



*The Proposed Massachusetts Carbon Tax: A High-Cost, Low-Benefit Policy**

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Executive Summary

In January 2019, State Representative Jennifer E. Benson filed H.2810, *An Act to Promote Green Infrastructure and Reduce Carbon Emissions*, which would establish a greenhouse gas (GHG) pollution charge or carbon tax for the Commonwealth of Massachusetts. The legislation would make Massachusetts the first U.S. state with a carbon tax.¹

A carbon tax is intended to reduce the social costs of carbon dioxide and other greenhouse gas (GHG) emissions. This represents a benefit to the economy. But there are costs, as well. To mitigate these costs, H.2810 would rebate 70 percent of carbon tax revenues to households and businesses, with special set-asides for rural motorists and lower income areas. The rest of the carbon tax revenue would be placed into a newly formed “Green Infrastructure Fund.”²

Any reduction in GHG emissions resulting from a carbon tax would, as most believe, confer economic benefits by mitigating the adverse effects of climate change on the economy. The potential benefits include avoiding crop and livestock losses, property damages from increased flood risk, and other impacts caused by a changing climate.³

The Beacon Hill Institute has undertaken the task of evaluating the costs and benefits of the carbon tax proposed in H.2810. We assume that the state agencies would need time to implement the bill, and thus we report the results for 2022 through 2026. This five-year period includes the maximum tax rate outlined in the bill. Table 1 displays the results for the Massachusetts economy.

¹ Bill H.2810, 191st, <https://malegislature.gov/Bills/191/HD2370>.

² Ibid.

³ U.S. Environmental Protection Agency, Environmental Economics, Economics of Climate Change, <https://www.epa.gov/environmental-economics/economics-climate-change>.

Table 1: The Costs and Benefits of H.2810

Variable	2022	2023	2024	2025	2026
Static carbon tax revenue (\$, mil.)	1,253	1,573	1,895	2,220	2,549
Revenue changes from other state taxes (\$, mil.)	-326	-410	-496	-584	-676
Net dynamic revenue change (\$, mil.)	927	1,163	1,399	1,636	1,873
Private employment (jobs)	-11,090	-13,360	-15,660	-15,900	-18,240
Investment (\$, mil.)	-925	-1,119	-1,320	-1,371	-1,585
Disposable income, real (\$, mil.)	-1,950	-2,356	-2,781	-2,832	-3,266
Social costs of carbon tax (\$, mil.)	2,254	2,802	3,348	3,923	4,520
Social benefits of carbon tax (\$, mil.)	57	63	70	77	86
Net benefits (benefits-cost) (\$, mil.)	-2,197	-2,739	-3,278	-3,845	-4,434

The proposed carbon tax would reduce GHG emissions by 1.43 million metric tons (MMT) of carbon dioxide equivalent (CO₂E) in 2022 and by 1.9 MMT in 2026. A “static” estimate (that is, one that ignores the adverse effects of the tax on economic activity) shows that the tax would generate \$1,253 million in revenue in 2022, increasing to \$2,549 million in 2026. But the adverse economic effects of the carbon tax would reduce other tax revenues by \$326 million in the first year, resulting in a net increase of \$927 million in state tax revenues. This last figure can be considered the net “dynamic change” in tax revenue, that is, the change that takes into account the shrinkage in economic activity brought about by the tax. In 2026, the carbon tax, computed as a static estimate, would raise \$2,549 million, other tax revenues would fall by \$676 million, and the state would experience a net dynamic change of \$1,873 million in tax revenue.

The tax would also, in the first year, reduce business investment by \$925 million, disposable income by \$1,950 million, and private employment by 11,090 jobs. As time passed and the tax rate rose, the carbon tax would produce more substantial economic effects. By 2026, investment would fall by \$1,585 million, disposable income by \$3,266 million, and private employment by 18,240 jobs.

The loss of output, measured as real gross domestic product (GDP), due to the carbon tax would be \$2,254 million in 2022 and rise to \$4,520 million in 2026. This loss represents the total social costs of the carbon tax to Massachusetts.

BHI used the Dynamic Integrated model of Climate and the Economy (DICE) 2017 model, crafted by William Nordhaus of Yale University, to calculate the total social benefits (that is, the reduction in the social costs) of greenhouse gases for each year of our analysis, as conferred by H.2810.⁴ When we apply the proposed Massachusetts tax to DICE, we find that the tax would confer benefits of \$57 million in 2022, increasing to \$86 million in 2026.⁵ As a result, the carbon tax would impose a net social cost on Massachusetts of \$2,197 million in 2022, rising to \$4,434 million in 2026. This high net cost is a result of the fact that Massachusetts emissions are only a small fraction of global carbon emissions and any reduction in those emissions would have a minuscule effect on global emissions.

The costs of the carbon tax substantially outweigh the benefits. Massachusetts citizens alone would bear the costs, while all citizens of the world share the benefits, at the expense of the Massachusetts economy.

We find that H.2810 would bring about very small reductions in GHG emissions, raising the prospect that the legislature will enact further increases in the carbon tax as time passes. Based on the experience of Canada and Australia, the reductions are likely to be not only small but costly to households, with much of the rebated tax revenue going to business.

⁴ The latest version of the DICE 2017 model is available online at <http://nordhaus.econ.yale.edu/DICE2007.htm>. We downloaded the model for the runs reported here on April 1, 2019.

⁵ Note that these are social benefits, which to say they include benefits to the entire globe, not just Massachusetts. It counts, as a benefit, the harm avoided by stemming the rise in the sea level in both Singapore and Boston.

Introduction

In January 2019, State Representative Jennifer E. Benson filed H.2810, *An Act to Promote Green Infrastructure and Reduce Carbon Emissions*, which would establish a carbon tax for the Commonwealth of Massachusetts.⁶ Representative Benson and 108 co-sponsors in the legislature would make Massachusetts the first U.S. state with an explicit carbon tax. The proposal appears against the backdrop of the state *Green Communities Act* and the *Global Warming Solutions Act*.

Any carbon tax proposal calls for a cost-benefit analysis. It is our task here to provide that analysis.

As the debate over policy responses to climate change intensifies, economists have generally advocated carbon taxes (in contrast to cap-and-trade laws) as a solution. Economists view greenhouse gas emissions (GHG) as a negative externality. One way to curb an externality is to put a price on the harm it causes. The most common instrument is a tax, which is intended to create a true market price for the externality (in this case, GHG emissions). The tax would give consumers an incentive not to overuse fossil fuels, which contribute to the emission of GHG gas emissions.

However, like most taxes, carbon taxes also shrink economic activity and consumer welfare. To curb these effects, carbon taxes are often paired with rebates or cuts in other taxes. H.2810 directs the Department of Revenue (DOR), in coordination with the Executive Office of Energy and Environmental Affairs (EEA), to collect the GHG pollution charges. Under H.2810, 70 percent of the revenue raised by the tax would be rebated to residents and businesses to offset the burden of the tax. Special set-asides for

⁶ Bill H. 8210, 191st, <https://malegislature.gov/Bills/191/HD2370>.

rural motorists and lower income areas are also included.⁷ The Act establishes the “Green Infrastructure Fund” to support “investments in clean energy, clean transportation, and resiliency to the local impacts of climate change.”⁸ The DOR commissioner will deposit the remaining 30 percent of the tax revenue raised by the tax into the “Green Infrastructure Fund”.

Whatever rebate mechanism is chosen, a carbon tax imposes immediate costs on the economy in exchange for future benefits. Because these costs will be far higher than the revenues collected under the carbon tax, it will be impossible to compensate households and businesses for the full cost they bear as a result of the tax.

H.2810 defines the source of GHG emissions to include motor vehicle fuels, oil, and natural gas. As part of the law, animals and crops are not considered GHG emitting priorities.

H.2810 sets the charge at \$20 per ton of carbon dioxide equivalent (C02E) in the first year. The rate would rise by \$5 each year until the price is \$40 per ton. Thereafter, state officials will report to the state legislature the amount of progress made in curbing GHG emissions. (Some of the goals are outlined in the state’s existing Climate Protection and Green Economy Act.) State officials must also mitigate “negative impacts on economic sectors, economic sub-sectors or individual employers of the Commonwealth caused by the collection of carbon dioxide emission charges.”⁹

Massachusetts already faces high energy costs because of limited pipeline capacity for natural gas. The carbon tax, combined with these high costs, poses a threat to the

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.

state's long-term competitive advantage and its ability to sustain and secure advanced manufacturing capacity.

GHG emission reduction can confer economic benefits by mitigating the adverse effects of climate change. The potential benefits include avoiding crop and livestock losses, property damages from increased flood risk, and other impacts caused by a changing climate.¹⁰ Any serious analysis must consider both the potential benefits and the costs of reducing GHG emissions.

Carbon Taxes in Canada

The only subnational jurisdictions in North America that have carbon taxes in place are British Columbia, Alberta, and Quebec in Canada. In June 2007, the Canadian province of Quebec (Canada's second largest province) introduced a tax on carbon emissions, the first in Canada.¹¹ The tax applies to 50 companies operating in Quebec that use a "significant amount of hydrocarbons."¹² The tax rates differ by the following fuel type: 0.8 cents per liter of gasoline; 0.9 cents for diesel fuel; 0.96 cents for light heating oil; 0.5 cents for propane; and \$8.00 per MT for coal.¹³ The revenue generated by the tax

¹⁰ U.S. Environmental Protection Agency, Environmental Economics, Economics of Climate Change, <https://www.epa.gov/environmental-economics/economics-climate-change>.

¹¹ CBC News, "Quebec to collect nation's 1st carbon tax" (2007, June 07). <https://www.cbc.ca/news/canada/montreal/quebec-to-collect-nation-s-1st-carbon-tax-1.684888>

¹² Klean Industries, "Market News" (2007, June 13). http://www.kleanindustries.com/s/environmental_market_industry_news.asp?ReportID=192052

¹³ Ibid.

is deposited into the Green Fund, which dispenses funds toward the reduction of GHG emissions and improvement of public transportation.¹⁴

The government of British Columbia implemented the first broad-based revenue-neutral carbon tax in North America, effective July 1, 2008.¹⁵ Under the law, the tax applies to 70 percent of provincial GHG emissions stemming from the purchase and use of fossil fuels, such as gasoline, diesel, natural gas, heating fuel, propane, and coal.¹⁶ The law imposed an initial tax of \$10 per ton of CO₂E and increases the tax to \$30 per ton in 2012.

The tax was hailed a success for its ability to reduce GHG emissions. However the initial decline in GHG emissions cannot be attributed entirely to the carbon tax itself, and likely resulted, in part, from the “Great Recession.”¹⁷ According to a 2016 *Food & Water Watch* report, GHG emissions resulting from taxed sources increased 4.3 percent from 2009 to 2014, even though carbon tax rates and revenues also increased. Over the same period, the study found non-taxed sources to decrease by 2.1 percent. British Columbia, in its *Budget 2017 Update*, announced that the carbon tax rate would increase by \$5 per ton of CO₂E in April 2018, and increase by an additional \$5 per year until 2021 when it reaches \$50 per ton.

British Columbia’s annual revenue from the carbon tax was \$306 million in fiscal year (FY) 2008-2009 and increased to \$906 million in FY 2011-2012. Despite the intended revenue neutrality of British Columbia's carbon tax, the tax rebates have

¹⁴ Ibid.

¹⁵ British Columbia's Carbon Tax (2019, April 15).

<https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax>

¹⁶ Ibid.

¹⁷ Food & Water Watch, “British Columbia Carbon Tax” (2016, October 1).

https://www.foodandwaterwatch.org/sites/default/files/rpt_1609_carbontax_web17011.pdf

disproportionally benefitted businesses. The *Food & Water Watch* study reports that, as of FY 2014-2015, British Columbia distributed 70 percent of tax rebates to businesses. According to the report, “As the carbon tax rate and revenue increased, British Columbia has failed to ensure that the tax rebates remain focused on individuals.”¹⁸ Revenues from the tax have been used for other governmental purposes over recent years, failing to meet the original goal of adopting a revenue-neutral policy and of reducing the tax burden on individual households and businesses.¹⁹

In Vancouver—a seaport city located in British Columbia—the British Columbia carbon tax raises between \$175 million and \$200 million in annual revenue from vehicle fuel usage. However, the tax has failed to achieve its targeted emission reduction goals.²⁰ Pacific Analytics, Inc. conducted a study in 2015, which found that the carbon tax has had relatively insignificant effects on vehicular fuel GHG emissions in Vancouver. The study concluded that “the carbon tax at present reduces annual GHG emissions by just under 1%. To put that into context, to reduce vehicular emissions by the provincial goal of 30% would require a carbon tax over \$2.00 per litre.”²¹ The British Columbia carbon tax is aimed at reducing fuel-related carbon emissions. Vancouver exemplifies the tax’s inadequacy to reduce sector-specific (fuel, in this case) GHG emissions.

¹⁸ Ibid.

¹⁹ Nicholas Institute for Environmental Policy Issues, “British Columbia’s Revenue-Neutral Carbon Tax: A Review of the Latest ‘Grand Experiment’ in Environmental Policy” (2015, October 1).

<https://nicholasinstitute.duke.edu/environment/publications/british-columbia%E2%80%99s-revenue-neutral-carbon-tax-review-latest-%E2%80%9Cgrand-experiment%E2%80%9D>

²⁰ Pacific Analytics Inc., “The Impacts of the Carbon Tax on Vehicle Fuels in Metro Vancouver” (2015, March 1).

<http://pacificanalytics.ca/sites/default/files/reports/The%20Impacts%20of%20the%20Carbon%20Tax%20on%20Vehicle%20Fuel%20Usage%20in%20Metro%20Vancouver.pdf>

²¹ Ibid.

Canada has since implemented a federal revenue-neutral carbon tax.²² The *Greenhouse Gas Pollution Pricing Act* (S.C. 2018, c12, s 186), imposes carbon pricing at the federal level, effective June 21, 2018.²³ The Act levies a tax of \$20 per ton of GHG emissions in Canadian provinces, which will increase by \$10 per ton until reaching \$50 in 2022.²⁴ The Act applies to provinces whose current jurisdictional carbon pricing systems are insufficient to meet federal requirements (carbon taxes less than the minimum requirement of \$20/ton of GHG emissions).²⁵

A “Revenue Neutral” Carbon Tax in Australia

In 2012, as part of the enactment of the *Clean Energy Act 2011*, Australian Prime Minister Gillard’s Labor Government implemented a broad-based carbon tax.²⁶ The partial revenue-neutral policy required over 50 percent of the annual carbon tax revenue to be recycled back to individual households through income tax breaks and rebates. It directed 40 percent to government programs assisting business sectors that shoulder the larger burden of tax incidence, and the remaining 10 percent to “transitional” and governmental measures, such as government administrative costs.²⁷ The tax started at “AUD 23.00 [23.00 Australian dollars] per MT of CO₂e in FY 2012–2013, rose to AUD 24.15 in FY 2013–2014 and AUD 25.40 in FY 2014–2015 before a scheduled gradual transition to a market-based floating carbon price in 2015.”²⁸ The top 350 polluters—businesses whose CO₂ emissions exceed 25,000 per ton and represent 60 percent of

²² Greenhouse Gas Pollution Pricing Act, SC 2018, c 12, s 186, <http://canlii.ca/t/53920>

²³ Ibid.

²⁴ Ibid.

²⁵ Ibid.

²⁶ Centre for Public Impact, “Case Study: The Carbon Tax in Australia” (2017, May 5). <https://www.centreforpublicimpact.org/case-study/carbon-tax-australia/>

²⁷ Ibid.

²⁸ Ibid.

Australia's total GHG pollution—faced the tax, whereas in British Columbia the tax is applied to all end users.²⁹

Under the *Clean Energy Act of 2011*, GHG emissions fell by 1.4 percent in its second year. However, GHG emissions had been falling in Australia from the peak in 2008 as a result of “winding down of parts of Australia’s manufacturing base and energy efficiency initiatives.”³⁰ Australia's Department of the Environment reported that the tax increased the cost of electricity for the average family by 10 percent, increased the average cost of living of households by AUD 9.90 per week, and increased the Consumer Price Index (CPI) by 0.7 percent.³¹

In July 2014, Prime Minister Abbott’s Government repealed the Clean Energy Act of 2011, thereby removing the Australian federal carbon tax.³²

Energy Taxes in the United States

In 1993, President Clinton proposed a budget including an energy tax based on British Thermal Units (BTU).³³ Under the proposed budget, all energy sources such as coal, natural gas, liquefied petroleum gases, gasoline, nuclear-generated electricity, hydro-electricity, and imported electricity were subject to a base tax of 25.7 cents per million BTU.³⁴ The tax imposed 34.2 cents per million BTU on refined petroleum products, in addition to the base tax of 25.7 cents per million BTU.³⁵ The proposed BTU

²⁹ Ibid.

³⁰ La Paz Group, “Australian Emissions Drop with New Carbon Tax” (2014, December 27). <https://lapazgroup.net/2014/12/27/australian-emissions-drop-with-new-carbon-tax/>

³¹ Shultz-Stephonson Task Force on Energy Policy, “Revenue-Neutral Carbon Taxes in the Real World” (2012, December 21). <https://www.hoover.org/sites/default/files/research/docs/117649691-revenue-neutral-carbon-taxes-in-the-real-world-insights-from-british-columbia-and-australia.pdf>

³² Ibid.

³³ Carbon Tax Center, “History” (n.d.). <https://www.carbontax.org/history/>

³⁴ Ibid.

³⁵ Ibid.

tax received significant backlash, and, though the law initially passed in the House of Representatives, it was overwhelmingly rejected in the Senate.³⁸

On March 20, 2015, *Initiative Measure No. 732* (I-732) imposing a state-wide carbon tax was placed on the ballot in Washington state.³⁹ Under I-732, the policy would levy a \$15 per ton tax on CO₂E in the first year, increasing to \$25 per ton in the second year and subsequently increasing 3.5 percent per year (adjusting for inflation).⁴⁰ The measure was designed to be revenue-neutral, through an annual rebate of up to \$1,500 to low-income households, the repeal of the business and occupation tax for manufacturers, and a reduction in the state sales tax by one percentage point.⁴¹ The proposed initiative failed to pass on the 2016 ballot, as 59.3 percent of voters opposed the tax. Again in 2018, *Initiative Measure No. 1631* (I-1631), an act nearly approximating I-732's carbon tax was opposed by 56.3 percent of voters.⁴²

Massachusetts' Current Climate Policies

In January of 2007, Massachusetts entered into the Regional Greenhouse Gas Initiative (RGGI).⁴³ RGGI is a carbon dioxide cap-and-trade agreement between nine Northeastern states.⁴⁴ RGGI, Inc. is the entity responsible for managing the goals of the law. RGGI imposes a limit on the amount of carbon dioxide (CO₂) emitted by all of the regulated electric power plants in the region. Each state agrees to issue a fixed amount

³⁸ Ibid.

³⁹ Initiative Measure No. 732, https://www.sos.wa.gov/assets/elections/initiatives/finaltext_779.pdf.

⁴⁰ Ibid.

⁴¹ Tax Foundation, "Washington Voters to Consider a Carbon Tax—Again" (2018, September 13). <https://taxfoundation.org/washington-consider-carbon-tax/>

⁴² Ibid.

⁴³ The Beacon Hill Institute, "Exit RGGI: The Potential Economic Impact of a Maine Withdrawal from the Regional Greenhouse Gas Initiative" (2014, March 1) <http://beaconhill.org/energy-economic/>

⁴⁴ See RGGI Inc., <https://www.rggi.org/https://malegislature.gov/Bills/191/HD2370>.

of allowances corresponding to this limit, proportional to the number of power plants in the state. The participating states agreed to eliminate 10 percent of power sector GHG emissions by 2018.

In August 2008, Massachusetts passed the *Global Warming Solutions Act* (GWSA). With the law's passage, Massachusetts became one of the first states to enact legislation to combat climate change.⁴⁵ The GWSA created a framework for reducing GHG emissions, requiring a 10-25 percent reduction in GHG emissions by 2020 (from the 1990 baseline year), and an 80 percent reduction by 2050.⁴⁶ As of 2009, the GWSA stipulates that the Commonwealth's largest emission sources are required to report and provide data on their GHG emissions.

In 2016, Massachusetts Governor Charlie Baker signed *Executive Order 569*, requiring the Executive Office of Energy and Environment Affairs to create new solutions aimed at mitigating GHG emissions. Under the Order, the state imposes limitations on GHG emissions from Massachusetts state fleet vehicles, on GHG emissions from transportation, on methane emissions from natural gas pipelines, on carbon dioxide emissions from power plants, and on sulfur hexafluoride emissions from gas-insulated switchgear.⁴⁷ The Order provides no specific policy to achieve said GHG emission targets.

⁴⁵ See <https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298>.

⁴⁶ See No.569, <https://www.mass.gov/executive-orders/no-569-establishing-an-integrated-climate-change-strategy-for-the-commonwealth>

⁴⁷ Utility Dive, "New Massachusetts rules provide boost toward state climate goals" (2017, August 14). <https://www.utilitydive.com/news/new-massachusetts-rules-provide-boost-toward-state-climate-goals/449223/>

Massachusetts' Carbon Emissions History

The Massachusetts carbon tax would be levied on the production of goods and services that produce GHG emissions. GHG emissions are generated when fossil fuels are burned in the production process. As a result, the transportation, electricity generation, residential, commercial heating, and industrial sectors produce the vast majority of the GHG emissions in Massachusetts. Table 2 displays Massachusetts GHG emissions by

Table 2: Massachusetts GHG Emissions by Sector (MMT of CO₂E), 1990-2016

	1990	2000	2010	2015	2016
Energy CO₂E Emissions					
Energy CO₂E Emissions by Major Sector					
Residential	15.3	15.8	13.7	13.7	11.5
Commercial	8.4	6.8	6.7	7.6	7.0
Industrial	5.8	5.9	3.9	3.7	3.5
Electricity	28.2	26.7	22.9	15.6	14.7
Transportation	30.5	33.6	30.3	29.7	31.7
Total Energy CO₂E Emissions by Major Sector	88.2	88.8	77.6	70.3	68.5
Natural Gas Systems CO₂E Emissions	2.4	1.7	1.0	0.8	0.8
Total Energy CO₂E Emissions	90.6	90.5	78.7	71.1	69.3
Other CO₂E Emissions					
Industrial Processes	0.7	2.5	3.5	3.9	3.9
Agriculture & Land Use	0.3	0.3	0.3	0.3	0.2
Waste	2.7	1.1	0.9	0.8	0.8
Total Other CO₂E Emissions	3.7	3.9	4.7	5.0	4.9
Gross CO₂E Emissions	94.5	94.4	83.3	76.1	74.2
Percentage Change from 1990	0.0	-0.1	-11.8	-19.4	-21.4

sector for selected years beginning with 1990.⁴⁸ In Table 2, we calculate Total Energy CO₂E Emissions by adding Total Energy CO₂E Emissions by Major Sector to Natural Gas

⁴⁸ Massachusetts Department of Environmental Protection, MassDEP Emissions Inventory, Greenhouse Gas Baseline, Inventory & Projection, Appendix C: Massachusetts Annual Greenhouse Gas Emissions Inventory: 1990-2016, with Partial 2017 Data, (accessed March 2019), <https://www.mass.gov/lists/massdep-emissions-inventories#2>.

Systems CO2E Emissions.⁴⁹ We then calculate Gross CO2E Emissions by adding Total Energy CO2E Emissions to Total Other CO2E Emissions.

The data in Table 2 establishes the baseline GHG emissions on which a Massachusetts carbon tax would be levied. Table 2 highlights two interesting facts. First, energy emissions produced 96 percent of gross Massachusetts GHG emissions in 1990 and have trended slightly downward over the period. Second, although emissions fluctuate with the business cycle, Massachusetts' gross emissions have decreased 21.4 percent from 1990 to 2016, the latest year the data is available. As of 2016, the reduction in GHG emissions is only 3.6 percentage points short of the state's 2020 target of a 25 percent reduction from 1990 levels.

The electricity sector produced the most significant drop in GHG emissions over the period as the state joined the rest of New England in eliminating coal-fired power plants.⁵⁰ The *Massachusetts Global Warming Solutions Act* and the *Regional Greenhouse Gas Initiative* (outlined above) undoubtedly contributed to the decline in Massachusetts GHG emissions over the period.

The Fiscal and Economic Effects of H.2810

H.2810 would impose a tax of \$20 per MT of CO2E in the first year and increase by \$5 per year until it reaches \$40 per MT. Thereafter, the bill calls for the EEA Secretary to update the greenhouse gas pollution charge on the first of the following year if GHG emissions in the previous year exceed the annual emissions target. The charge is defined as "\$5 multiplied by the total number of years since the fifth calendar year of implementation." We assumed that state agencies would need time to set up the

⁴⁹ Million Metric Tons of CO2 Equivalent.

⁵⁰ Craig Layout, "Last Coal Power Plant in Massachusetts Shuts Down," WGBH, (June 1, 2017), <https://www.wgbh.org/news/2017/06/01/news/last-coal-power-plant-massachusetts-shuts-down>.

infrastructure to implement the bill. Therefore, we assumed that the bill would be implemented in 2022 at a tax rate of \$20 per MT of CO₂E and rise to \$40 per MT of CO₂E by 2026.

H.2810 excludes the electricity generation sector from the tax, because it is regulated under the RGGI cap-and-trade program. The bill states “power plants regulated by the Regional Greenhouse Gas Initiative, as defined in CMR 7.70(1)(b), shall be exempt from the greenhouse gas pollution charges.”⁵¹ As a result, we excluded emissions from electricity generated in Massachusetts from our analysis but included electricity imported from outside the state. As a result, emissions subject to the carbon tax would be 62.6 MMT of CO₂E in 2016. We project Massachusetts emissions for each of the remaining sectors through 2026 using the compound annual growth rate (CAGR) from 1990 to 2016. Table 3 displays the results.

Table 3: Massachusetts Baseline Projections (MMT of CO₂E), 2022-2026

	2022	2023	2024	2025	2026
Energy CO₂E Emissions					
Energy CO₂E Emissions by Major Sector					
Residential	10.8	10.7	10.6	10.5	10.4
Commercial	6.7	6.7	6.6	6.6	6.6
Industrial	3.1	3.1	3.0	2.9	2.9
Electricity	3.0	3.0	3.1	3.1	3.2
Total Energy CO₂E Emissions by Major Sector	55.5	55.5	55.4	55.3	55.3
Natural Gas Systems CO₂E Emissions	0.6	0.6	0.6	0.6	0.5
Total Energy CO₂E Emissions	56.1	56.1	56.0	55.9	55.8
Other CO₂E Emissions					
Industrial Processes	5.5	5.9	6.3	6.7	7.1
Agriculture & Land Use	0.2	0.2	0.2	0.2	0.2
Waste	1.7	1.7	1.7	1.7	1.7
Total Other CO₂E Emissions	7.4	7.8	8.2	8.6	9.0
Gross Emissions	63.5	63.9	64.2	64.5	64.8

⁵¹ Bill H. 2810, 191st, <https://malegislature.gov/Bills/191/HD2370>.

We project that gross baseline emissions will fall to 63.5 MMT of CO₂E by 2022 and then increase to 64.8 MMT by 2026. When we apply the proposed carbon tax rates to the total emissions for each year, we arrive at a static estimate of the tax revenue generated by the carbon tax each year. However, the law of demand states that if the price of a product increases, the quantity demanded (or consumed) will decrease, which is the point of the carbon tax.

We account for this “dynamic” effect by calculating the percentage increase in the price of each major product (such as coal, natural gas, petroleum products, etc.) in each major emissions sector and then calculating the responsiveness of each product to price and applying the result to the emissions in each sector. This allows us to calculate the reduction in emissions resulting from the increase in the price of each product due to the carbon tax. We then apply the carbon tax rate to the emissions from the remaining sectors to calculate the total carbon tax revenue for each year. The Appendix provides further details.

The Massachusetts carbon tax would apply to energy produced by burning fossil fuels. Energy products have very low responses, or elasticities, to prices changes. As a result, the proposed carbon tax would have a limited impact on emissions reductions in Massachusetts. For example, in 2022, the proposed carbon tax would reduce emissions by 1.43 MMT, or 2.3 percent. As the proposed carbon tax increases, the emissions would drop by 1.9 MMT in 2026, or by 2.9 percent. We apply the carbon tax to the reduced level of emissions to obtain a static estimate of the revenue that the carbon tax would generate. The static estimate is \$1,253 million in tax revenue in 2022 and \$2,549 million in 2026.

To estimate the economic effects of the proposed carbon tax, BHI has developed a Computable General Equilibrium (CGE) model. The purpose of the BHI model, called

MA-STAMP (Massachusetts State Tax Analysis Modeling Program), is to identify the economic effects of tax changes on a state's economy.⁵² Using the STAMP model, we find that the imposition of a carbon tax imposes losses on the Massachusetts economy.

BHI modified the MA-STAMP model to accommodate the proposed carbon tax. First, we introduced the carbon tax and the carbon tax rebate fund to the model. Second, we allocated the carbon tax to STAMP's 27 industrial sectors and allocated the carbon tax rebate fund's revenues to industries, households, and governments based on employment or population of each sector relative to the total. The Appendix provides additional details.

As shown in Table 4, the proposed carbon tax would reduce investment by \$925 million, disposable income by \$1,950 million, and private employment by 11,090 jobs in

Table 4: The Fiscal & Economic Consequences of H.2810 for Massachusetts

Variable	2022	2023	2024	2025	2026
Carbon tax emissions change (MMT of CO ₂ E)	-1.43	-1.53	-1.64	-1.77	-1.90
New emissions (MMT of CO ₂ E)	62.07	62.37	62.56	62.73	62.89
Percentage change	-2.3	-2.4	-2.6	-2.7	-2.9
Static carbon tax revenue (\$, mil.)	1,253	1,573	1,895	2,220	2,549
Revenue changes in other state taxes (\$, mil.)	-326	-410	-496	-584	-676
Net dynamic revenue change (\$, mil.)	927	1,163	1,399	1,636	1,873
Private Employment (jobs)	-11,090	-13,360	-15,660	-15,900	-18,240
Investment (\$, mil.)	-925	-1,119	-1,320	-1,371	-1,585
Disposable Income, real (\$, mil.)	-1,950	-2,356	-2,781	-2,832	-3,266
Total social cost of carbon tax (\$, mil.)	-2,254	-2,802	-3,348	-3,923	-4,520

2022. The total cost of the carbon tax lost in real GDP would be \$2,254 million in 2022. A static estimate shows that the tax would raise \$1,253 million in carbon tax revenue in 2022. However, the adverse economic effects of the proposed carbon tax would reduce other tax revenues, such as personal and corporate income taxes. Revenues from these

⁵² For a description of the model see www.beaconhill.org.

sources would decrease by \$326 million in 2022, resulting in a net increase in revenue of \$927 million in 2022.

As time passes and the carbon tax rate increases, the economic effects of the carbon tax would produce more substantial economic effects. By 2026, investment would fall by \$1,585 million, disposable income by \$3,266 million, and private employment by 18,240 jobs. The total cost of the carbon tax in real GDP would be \$4,520 million in 2026.

A static estimate shows that the carbon tax would raise \$2,549 million in tax revenue in 2026. However, other tax revenues would fall by \$676 million, leaving the state with a net gain of \$1,873 million in tax revenue.

The Costs and Benefits of H.2810

The proposed Massachusetts carbon tax would also confer benefits to the global community in the form of reduced GHG emissions. However, the Massachusetts emissions subject to the proposed carbon tax are but a small fraction of global emissions. Global GHG emissions were 50.9 gigatons of CO₂E in 2017, compared to Massachusetts emissions subject to the proposed carbon tax of 62.7 million tons of CO₂E. Thus Massachusetts accounts for a mere 0.12 percent of global emissions and only a fraction of the 1.2 percent increase in global emissions from 2016.⁵³ Nonetheless, the reduction in Massachusetts GHG emissions would provide an economic benefit against the baseline case of no emissions reduction.

To analyze the economic and global temperature effects of GHG emission reduction policies, BHI utilized the 2017 Dynamic Integrated model of Climate and the

⁵³ Netherland Environmental Assessment Agency, "Trends in global CO₂ and total greenhouse gas emissions: 2018 report," (May 12, 2018), <https://www.pbl.nl/en/publications/trends-in-global-co2-and-total-greenhouse-gas-emissions-2018-report>.

Economy (DICE).⁵⁴ As the name of the model indicates, the DICE 2017 model integrates an economic model with a climate model. A thorough description of the DICE 2017 model, as well as results related to different policy guidelines, the Kyoto Protocol (or the Stern Review), is available in Nordhaus (2008).⁵⁵ We used the DICE 2017 model to calculate the social benefits of carbon reductions resulting from the proposed Massachusetts carbon tax.

BHI used the DICE model to calculate the social cost of carbon for each year of our analysis. We applied the social cost of carbon from the DICE model to our estimate of the reduction in CO₂E due to the proposed carbon tax. Table 5 displays the results.

BHI projects that the carbon tax would reduce emissions by 1.43 MMT of CO₂E by 2022 and by 1.9 MMT of CO₂E in 2026. The DICE model projects the social cost of carbon at \$39.95 per MT of CO₂E in 2022, increasing to \$45.52 per MT of CO₂E in 2026. As a result, the proposed carbon tax would provide \$57 million in social benefits in 2022 and \$87 million in social benefits in 2026.

When comparing the costs of the carbon tax with the benefits, we find that the carbon tax would produce a net cost to Massachusetts of \$2,197 million in 2022, rising to \$4,434 million in 2026.

Table 5: The Costs and Benefits of H.2810 to Massachusetts

Costs and Benefits	2022	2023	2024	2025	2026
Carbon tax emissions change (MMT of CO ₂ E)	-1.43	-1.53	-1.64	-1.77	-1.90
Social benefits per MT of CO ₂ E reduction	39.95	41.30	42.66	44.01	45.52
Total social benefits of CO ₂ E reduction (\$, mil.)	57	63	70	78	86
Total social costs of carbon tax (\$, mil.)	-2,254	-2,802	-3,348	-3,923	-4,520
Net benefits (benefits-cost) of carbon tax (\$, mil.)	-2,197	-2,739	-3,278	-3,845	-4,434

⁵⁴ The latest version of the DICE 2017 model is available online at <http://nordhaus.econ.yale.edu/DICE2007.htm>. We downloaded the model for the runs reported here on April 1, 2019.

⁵⁵ Nordhaus, William, *A Question of Balance: Weighing the Options on Global Warming Policies*, 1. ed., New Haven, CT: Yale University Press, May 2008.

Conclusion

Massachusetts lawmakers have been aggressive in enacting policies to combat climate change. The state legislature passed the *Global Warming Solutions Act* and joined the *Regional Greenhouse Gas Initiative* in order to reduce the state's GHG emissions. Whether as a result of these policies or the fall in the price of natural gas, Massachusetts is well on the way to meeting its goal of a 25 percent reduction in GHG emissions from 1990 levels. For some policymakers, this is not enough.

Lawmakers, including Senator Michael J. Barrett and Representative Jennifer E. Benson and their co-sponsors, filed bills to enact a carbon tax in Massachusetts. While carbon taxes are a tool favored by economists to address climate change, they are not without costs and limits.

Any proposed carbon tax in Massachusetts would have negligible effects on global emissions. Massachusetts GHG emissions subject to the proposed carbon taxes are only 0.12 percent of global GHG emissions, which grew at a rate of 1.2 percent between 2016 and 2017. The global *growth* of GHG emissions between 2016 and 2017 was ten times greater than the Massachusetts emissions subject to the carbon tax.

Yet the Massachusetts economy would suffer under the proposed carbon taxes. The carbon tax would cost thousands of jobs, over one billion dollars in investment, and billions of dollars in lower incomes and real GDP by 2026.

BHI compared the costs of a carbon tax to the benefits of reduced GHG emissions. We calculated the benefits of the carbon tax at less than \$100 million in 2026. The costs (\$4.52 billion by 2026) of the carbon tax far outweigh the benefits. Moreover, Massachusetts citizens alone would bear the costs, while all citizens of the world share

the benefits. Massachusetts lawmakers should keep this in mind when considering carbon tax legislation.

There is more to consider. Once legislators understand the small effect that the proposed legislation would have on Massachusetts GHG emissions, they are likely to demand a far higher carbon tax with commensurate harm to the economy. Furthermore, from the experience of Canada and Australia, the reductions are likely to be not only small but costly to households, with more of the rebated tax revenue going to business. Finally, with GHG emissions on track, without a carbon tax, to meet previous policy goals, it is worth asking if Massachusetts needs a carbon tax at all.

It would seem appropriate to shift the debate over GHG emissions to the national level, where the challenges of limiting global GHG emissions are better confronted.

Appendix

BHI used its multisector Massachusetts STAMP model to estimate the economic cost of a proposed carbon tax on the state economy. The existing model provided fields in which we could enter changes in the state income, corporate and, sales tax. We needed to modify the model by (1) adding the carbon tax, (2) adding the carbon tax rebate fund, and (3) allocating the carbon tax revenue to the 27 industry sectors, 13 government sectors, and seven household sectors. We allocated the revenue based on the number of employees in the industry and government sectors and on population in the household sectors relative to the sum of all workers and population in all three sectors. As a result, the business sectors received 37 percent of the revenue, the government sectors received 4 percent, and households received 59 percent.

BHI next estimated the reduction in GHG emission that would result from the imposition of the carbon tax. To accomplish this, BHI (1) estimated the price elasticities

of demand for the different fossil fuels specified in the carbon tax bill, (2) obtained or calculated the price of fossil fuels for the time period, and (3) estimated the price change for each fossil fuel that would result from the carbon tax.

BHI utilized data on fossil fuel prices and consumption from the U.S. Department of Energy's Energy Information Administration (EIA) for Massachusetts to calculate price elasticities of demand for each fossil fuel, such as gasoline, diesel, natural gas, heating oil, kerosene, and fuel oil.⁵⁶ We calculated price elasticities of demand for each type of end-user: residential, commercial, industrial and transportation. We used a log-log model, according to which $\log(\text{consumption}) = \beta + \alpha \log(\text{price}) + \varepsilon$, where β is the intercept, α is the elasticity, and ε is the error term, to calculate the elasticities. Table A1 displays the results.

Table A1: Elasticities of Demand for Fossil Fuels in Massachusetts

Fuel	Residential	Commercial	Industrial	Transportation
Natural gas	-0.21	-0.29	-0.01	-0.29
Petroleum products	-0.40	-0.69	-0.63	-0.63
Gasoline	na	na	na	-0.20

The EIA provides historical price data for each fossil fuel and sector.⁵⁷ However, we needed to estimate the future prices of the products. The CME Group estimates future prices for natural gas (CME code NG), gasoline (RB) and fuel oil products (MF). We used

⁵⁶ U.S. Department of Energy, Energy Information Administration, Massachusetts State Profile and Energy Estimates, More Data & Analysis in Massachusetts by Source, (accessed March 2019), <https://www.eia.gov/state/search/#?1=79&2=200>.

⁵⁷ Ibid.

the percentage change in the futures prices to project the fossil fuel prices for 2022 through 2026.⁵⁸

The EIA provides carbon dioxide emission coefficients by fuel per unit of volume and per million BTU. We converted the emissions coefficients into metric tons for petroleum products and thousands of cubic feet for natural gas to match the measure used in the EIA price data. For example, the EIA estimates that a gallon of gasoline produces 8.89 kilograms of CO₂. We converted the 8.89 kilograms into metric tons by dividing 8.89 by 1,000 to get the tons of CO₂ contained in a gallon of gasoline, or .00889 metric tons per gallon. We repeat the process for the other fossil fuels.⁵⁹

We calculated the price change that would result from the carbon tax by multiplying the carbon tax rate by the CO₂ emissions coefficient. For example, we multiplied the carbon tax of \$20 for 2022 by the coefficient for gasoline (.009) to arrive at a price increase of \$0.178 per gallon. We then divided the price increase by our estimated price of the fossil fuel for the corresponding year to get the percentage change in price. For gasoline, we divided \$0.178 by \$2.82 to get a 6.3 percent increase in the price of gasoline due to the carbon tax for 2022. We repeated this process for all years, fossil fuels, and sectors.

The EIA provides data on emissions by fossil fuel and sector. We used this data to estimate the reduction in GHG emissions under the carbon tax. We assumed that the emissions reduction would fall in line with the reduction in consumption. Thus, we multiplied the elasticity by the percentage change in price under the carbon tax, and then

⁵⁸ CME Group, Trading, Energy, Quotes (Accessed April 2019),

https://www.cmegroup.com/trading/energy/natural-gas/natural-gas_quotes_globex.html

⁵⁹ U.S. Department of Energy, Energy Information Administration, Environment, Carbon Dioxide Emissions Coefficients, (Accessed April 2019),

https://www.eia.gov/environment/emissions/co2_vol_mass.php.

multiplied that result by the pre-carbon tax emissions to get our estimate of the reduction in emissions due to the carbon tax.⁶⁰ For example, we multiplied the increase in gasoline price (6.3 percent) by the elasticity for gasoline (-0.198) and by the emissions from the transportation sector (30.3 MMT of CO₂E) to estimate that the carbon tax of \$20 per ton in 2022 would reduce emissions by 378,000 MT of CO₂E. Once again, this process was repeated for the other fossil fuels and sectors. We summed the results for each industry and fuel to obtain our estimate of the reduction in CO₂E due to the carbon tax.

Because the emissions estimates from the Massachusetts Department of Environmental Protection differ from the EIA estimates, we corrected the difference by multiplying our emissions reduction estimate by the ratio of emissions data from the Department of Environmental Protection to the emissions data from the EIA.

Next, we calculated the revenue that would be generated by the proposed carbon tax. We subtracted our estimate of the emissions reduction from the total emissions and multiplied the result by the applicable carbon tax for that year. We used the resulting revenue figures as inputs to the STAMP model.

⁶⁰ U.S. Department of Energy, Energy Information Administration, Environment, State Carbon Dioxide Emissions Data, (Accessed March 2019), <https://www.eia.gov/environment/emissions/state/>.

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