AESC 2024

Presentation to EMT board

May 22, 2024

Pat Knight | Synapse Energy Economics | pknight@synapse-energy.com

www.synapse-energy.com | ©2024 Synapse Energy Economics Inc. All rights reserved.

What is AESC?

- Avoided Energy Supply Components (AESC) in New England study is an analysis performed every three years.
- In 2023-2024, Synapse was hired by a cohort of a dozen entities installing energy efficiency and electrification measures in the six New England states, including Efficiency Maine Trust.
- Over a six-month period, our team met weekly or biweekly with the study group (study sponsors, plus other interested parties such as Maine PUC) to discuss methodologies, inputs, interim findings, and deliverables.
- The goal of the study is to produce a set of avoided costs for estimating the costs and benefits of installing demand-side measures, such as energy efficiency and electrification measures.
  - Deliverables include numerous Excel workbooks with the avoided costs themselves, as well as a report to provide additional context.
  - All materials are available online at https://www.synapse-energy.com/aesc-2024-materials.

Synapse Energy Economics, Inc. is an energy, economic, and environmental consulting company based in Cambridge, MA. We are a leader in providing rigorous analysis of the electric power and natural gas sectors for public interest and government clients. The Synapse Team for the AESC 2024 Study includes Synapse Energy Economics, Sustainable Energy Advantage, Northside Energy, Les Deman Consulting, and Resource Insight.

©2024 Synapse Energy Economics Inc. All rights reserved.

What avoided costs are included in AESC?

- Categories of avoided costs include:
  - Natural gas
  - Fuel oil & other fuels
  - Avoided capacity
  - Avoided energy
  - Avoided cost of compliance with renewable portfolio standard (RPS) policies
  - Non-embedded environmental costs (including benefits of GHG reductions)
  - Demand reduction induced price effects (DRIPE)
  - Avoided T&D costs
  - Value of improved reliability

- Avoided costs are provided from 2024-2050. All costs are provided annually.
- Some costs are provided seasonally or even hourly.
- All costs are available at the state-specific level.

©2024 Synapse Energy Economics Inc. All rights reserved.

What framing is used in AESC?

- AESC uses a “counterfactual” framing approach to scenario analysis.
- The primary counterfactual imagines a future in which no new energy efficiency or electrification measures are installed anywhere in New England in 2024 or any later years.
- This allows us to estimate the impacts of installing any incremental energy efficiency or electrification measures anywhere in New England, at any point in the future.
- We also perform scenario analysis of other perspectives (such as estimating avoided costs in futures with EE but not electrification). These help us to understand the sensitivity of the outputs to the inclusion of these inputs.

 | ©2024 Synapse Energy Economics Inc. All rights reserved.

Main findings

Illustrative avoided costs for hypothetical energy efficiency measure installed in Maine, AESC 2024 Counterfactual #1 versus AESC 2021 Counterfactual #1

		AESC 2021	AESC 2024	Differ-ence	% Differ-ence	Notes
Energy	*2024 $/MWh*	$46	$51	$5	10%	*4*
RPS compliance	*2024 $/MWh*	$8	$15	$7	97%	*4, 5*
Electric energy and cross-DRIPE	*2024 $/MWh*	$4	$5	$1	30%	*6*
GHG non-embedded	*2024 $/MWh*	$50	$86	$36	71%	*4,7,8*
Energy subtotal	***2024 $/MWh***	**$108**	**$157**	**$49**	**45%**	
Capacity	*2024 $/kW-year*	$48	$52	$4	9%	*9*
Capacity DRIPE	*2024 $/kW-year*	$3	$3	$0	-9%	*9,10*
Regional Transmission (PTF)	*2024 $/kW-year*	$95	$69	-$26	-28%	*11*
Value of reliability	*2024 $/kW-year*	$1	$0	$0	-87%	*9*
Capacity subtotal	***2024 $/kW-year***	**$146**	**$123**	**-$23**	**-16%**	-
Capacity subtotal	***2024 $/MWh***	**$30**	**$25**	**-$5**	**$0**	*12*
Total	***2024 $/MWh***	**$138**	**$182**	**$44**	**32%**	-

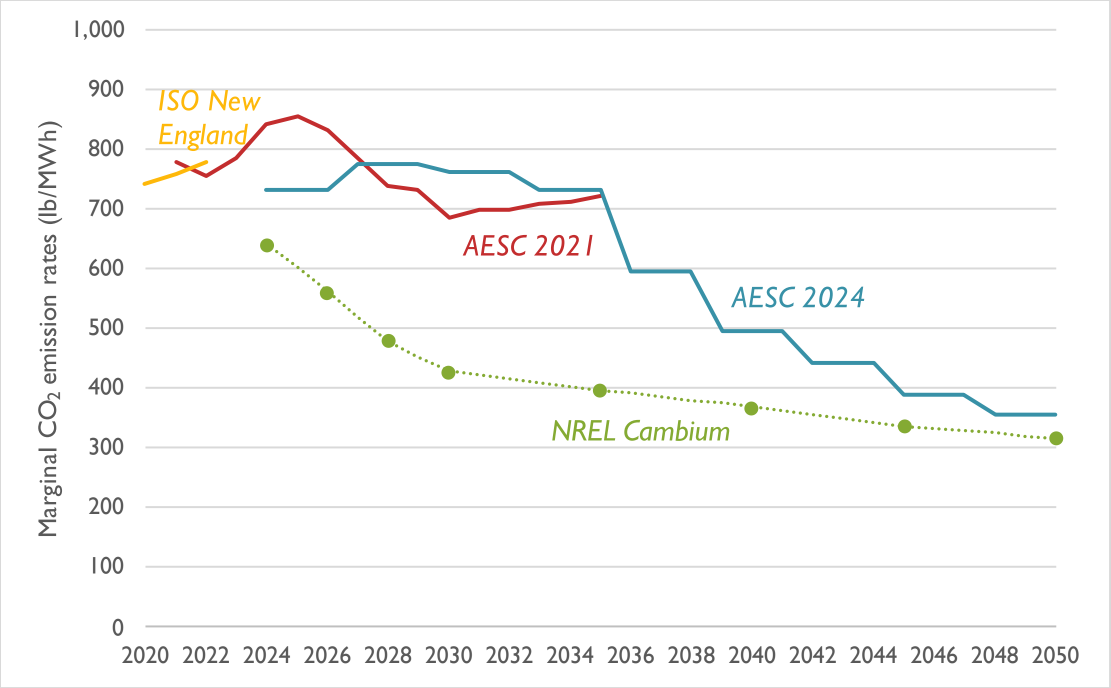
All values are 15-year levelized costs.
For states that use a social cost of carbon, a 2% discount rate is used for this illustrative example. The AESC 2024 report recommends the use of the EPA-derived SC-GHG, which includes costs for 1.5% and 2% discount rates.

- This illustrative table only shows values for Maine, using the historical Maine tabulation of avoided costs. See Slide 9 for notes.
- The following slides summarize results for more counterfactuals and all states.
- **Energy** costs in AESC 2024 are slightly higher due to increases in near-term gas prices and deferral of zero-marginal-cost clean energy resources, relative to AESC 2021.
  - **Energy DRIPE** trends follow energy cost trends for the same reasons.
- **RPS compliance** costs are higher due to increased RPS stringencies across New England and increased technology costs.
- **GHG non-embedded** values are higher due to a change in assumed basis for costs. Illustrated here:
  - AESC 2021 values are shown assuming a cost based on the New England electric sector marginal abatement cost.
  - AESC 2024 values are shown assuming an EPA-derived social cost of greenhouse gases, using a 2% discount rate.
- **Capacity** and **Capacity DRIPE** costs are slightly higher, caused by higher resource costs and loads.
- **Regional transmission (PTF)** costs are lower due to a change in primary reference source.

©2024 Synapse Energy Economics Inc. All rights reserved.

Marginal emission rates for the electric sector

Figure 52. Marginal emission rates



Notes: ISO New England data is from the 2022 Air Emissions Report; NREL Cambium data is from the 2022 MidCase for New England. NREL Cambium data is provided for 2024, 2026, 2028, 2030, 2035, 2040, 2045, and 2050. All other data points shown in this figure are interpolated.

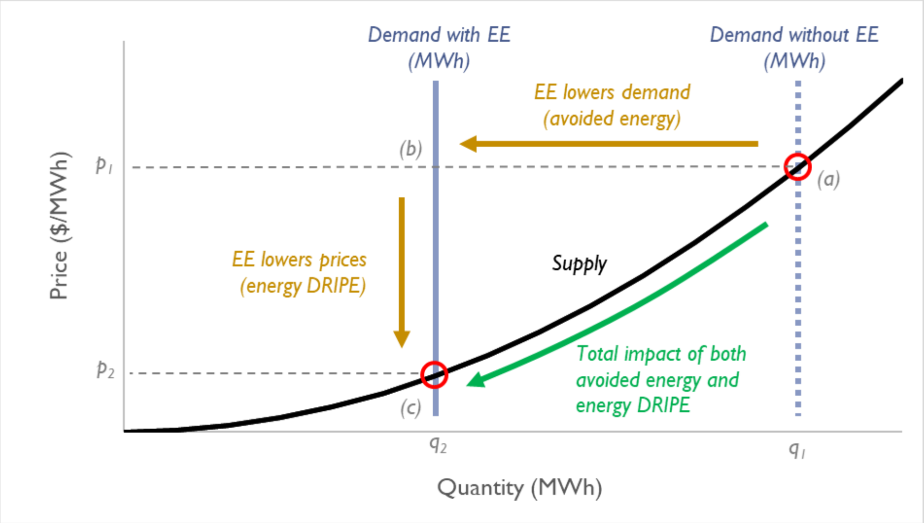
- As in AESC 2021, we observe a marginal emission rate (MER) that resembles a gas plant in the near term in AESC 2024.
  - Over time, clean energy tends to make a larger and larger share of the differences in load, leading to a steadily decreasing MER.
  - The MER in AESC 2024 falls in the mid-2030s, as compared to AESC 2021, because AESC 2024 assumes a delay in some large renewable procurements.
  - In the near term, AESC 2024 MERs resemble data from ISO New England and long-run marginal emission rates (LRMERs) from NREL's Cambium modeling. NREL's MERs fall at a faster rate than those calculated in AESC 2024 because NREL does not make the same assumptions regarding large renewable procurements.
- MERs in AESC 2024 are calculated across a large subset of combinations of scenarios.
  - They are weighted by the deltas between scenarios loads to emphasize observations with larger load differences and reduce noise.
  - In addition, a smoothing trend is applied to results, since these modifications do not fully address the lumpiness related to clean energy deployment.
  - An analogous methodology is used for marginal heat rates.

©2024 Synapse Energy Economics Inc. All rights reserved.

DRIPE

- Demand Reduction Induced Price Effect (DRIPE)
- AESC 2024 models:
  - Energy DRIPE
  - Capacity DRIPE
  - Natural gas DRIPE
  - Cross-DRIPE (which carry over dynamics between the gas and energy markets)
  - Oil DRIPE
- DRIPE results in AESC 2024 differ from those in AESC 2021 because of updated information changes in utility long-term energy purchases, updated market data, and new commodity forecasts.
- We find:
  - Similar energy DRIPE values due to a number of factors (including changes in energy prices, changes in load, and changes in hedging assumptions) that largely offset one another.
  - Generally similar trends in capacity DRIPE values, with values that are highly variable year-to-year in both AESC 2024 and AESC 2021, especially in the near-term years due to market price separation.
  - Lower gas supply and electric-to-gas DRIPE values due to decreases in price shifts.
  - Higher gas-to-electric cross-DRIPE values due to increases in price shifts.
  - Higher oil DRIPE values, due to changes in the underlying projection of crude oil prices.

Example figure depicting separate and non-overlapping avoided energy and energy DRIPE effects



Note: This example figure depicts impacts in the energy market, but the principles are the same for all other DRIPE categories. This figure also uses "EE" as an example measure. DRIPE effects can be calculated for any measure (EE or otherwise), including measures that increase the demand of a commodity.

 ©2024 Synapse Energy Economics Inc. All rights reserved.

Contact

Pat Knight, Senior Principal

pknight@synapse-energy.com | 617.453.7051

 ©2024 Synapse Energy Economics Inc. All rights reserved.

Notes for slide 6

Notes:

- [1] All costs are shown levelized over 15 years. All costs are shown for Maine and are tabulated using the historical method in Maine. Costs have not been adjusted for risk premiums or T&D loss factors.
- [2] All avoided costs are estimated based on the methods states have previously used to tabulate avoided costs. These methods may change in the future.
- [3] AESC 2024 data is from the AESC 2024 User Interface. AESC 2024 values are levelized over 2024-2038, using a real discount rate of 1.74%.
- [4] Energy, energy DRIPE, and GHG non-embedded costs are based on annual average numbers.
- [5] Costs of RPS compliance are the sum of the per-MWh cost for all RPS programs active in this state.
- [6] Electric energy and cross-DRIPE includes intrazonal energy DRIPE, E-G DRIPE, and E-G-E DRIPE. Interzonal effects are not included.
- [7] For AESC 2021, GHG non-embedded costs for Maine are based on a marginal abatement cost derived from the electric sector. For AESC 2024, GHG non-embedded costs are shown based on a social cost of greenhouse gases estimated with a 2% discount rate. AESC 2024 social cost of GHG costs include impacts from CO2, CH4, and N2O pollution and exclude impacts from upstream emissions. The AESC 2024 report recommends the use of the EPA-derived SC-GHG, which includes costs for 1.5% and 2% discount rates.
- [8] GHG non-embedded costs subtract embedded costs (RGGI, state-specific costs in MA) from the social cost of GHGs.
- [9] Capacity, capacity DRIPE, and reliability values are shown for cleared values only. Uncleared values are not included.
- [10] Capacity DRIPE values include intrazonal effects only. Interzonal effects are not included.
- [11] “Regional Transmission (PTF)” values only include regional transmission costs. This cost does not include more localized transmission costs and does not include any distribution costs. These other avoided costs may be specifically calculated in each jurisdiction.
- [12] Capacity values are converted to energy values using a load factor of 56%.

 | ©2024 Synapse Energy Economics Inc. All rights reserved.