ANALYSIS GROUP

Carbon Pricing for New England

Context, Key Factors, and Impacts

SUMMARY FOR POLICY MAKERS

June 2020

Joseph Cavicchi
Paul Hibbard

Summary for Policy Makers

The New England states, motivated by a sense of urgency to address and reduce the risks of climate change, have made substantial commitments to reduce greenhouse gas (GHG) emissions on an expedited schedule. Collectively, the requirements, policies, and goals adopted by the states equate to regional economy-wide reductions in GHG emissions by 2050 of almost 80 percent relative to 2015 actual emissions. There is little doubt that meeting the standards will require an unprecedented magnitude and pace of change in how the region produces and consumes energy for electricity, transportation, heating, and other uses.

Generally, *how* to meet the states' GHG reduction standards is, at this point, only loosely defined. Yet the path the region takes to the decarbonized end state will be the most important driver of the cost, technological, and reliability challenges consumers and industry stakeholders will face along the way. The transformation will require deep and continuous investments in transportation, heating, and power system infrastructure, and will accelerate the development and commercialization of a wide array of energy-related technologies and services. It will also fundamentally transform the location, size, fuel needs, and operational characteristics of the power supply infrastructure used to keep the lights on.

In this context, the proper pricing of goods and services – including an effective price on emissions of carbon dioxide (CO_2) – could be essential to guiding the states through a challenging transition in a way that maintains reliability, encourages efficiency, fosters innovation, and minimizes the cost to society to meet the GHG reduction mandates. There is wide agreement among economists and policy analysts that carbon pricing would be a key component of a cost-effective policy to materially reduce carbon emissions. The introduction of a multi-sector carbon price would provide consumers with an important indication of the costs associated with carbon emissions and reduce consumer demand for carbon-based fuels across all sectors. A meaningful multi-sector price on carbon could both help drive the investments in the electric sector necessary to support electrification, and provide an important price signal to facilitate reductions from those other sectors. This is particularly true in ensuring that emissions valuation largely remains consistent across sectors. Without a multi-sector approach, the financial signal for electrification in transportation or residential heating would be undermined because CO_2 emissions have only been valued in the electricity sector.

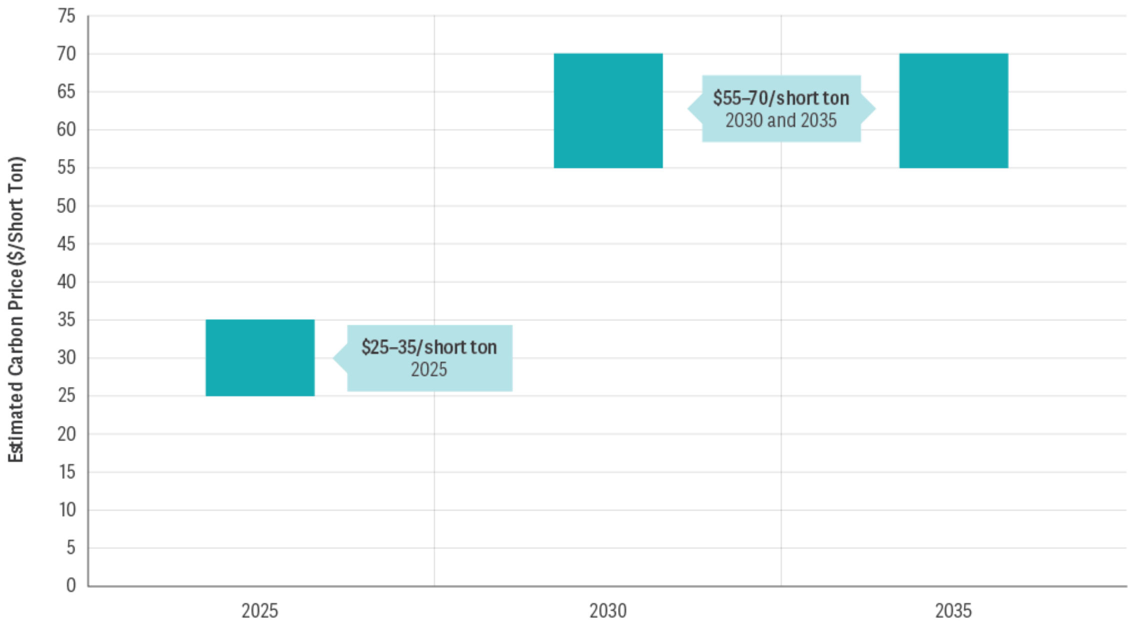
Ironically, steady reductions over the past couple of decades in electric sector CO_2 emissions have limited consideration of the potential benefits that could be obtained on a going-forward basis by establishing an effective price on CO_2 emissions for the electric sector. In the current context, because electrification of the transportation and heating sectors will be critical to meet state GHG reduction objectives and fundamentally alter the level and shape of electricity demand, the potential benefits of enhanced market-based CO_2 emission pricing should not be overlooked.

Given our expectation of the primary role the electric sector will play supporting decarbonization, at least in the early years, our analysis evaluates the application of carbon pricing in the electric sector. The analysis focuses on decarbonization of the electric sector simultaneous with aggressive electrification of the transportation and residential heating sectors over the next 15 years as a likely initial pathway towards meeting the New England states' aggregate long-term GHG emission reduction standards. The analytic method involves production cost modeling to simulate the operation of the New England power system under scenarios that include progressive electrification of transportation and heating, major additions of low and zero-carbon electric generating resources, and the pricing of CO_2 emissions to guide power system infrastructure development and operations. We evaluate three years (2025, 2030, and 2035), and use the analysis to identify the carbon price at which the resources needed to meet GHG reduction standards achieve revenue sufficiency in wholesale markets, absent any state or federal procurement mandates or subsidies. We also use the modeling results to evaluate implications of the transition for power system operations, costs, and emissions.

Based on the analysis, we come to a number of observations:

Sufficient progress can be supported by a progressively increasing price on emissions of CO_2 that falls in a range of $25–35/short ton CO_2 in 2025 and $55–70/short ton CO_2 in 2030 and 2035. (See Figure ES-1). While these prices are lower than the estimated social cost of carbon over this time frame, they would allow for market competition to drive evolution of the region's power system without state-mandated procurement of specific generation resources. This would help decarbonize the power sector and also reliably address the rapidly rising electricity demand associated with continuous electrification of transportation and heating sectors.

Figure ES-1: Carbon Dioxide Prices

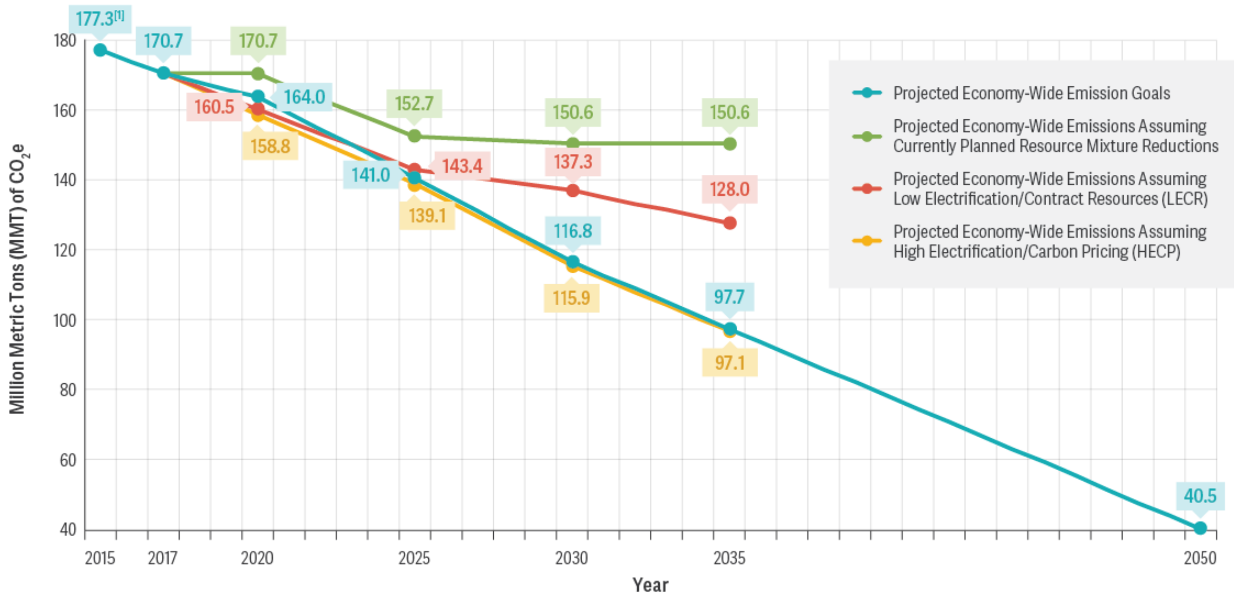


This change in how energy is used also offers consumer opportunities and cost savings. A review of consumer energy costs illustrates that electrification of transportation and heating is expected to lower household energy cost. Figure ES-2 shows the estimated decline in average residential household energy cost following electrification of light-duty vehicles and conversion of home heating system from fuel oil to an electric heat pump, assuming that consumers elect to adopt electric transportation and heating by 2035 (i.e., the technologies are cost competitive and/or incentives are provided as part of state's objectives to meet GHG emission reductions). The two bars on the left of Figure ES-2 show estimated 2020 and 2035 annual household energy costs without increased electrification; this includes the cost of gasoline, fuel oil, and electricity. The two bars on the right of Figure ES-2 show the estimated reduction in household energy cost that results following electrification both with and without a carbon price. Electrification decreases household energy cost enough that even with a carbon price estimated household energy costs are expected to decline.

Figure ES-2: Estimated Average Annual Consumer Energy Costs for Households that Adopt Electric Vehicles and Convert Home Heating System from Fuel Oil to Electric Heat Pumps

Figure ES-3 plots scenario emission impacts. While the currently expected state-driven procurement of renewable resources helps decarbonize the power sector (the light green line in Figure ES-3), it falls well short of the reductions needed to make reasonable progress towards the New England states' economy-wide GHG emission reduction targets ("reasonable progress" is represented by the blue line in Figure ES-3). The red and yellow lines in Figure ES-3 represent scenarios combining carbon pricing (supporting additional decarbonization of the electric sector) with electrification of the transportation and residential heating sectors (with the yellow line being the most aggressive level of electrification).

Figure ES-3: New England Emission Reduction Standards Compared with Power Sector Emission Reductions from Renewable Resource Additions and Increased Electrification



Notes:

[1] In 2015, total GHG emissions across New England were 177.3 MMT of CO_2e (43.8 in CT, 76.1 in MA, 19.1 in ME, 17.0 in NH, 11.3 in RI, and 10.0 in VT).

[2] Economy-wide emission reduction goals are determined by aggregating each New England state's historical emissions and annual emission targets. If data is unavailable for a given year, the goal is estimated by interpolating results from years where it is available by state.

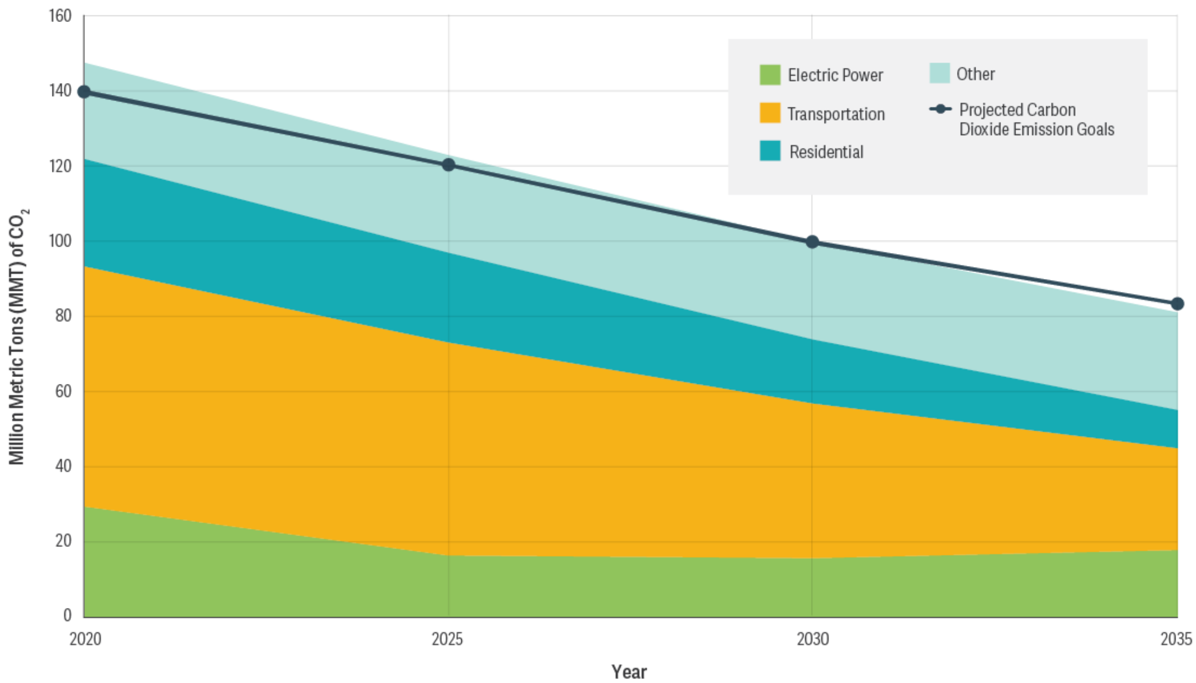
[3] Resource mixture adjustments include the retirement of fossil-fuel plants and the addition of renewable resources.

[4] The LECR scenario assumes 12.5% (2025), 17.5% (2030), and 30% (2035) of residential homes currently heating with gas, oil, or propane switch to electric heating. The LECR scenario also assumes 25% (2025), 35% (2030), and 60% (2035) of consumers driving light-duty vehicles switch to electric vehicles.

[5] The HECP scenario assumes 25% (2025), 50% (2030), and 75% (2035) of residential homes currently heating with gas, oil, or propane switch to electric heating and 25% (2025), 60% (2030), and 90% (2035) of consumers driving light-duty vehicles switch to electric vehicles. It also assumes additional energy efficiency (EE) at a 25% increase over assumed 2035 EE, and adds additional storage and zero-emission resources needed to accommodate increased electrification and maintain New England's progress towards meeting its carbon reduction standard. Finally, it adds a $25/short ton price on carbon in 2025, $65/short ton in 2030, and $70/short ton in 2035.

Figure ES-4 illustrates the relative impact of each economic sector on GHG emission reductions over time. Despite pronounced increases in electricity demand, power sector decarbonization achieves significant early reductions and continuous decreases in electric-sector carbon intensity stemming from the resource and operational effects of carbon pricing. Electrification of the transportation sector drives the greatest level of reductions, particularly in later periods, while residential heating electrification (in particular the conversion of oil and propane heating sources) provides modest contributions to GHG emission reductions.

Figure ES-4: Projected CO_2 Emissions Changes by Sector: High Electrification



Notes:

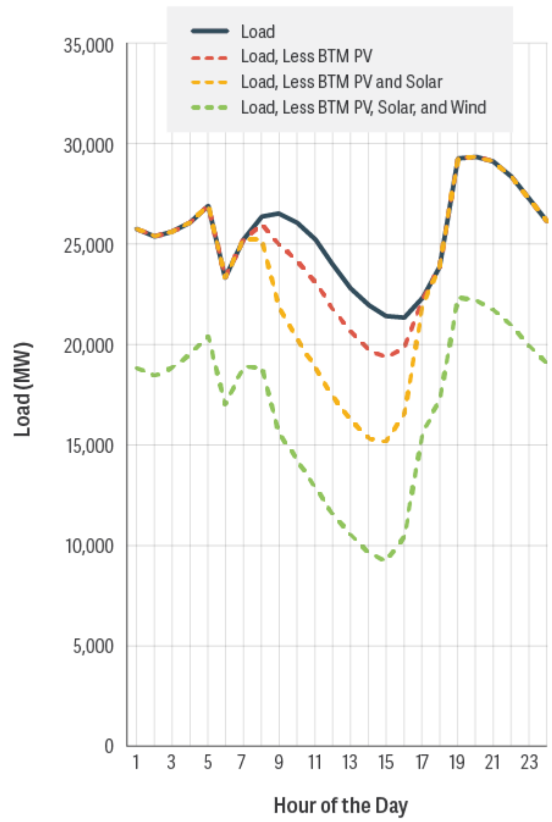
[1] Economy-wide emission reduction goals are determined by aggregating each New England state's historical emissions by sector and annual GHG emission targets. If data is unavailable for a given year in a state, the goal is estimated by interpolating results from years where it is available. The carbon-specific emission goal is estimated by using historical data on the share of total GHG emissions derived from carbon emissions.

[2] Power generation adjustments include higher levels of electrification, the retirement of fossil-fuel plants, the addition of renewable resources, additional energy efficiency, and a $25/short ton price on carbon in 2025, $65/short ton in 2030, and $70/short ton in 2035.

[3] Electrification assumes 25% (2025), 50% (2030), and 75% (2035) of residential homes currently heating with gas, oil, or propane switch to electric heating. It also assumes 25% (2025), 60% (2030), and 90% (2035) of consumers driving light-duty vehicles switch to electric vehicles.

Finally, the substantial level of electrification assumed in the analysis would not be possible without adequate and flexible electric sector resources to reliably manage increased hourly net load variability over time. Figure ES-5 shows how the combination of greater variable renewable resources and the addition of electric vehicle and heating loads affects the average hourly “ramping” requirements on a representative winter day – projected to exceed 15,000 megawatts (MW) over very short time periods on particular days. Moreover, at the levels of electrification we assume, the addition in particular of new heating load shifts the annual peak from summer to winter months before the end of this decade. Even assuming a significant quantity of technologically feasible energy storage resources, the availability of existing fossil fuel generators will be vital over at least the next one to two decades for the New England Independent System Operator (ISO-NE) to manage the change in load shape and growth in daily ramping requirements if the states are to achieve sufficient reductions in GHG emissions on a path to 2050 standards.

Figure ES-5: Representative Daily Net Load Variability
January 2035



It is obvious that establishing enhanced carbon pricing in electric energy markets is not an easy path to take from political and regulatory perspectives. Yet pursuing these objectives through state-mandated programs and procurements will almost certainly achieve the results imperfectly, and at costs in excess of what would result through efficient carbon pricing. For example, we estimate that the benefits of relying on competitive markets with efficient carbon pricing to drive new and ongoing investment in zero-emission resources necessary to achieve the states' aggregate objectives – in contrast to reliance on utility-administered resource procurements – could save consumers on the order of $100–300 million ($2020) over the 10-year period 2026–2035. While it is difficult to estimate with certainty what the level of savings could be, the expectation of substantial savings is supported by a wealth of experience with the introduction of competition in wholesale markets and the use of market-based mechanisms for emission control.

After analyzing our modeling results and assessing the region's history with competition and emission control programs, we conclude that implementation of carbon pricing in the electric sector can be a vital tool supporting the states' achievement of decarbonization targets at the lowest possible cost, while preserving and enhancing the benefits of wholesale market competition for New England's electricity consumers.

Acknowledgments

This report has been prepared at the request of the New England Power Generators Association (NEPGA) to analyze the appropriate level and potential impacts of a carbon pricing mechanism that may be introduced to help the New England states achieve current and future GHG reduction requirements and goals.

This is an independent report by Joseph Cavicchi and Paul Hibbard of Analysis Group, Inc.. They wish to express their appreciation for the assistance of colleagues at Analysis Group: Scott Ario, Luke Daniels, Grace Howland, and Phillip Ross. Also, our work has benefited from input and comment from NEPGA. However, the analysis and conclusions herein reflect the independent judgment of the authors alone, and do not necessarily align with NEPGA or NEPGA's members.

About the Authors

Mr. Cavicchi, a vice president in Analysis Group's Boston office, is an expert on the economics of wholesale and retail electricity markets. Mr. Cavicchi's work focuses on issues associated with wholesale power market design and market power mitigation frameworks, wholesale and retail contracting practices, and regulatory and contract disputes arising in these marketplaces. Mr. Cavicchi has extensive experience testifying before the Federal Energy Regulatory Commission (FERC), before other federal and state regulatory authorities, and in civil proceedings. He presents and publishes frequently on issues relevant to electricity market design and industry evolution. He is also a registered professional mechanical engineer in the Commonwealth of Massachusetts.

Mr. Hibbard, a principal in Analysis Group's Boston office, has public and private sector experience in energy and environmental technologies, economics, market structures, and policy. Mr. Hibbard's work has addressed the implications of new public policy programs; the impacts of infrastructure development options on market pricing and ratepayer costs; the evolution of electricity market structures and wholesale rate design; utility ratemaking practices; and the transfer of US federal and state emission control programs to other countries. He served as chairman of the Massachusetts Department of Public Utilities, was a member of the Massachusetts Energy Facilities Siting Board, and has testified before Congress, state legislatures, and federal and state regulatory agencies. Mr. Hibbard also has authored numerous articles, white papers, and reports for journals, foundations, commissions, and industry organizations.

Introduction to Analysis Group

Analysis Group is one of the largest international economics consulting firms, with more than 1,000 professionals across 14 offices in North America, Europe, and Asia. Since 1981, Analysis Group has provided expertise in economics, finance, health care analytics, and strategy to top law firms, Fortune Global 500 companies, government agencies, and other clients worldwide.

Analysis Group's energy and environment practice area is distinguished by expertise in economics, finance, market modeling and analysis, regulatory issues, and public policy, as well as deep experience in environmental economics and energy infrastructure development. We have worked for a wide variety of clients, including (among others) energy producers, suppliers and consumers, utilities, regulatory commissions and other federal and state agencies, tribal governments, power-system operators, foundations, financial institutions, and start-up companies.