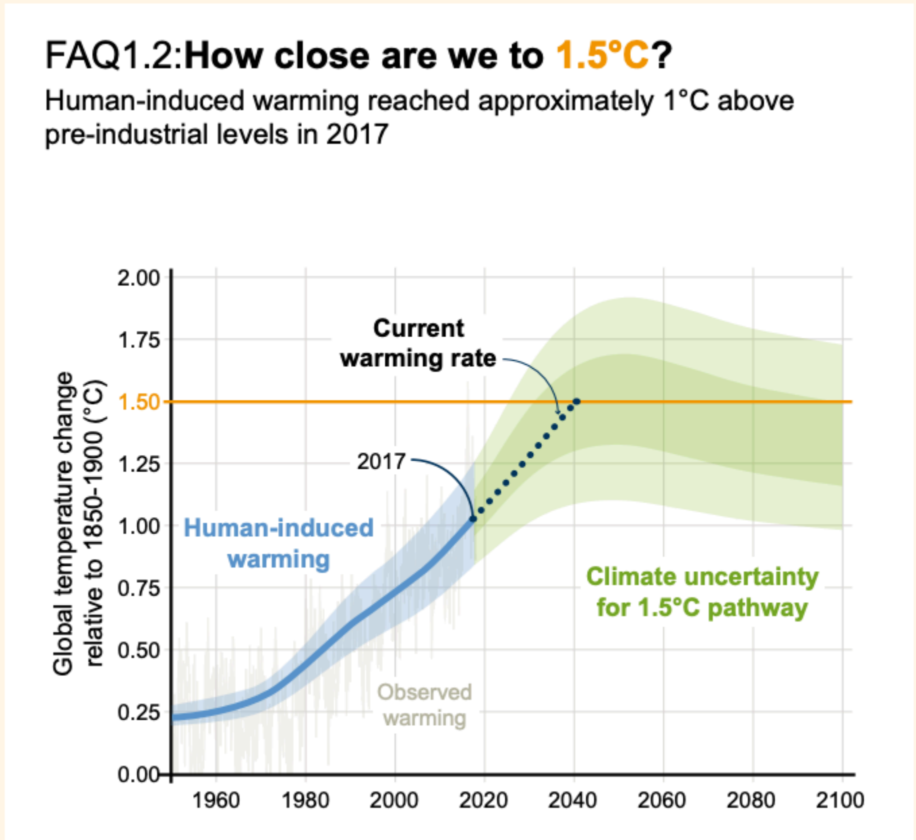
Questions Posed to This Panel

- *What should our wholesale markets look like when (and if) New England's grid is fully decarbonized?*
  - *Should we move to full scarcity pricing in our energy markets?*
  - *Does it make sense to have carbon pricing, and if so, should it be just for the electricity sector or economy-wide?*
  - *Will we still need a separate resource adequacy construct, and if so, would today's capacity market design suffice, or would something else be better - and if so, what and who should have lead responsibility (ISO New England or the states)?*

“What should our wholesale markets look like when (and if) New England's grid is fully decarbonized?”

- I’m uncomfortable with the “if” in the question
- Science shows we must reduce carbon emissions immediately and ultimately reach <u>net negative carbon</u> later this century to avoid the most catastrophic impacts of climate change
- We need to fully commit to decarbonizing the power sector and doing it quicker than most people think reasonable



FAQ 1.2, Figure 1 | Human-induced warming reached approximately 1°C above pre-industrial levels in 2017. At the present rate, global temperatures would reach 1.5°C around 2040. Stylized 1.5°C pathway shown here involves emission reductions beginning immediately, and CO_2 emissions reaching zero by 2055.

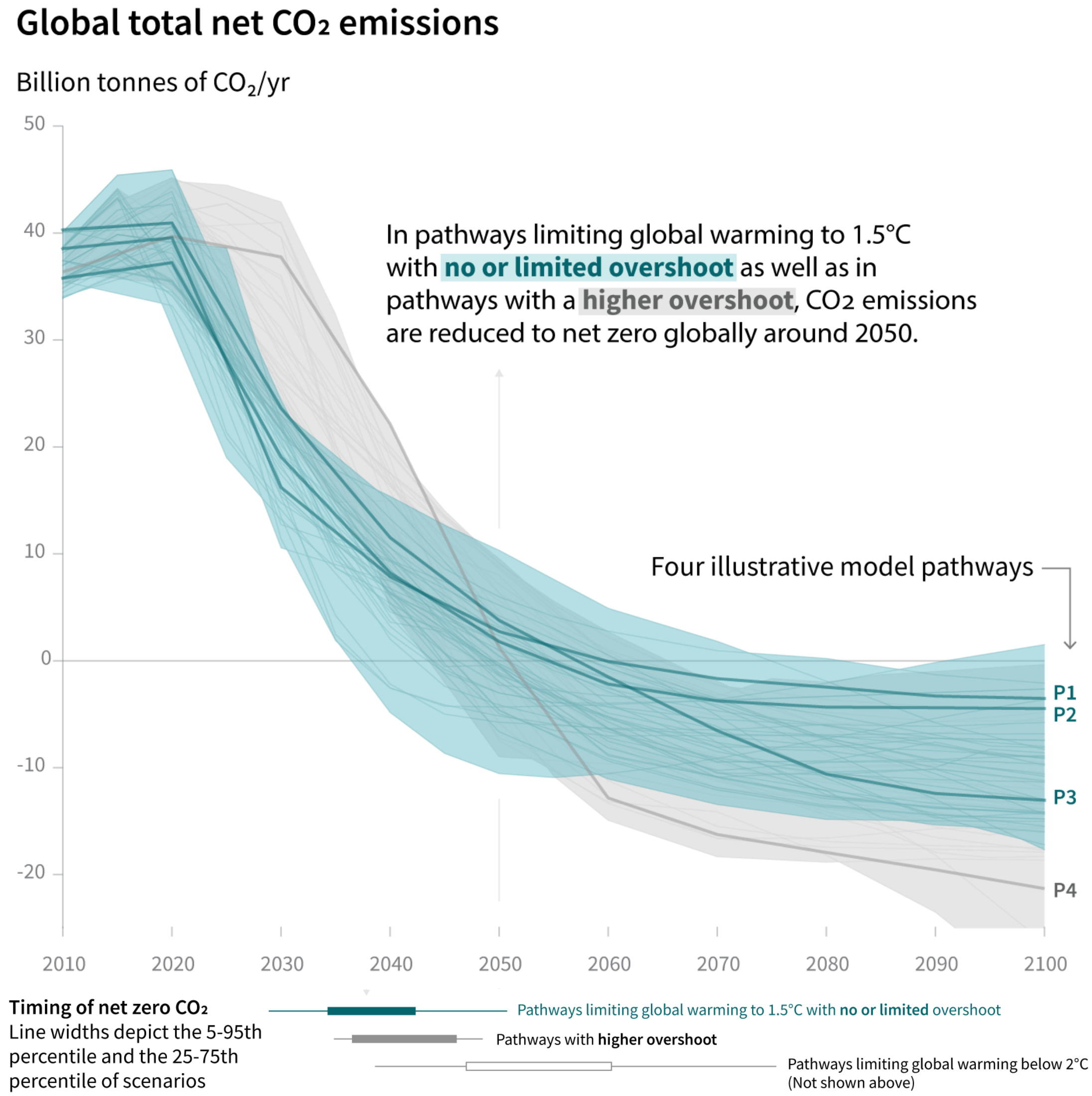
When Are We Talking about?

- There are significantly mismatched expectations about timing out there
- Latest ISO-NE Statements:
  - “The demand for carbon-free electricity will likely increase over the coming decades.”
  - “The steep part of the Clean Energy Transition is 2030 and beyond. We expect a ‘hockey stick’ in demand for clean electricity”

ISO-NE quote source: https://www.iso-ne.com/static-assets/documents/2020/02/2020_reo.pdf, https://www.iso-ne.com/static-assets/documents/2020/02/iso_ne_clean_energy_transition_2020.pdf

When Are We Talking about?

- Latest Science:
  - No pathway in IPCC report that waits until 2030 to begin serious reductions in emissions is able to limit warming to 1.5°C without significant overshoot
  - Simply reaching carbon neutrality by 2050 is insufficient



Questions Posed to This Panel
Cutting to the Chase

- *Should we move to full scarcity pricing in our energy markets?*
  - I'm not convinced
- *Does it make sense to have carbon pricing, and if so, should it be just for the electricity sector or economy-wide?*
  - Economy-wide, absolutely
- *Will we still need a separate resource adequacy construct,*
  - Yes, I believe we will
- *and if so, would today's capacity market design suffice,*
  - Absolutely not
- *or would something else be better - and if so, what and who should have lead responsibility (ISO New England or the states)?*
  - ISO could be well suited for this, but absent their leadership and state/fed support, states are next-best suited to fill the void

All Questions At Their Core Ask the Same Thing

- What revenues are needed to finance and operate clean energy resources in the most economically efficient manner while maintaining reliability?
- Nearly all primary energy sources in this future system have high capital cost, extremely low operating cost
  - Opposite of the vast majority of resources built under the existing markets
- Market must be able to reduce financing risk sufficiently for these resources to be built
  - Both during the transition and in this end-state
- Or else some out of market mechanism must step in to do this

Does It Reduce Financing Risk Sufficiently for High CapEx/Low OpEx Resources to Be Built?

- Scarcity pricing – fails
  - Decarbonized system only works if more wind/solar built than peak load
  - Energy prices should be around zero when sun is shining/wind is blowing
  - Only when it's not sunny/windy would we see high prices
  - Good for storage resources, not helpful for primary energy sources
  - Useful, but insufficient
- Carbon Pricing – fails
  - In <u>fully</u> decarbonized system, provides no revenues
  - May prevent backsliding, so useful but insufficient
- Resource Adequacy
  - Forward-looking planning to ensure a sufficient probability of meeting demand in all hours, not just the peak hour, strikes me as warranted

Does It Reduce Financing Risk Sufficiently for High CapEx/Low OpEx Resources to Be Built?

- Is today’s FCM sufficient?
  - No, and it has nothing to do with the MOPR
  - Can’t just focus on peak hour anymore
  - FCM design provides very different levels of investment risk reduction to resources with:
    - Low capital cost, high operating cost (e.g., historically gas)
    - High capital cost, low operating cost (e.g., nearly all zero-carbon resources)

How FCM Succeeded In Making Gas Plants Financeable Based on the Market

- According to ISO's modeling in 2016, new gas plants would lock in two thirds of their capital costs from the FCM at their break-even capacity price
  - Only 1/3 of revenues needed to recover capital costs subject to market risk
    - capacity revenue beyond 7 year rate lock
    - energy and ancillary services
- This was a good market design for competitively procuring new gas plants

	FCA 12 ORTP ($/kW-mo)	Share of overnight capital costs locked in at ORTP
Combined Cycle	$7.86	63%
Simple Cycle	$6.50	65%

Source: Final FCA 12 ORTP model from December 2016 Markets Committee materials

Why FCM Doesn't Make Clean Energy Financeable

- Assume 6.3% reduction in wind capital cost and 27% reduction in PV capital cost compared with ISO's 2016 modeling
  - Note: this is more modest than actual cost reductions since 2016
- SC Gas, Wind, and PV all end up with the same ORTP
- At $6.50/kW-mo, all have same 20-year net present value ($0)
  - Should be a toss up between them
  - SC Gas locks in enough revenue for financing
  - Wind and solar do not

	ORTP ($/kW-mo)	Share of overnight capital costs locked in at ORTP
Simple Cycle	$6.50	65%
Wind	$6.50	21%
PV	$6.50	35%

Capacity Market
Won't Make Clean Energy Financeable

- Academic paper last year by FERC Chief Economist describes this effect:

  "Introduction of a capacity mechanism has an asymmetric effect on the risk profile of different generation technologies, tilting the resource mix toward those with lower fixed costs and higher operating costs. One implication of this result is that current market structures may be ill-suited to financing low-carbon resources, the most scalable of which have high fixed costs and near-zero operating costs. Development of new risk trading mechanisms to replace or complement current capacity obligations could lead to more efficient outcomes."

policy brief

ELECTRICITY MARKETS

Decarbonizing electricity requires re-evaluating capacity mechanisms

Many electricity markets authorize capacity payments to generators to secure sufficient supply, unintentionally favouring peaking technologies like oil and gas. New approaches are needed to ensure reliability without discouraging investment in low-carbon resources such as solar, wind and nuclear.

Jacob Mays[1,2]*, David P. Morton[1] and Richard P. O'Neill[2]

BASED ON J. Mays et al. *Nature Energy* https://doi.org/10.1038/s41560-019-0476-1 (2019).

The policy problem
A key challenge in liberalized electricity markets is ensuring that investors build enough generation capacity to maintain reliability of the system. Instead of relying purely on energy market revenues to attract investment, many regions have put in place resource adequacy mechanisms that enable generators to receive supplementary payments for capacity. The addition of wind and solar power tends to depress energy market prices, so many project that these capacity payments will become increasingly important to guarantee reliability as markets evolve. As revenue from these resource adequacy mechanisms grows, however, flaws in their design are magnified, potentially hindering a transition to cleaner, more flexible and more efficient resources.

The findings
We find that from the perspective of investors, the financial impact of resource adequacy mechanisms is to replace highly volatile energy market revenues with relatively stable payments for capacity. This hedging property reduces the risk of investing in new generation, enabling developers to secure financing at lower cost. However, the quality of the hedge for each generation technology depends on how well the design of the mechanism aligns with its particular risk profile. Our findings suggest that the structure of current capacity mechanisms inadvertently favours generation resources with low capital costs and high operating costs, such as gas- and oil-fired peaking plants, over technologies with the opposite cost structure, like solar, wind and nuclear. Accordingly, current mechanisms may work against efforts to decarbonize.

The study
To examine the effect of risk and resource adequacy mechanisms on generation investment, we developed an equilibrium model describing a competitive market with limited outlets for risk trading. Unlike traditional analyses, in which the risk premium required by investors is assumed to be constant, our equilibrium framework allows the risk premium to change in accordance with the stabilizing effect that financial trades can have on generator revenues. Importantly, the study was theoretical rather than experimental. Due to the proprietary nature of most commodity trading, estimating the real-world magnitude of the effect described in the study remains a challenge. ❐

Messages for Policy

- Mechanisms designed to guarantee sufficient electricity supply may have unintended consequences on resource mix.
- Implementing capacity markets can shift the resource mix away from baseload and variable resources like nuclear and renewables, toward peaking technologies like oil and gas.
- Regions relying on competitive markets for resource adequacy should work to ensure robust markets for risk-trading instruments.
- Regions with explicit capacity requirements should consider a range of risks when designing those requirements.

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Further Reading

Cramton, P., Ockenfels, A. & Stoft, S. Capacity market fundamentals. *Econ. Energy Env. Pol.* **2**, 27–46 (2013).
Explains the rationale for and intent behind existing capacity market structures.

D'Aertrycke, G., Ehrenmann, A., Ralph, D. & Smeers, Y. *Risk Trading in Capacity Equilibrium Models.* Cambridge Working Paper Economics 1757 (University of Cambridge, 2017).
Defines several capacity investment models with different assumptions on market power and availability of risk trading mechanisms.

Ferris, M. & Philpott, A. *Dynamic risked equilibria* (Optimization Online, 2018).
Establishes the need for complete markets in risk to achieve efficient outcomes in competitive markets.

[1]Department of Industrial Engineering and Management Sciences, Northwestern University, Evanston, IL, USA. [2]Federal Energy Regulatory Commission, Washington, DC, USA. *e-mail: jacobmays@cornell.edu

Source: J. Mays et al. Nature Energy https://doi.org/10.1038/s41560-019-0476-1 (2019).

New Market Structure

- At minimum, market structure and incentives need to be realigned to allow the all-in least cost resources to be procured in a financeable manner. Not just the lowest capital cost resources.
  - Without change to ISO markets to address this, I expect states have no other reasonable option than to take over resource adequacy.
- For years, “off-grid” clean energy systems have successfully run economic optimizations of the resource mix that provides both the expected energy and resource adequacy needs
  - Whether ISO-NE market or state IRP, that is the same optimization that needs to be done here, on a larger scale

Questions?

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