Analysis of a Carbon Fee or Tax as a Mechanism to Reduce GHG Emissions in Massachusetts

Prepared for the Massachusetts Department of Energy Resources

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December, 2014

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Principal Findings

British Columbia (BC) precedent: BC provides a precedent for Massachusetts, having instituted a revenue-neutral carbon tax in 2008 that is now $30/ton. Since 2008, BC cut its GHG emissions substantially compared to the rest of Canada, while experiencing economic growth slightly higher than the rest of its nation.

Economy-wide coverage of the fee/tax: it would be administratively feasible and effective for the state to impose a fee/tax on our major sources of carbon dioxide emissions: direct combustion of fossil fuels and electricity consumption. However, the small emission cuts from including the electric sector argue for considering exempting it from the fee/tax.

Fee/tax rates modeled: we modeled three scenarios. In all three, the fee/tax begins at $10/ton and rises to $30/ton in year five (replicating British Columbia). In following years through 2040, rates rise gradually to either $50, $75, or $100/ton. At $30/ton, residential natural gas prices would rise by about 12%.

Feasible system for returning all funds to the public: it is feasible to return all of the revenue to households, businesses, and institutions through tax cuts or rebates. The revenues could be divided into two parts: (1) funds obtained from households, which would be returned to this sector as a whole, and (2) funds obtained from businesses and institutions, which again would be returned to these sectors.

Positive impacts on economic indicators: impacts from the fee/tax would be small in relation to the overall size of the state economy. However, economic indicators such as disposable personal income, personal income per capita, and the labor share of state income would rise due to the fee/tax.

Positive impacts on employment: employment is forecasted to grow by 4,000 to 10,000 jobs by 2030 due to the tax/fee, primarily because the state would be spending less on importing fuels and energy. Households at the lowest income levels would see the greatest job gains.

Carbon dioxide emissions would fall substantially: the greater the fee/tax rate, the greater the drop in pollution, with carbon dioxide emissions falling by 5% to 10%, larger than almost any of the state's other greenhouse gas reduction policies are projected to achieve.

Most households can be fully compensated for rising prices: fossil fuel cost increases will be relatively small, especially in the early years of a fee/tax. Under a system that gave equal rebates either per person or per household, or a mixture of these designs, on average low- and moderate-income households would have a net gain or come out about even. We find

that a per-person rebate, or a mixed system, would be more equitable than a per household rebate.

Businesses and institutions can be compensated: a system that gives all businesses, non-profit institutions, and governments rebates in proportion to their shares of either 1) total state employment or 2) total state payroll, would leave most entities with small gains from the fee and rebate combined, while for most others the fee would exceed the rebate by only a small amount in relation to their overall operating costs.

Executive Summary

I. Overview and Policy Context

Massachusetts is a national leader in energy and environmental policy. From energy efficiency and clean energy policies to environmental planning and protection efforts, Governor Deval Patrick's Administration has made combating and preparing for climate change a major component of his tenure.

This study was commissioned by the Massachusetts Department of Energy Resources (DOER) to analyze how a possible revenue-neutral carbon tax (or fee) could be implemented in the Commonwealth. The study was the outcome of discussions between several stakeholders and public officials including former Massachusetts Energy and Environmental Affairs Secretary Rick Sullivan; Massachusetts Energy and Environmental Affairs Secretary Maeve Vallely Bartlett; , Senator Marc Pacheco - Chair, Senate Committee on Global Warming and Climate Change; Senator Michael Barrett; Representative Frank Smizik - Chair, House Committee on Global Warming and Climate Change, and; Representative Thomas Conroy.

A carbon fee/tax is a simple and transparent way to create a price for emitting carbon dioxide (and possibly other greenhouse gases) to the atmosphere. Such a fee/tax would support the state's other policies that contribute to meeting the mandates of the Global Warming Solutions Act (GWSA) of 2008 and the roadmap set by the Massachusetts Clean Energy and Climate Plan for 2020. These documents require the state to reduce its greenhouse gas (GHG) emissions to 25% below the 1990 level by 2020 and to at least 80% below 1990 by 2050.

DOER requested the tax to be revenue-neutral, so that the residents, companies, and other institutions of the Commonwealth would receive back via tax cuts or rebates as much money as they are paying in carbon taxes. Our modeling is designed on this basis, and estimates the net impacts from the combination of a fee/tax along with returning all the funds to the public. There was broad support during the public stakeholder process for a system designed in this way; although some stakeholders felt that a portion of the funds should be used for government programs that help to reduce GHG emissions, such as providing incentives for energy efficiency and renewable energy.

British Columbia and Other Examples of Carbon Taxes

The full study and its appendices discuss in depth many of the existing examples of carbon taxes throughout the world. One jurisdiction with similarities to Massachusetts is British Columbia (BC), which instituted a revenue-neutral carbon tax in 2008. Since passage of the tax, BC has cut its GHG emissions substantially compared to the rest of Canada, while experiencing economic growth slightly higher than the rest of its nation.

In the United States, besides Massachusetts, legislative efforts surrounding carbon taxes are currently underway in the states of Washington, Oregon, and Vermont.

II. Design Issues in Imposition of the Tax

We were guided by the following key principles in designing the tax and methods of returning the revenue to the public:

- **High potential to reduce GHG emissions** – to be worth the effort of implementing it, a carbon tax should make a major contribution to achieving the state's GHG reduction mandate for 2050.
- **Economy-wide -** cover all major sources of greenhouse gas (GHG) emissions; beginning with fossil fuels and the electricity generated by such fuels.
- **Revenue-neutral** – the DOER specified that this study should assume that all revenues from the tax would be returned to the public.
- **Gradual phase-in -** the tax should be phased-in over time so that households and businesses would have time to consider their options for reducing their costs and for adjusting their energy (carbon) use.
- **Social equity** - both costs and other impacts may be distributed unevenly across geographic locations, income groups, and economic sectors. The study focuses on a tax design that corrects such inequities, including through how the tax revenues are returned to the public.
- **Protect business -** mitigate any economic dislocation that could be caused by competition from firms in untaxed jurisdictions

We modeled three price trajectories for the tax. In all three, the price begins at $10/ton and rises $5/year to reach $30 in the fifth year. After that, we model low, medium, and high annual rate increases that result in the tax reaching $50, $75, or $100 per ton in 2040, the last year of the modeling. In choosing the rates of price escalation we were guided by the first principle above, that the tax should make a major contribution toward reaching the state's legal requirement to reduce GHG emissions to at least 80% below the 1990 level by 2050.

Metric versus short tons: note that throughout this study all GHG emission impacts will be counted in metric tonnes, the accepted international unit. When the word "ton" appears, it should be understood to refer to metric tonnes.

Where and on what Entities Should the Carbon Tax be Levied?

For purposes of the study, we have assumed that the tax would be imposed only on the major sources of fossil fuel combustion (oil, natural gas, gasoline, and coal) and on emissions from electricity generation. Due to the small contribution that electricity makes to reducing CO2 emissions when the carbon tax is applied, exclusion of it from the fee/tax system should be considered. Optimally, the tax should also cover other greenhouse gases besides CO2, but we have not addressed them here. For each fossil fuel, we propose to institute the tax in a manner that is least costly to administer. This differs somewhat for each fuel, but in general the

preference is to place the tax at the point of first sale in Massachusetts, or on out-of-state suppliers where appropriate – as the full report discusses in detail.

Electricity Generation and Interactions with the Regional Greenhouse Gas Initiative (RGGI)

We examined several approaches for setting a price on carbon in the electricity sector. Implementing the tax on this sector involves complications due both to RGGI and to the regional nature of electricity supply. In recent years Massachusetts has imported on the order of one-third of its electricity, and existing tracking systems do not identify the sources of this electricity in a way compatible with a carbon tax.[1] Without such tracking, the Commonwealth cannot impose carbon-specific taxes on imports.

Given these difficulties, we have concluded that the most appropriate method of handling the electricity sector at present would be to apply the tax directly on household, business, and institutional consumers at the retail level, based on average emissions in the New England region. This would create less of an incentive to move toward lower-emission generation sources, but would be simple to implement and would give consumers an incentive to improve energy efficiency and to implement distributed generation of renewable power.

III. Designing a System for Rebating the Carbon Tax Revenues

The study also examines the impacts of instituting a carbon tax while then returning all the revenues to the public through cutting other taxes or providing rebates to households and businesses. We then estimate the net impacts on households at different income levels and businesses and institutions of different types.

The analysis in this section does not assume any changes in energy production and consumption as a result of the tax. But Section IV below will use other models to estimate changes in fossil fuel consumption due to the tax, which in turn will cause changes throughout the economy. These changes increase the benefits from a carbon tax in terms of employment and other economic indicators, relative to those documented in Section III.

Formulas for returning revenues to households

We assume that the household sector as a whole receives as much money back as it pays in for the carbon tax. Households are "ranked" by their income levels, and divided into 5ths, with the lowest-income 5th called Quintile 1 and the highest income Quintile 5.

Reducing tax rates inequitable: First, we have determined that reducing the rates of any of the major state and local taxes paid by households – income, sales, or

[1] Calculating imported power involves some complexities in the use of statistics from the U.S. Energy Information Administration, and the most recent EIA data currently available is for 2012.

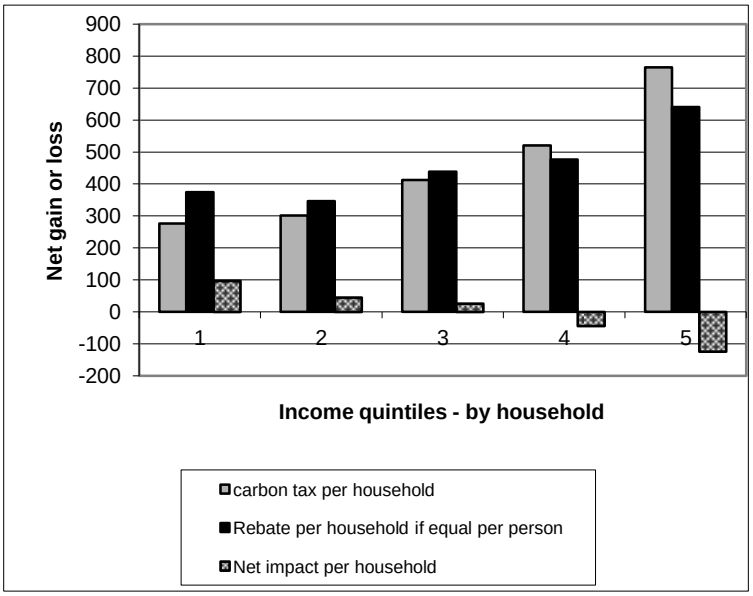
local property taxes – will not sufficiently protect lower-income households because on average they will pay more in carbon taxes than they would get back from the tax cuts; while higher-income households will get back more from tax cuts than they pay in.

Provide rebates instead: two scenarios are analyzed for how funds will be distributed:

1) equal rebate payments per household
2) equal rebate payments per resident of the state

Low and moderate income households gain or come out about even: Under either rebate scenario, because energy use rises with income, the bottom two quintiles will have a net gain from the combination of tax and rebate, while quintile three will come out about even, quintile 4 will have a small loss, and quintile 5 (those households with the highest incomes) will come out behind by about $100 to $300.

Figure ES-1: $30/ton tax, equal rebates per person



Impacts by household size: Equal rebates per household favor smaller households, while equal rebates per person favor larger households. The data shows that among the lowest-income quintile, equal rebates per household would mean that households with one to three members see a net benefit, while households with four or more members come out behind. In comparison, with equal rebates per person, the net benefit grows with the number of people in the household. We conclude that the fairer system is to provide equal rebates per person; or a "mixed" system, such as equal rebates for the first member of a household and half as large a rebate for each additional member.

How to distribute rebates to households

Three factors influence the choice of method to distribute rebates: (1) minimizing administrative cost, (2) maximizing visibility of the rebate, and (3) timing – providing rebates early or throughout the year so that they are available to pay higher energy costs. Possible methods include:

1) **Increase personal exemption on income tax** – to yield an average $460 rebate per household, the exemption would need to rise by $8,850 (since the tax rate is 5.2%), which would be a large increase compared to the current exemptions.[2]
2) **Create a carbon tax credit on state income taxes** – on a per person or per household basis.
3) **Rebate outside the tax system** – the state could treat the carbon price as a "fee," and send rebates to households independently of the existing income tax system.
4) **Households that do not file state income taxes** – about 9% of the state's residents are in households that do not file state income tax returns. In order to reach such households, we recommend that legislation instruct DOR and state agencies that administer programs serving low-income households to share their databases; so that as close to 100% of such households are identified as possible, with rebates sent by one of the state agencies involved.

Formulas for Returning Funds to Businesses and Institutions

First, we have determined that the state's corporate excise tax is not a good mechanism for returning funds. One reason is that many of the state's largest economic sectors, which will pay large amounts of carbon taxes, are not for-profits, and would not gain from cuts to the corporate excise tax – such as most hospitals, almost all universities and colleges, and all municipal governments as well as the state government itself.

Return funds according to employment or payroll: instead of giving a corporate tax cut, we recommend returning funds to all companies and institutions in proportion to their shares of either overall state employment or value of payroll. Our calculations indicate that the net impact of the carbon tax combined with such rebates would be quite small impacts on most sectors of the economy, with the state's dominant sectors having small gains. A few sectors, such as construction and several manufacturing industries, would have net losses ranging from 0.1% to 0.9% of their total annual operating costs.[3]

As discussed in Section III.D.4, another possibility that would be more complex, but would have some advantages, is "benchmarking" within an industry. In such a system each industry as a whole would receive rebates equal to the money it pays in carbon taxes, but particular

[2] If the carbon price is termed a "fee" an evaluation will be necessary to see whether returning the funds to the public through tax cuts is appropriate.
[3] The 0.9% figure is for chemical manufacturing, and the federal government data used here are much larger than data reported to MassDEP, so the true number may not be this high.

companies within an industry would receive different levels of rebates based on their emissions performance relative to other companies in the same industry.

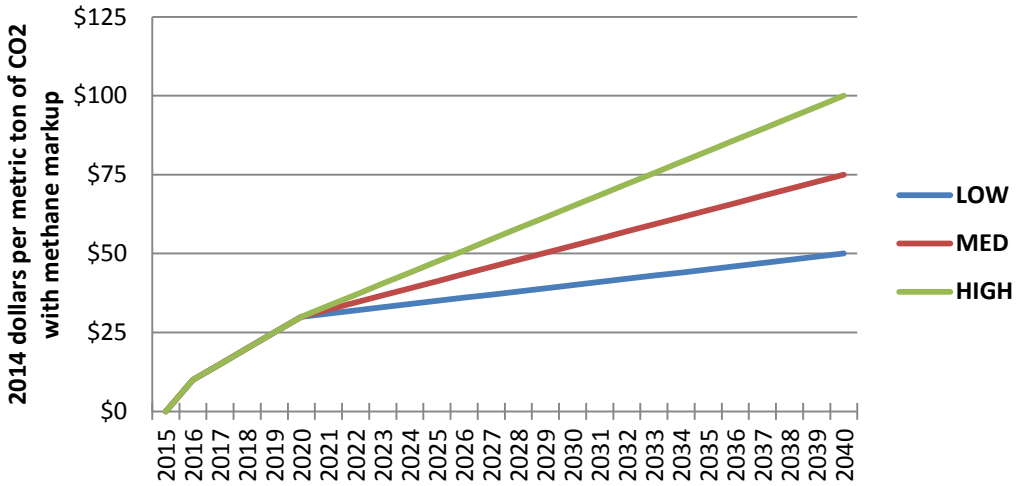
Public transit: We recommend that the state's regional mass transit authorities either be exempted from the carbon tax or be fully rebated for their increased costs.

Energy-intensive manufacturing: The standard rebates related to employment or payroll will yield reasonable net impacts on most manufacturing industries. However, we recommend that the state investigate this area in more depth, and consider targeted rebates for particular manufacturing industries that have substantially higher than average carbon tax costs and face tight competition from firms in other states and nations.

IV. Macroeconomic Impacts

The early years of the carbon tax are modeled to replicate the same tax rates as British Columbia, starting at $10/ton and rising $5 a year to reach $30 in the 5th year. By the 5th year (2020), the tax would bring in around $1.75 billion in revenue to be redistributed to the public. This is equivalent to about 7% of Fiscal Year 2015 state tax revenues[4] and 5% of expenditures (the other funds come from the federal government share of state program costs).[5] For the following years through 2040 we modeled three scenarios: gradual increases in the tax rate of $1.00 per year, $2.25 per year, or $3.50 per year.

Figure ES-2: Carbon Tax Rate 2016 Through 2040



All the funds collected would be divided into two buckets: revenues paid by households and individuals return to that sector, and funds paid by businesses, nonprofits, institutions, and governments return to that broad sector of the economy. We tested options and cases for each.

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[4] Massachusetts FY 2015 Budget Summary, http://www.mass.gov/bb/gaa/fy2015/index.html
[5] Massachusetts Tax Revenue Forecasts for FY 2014 and FY 2015, The Beacon Hill Institute at Suffolk University, 12/11/13, http://www.beaconhill.org/RevenueForecastsBHI/BHI-MAForecastFY14FY15-for-2013-12-11-FINAL.pdf

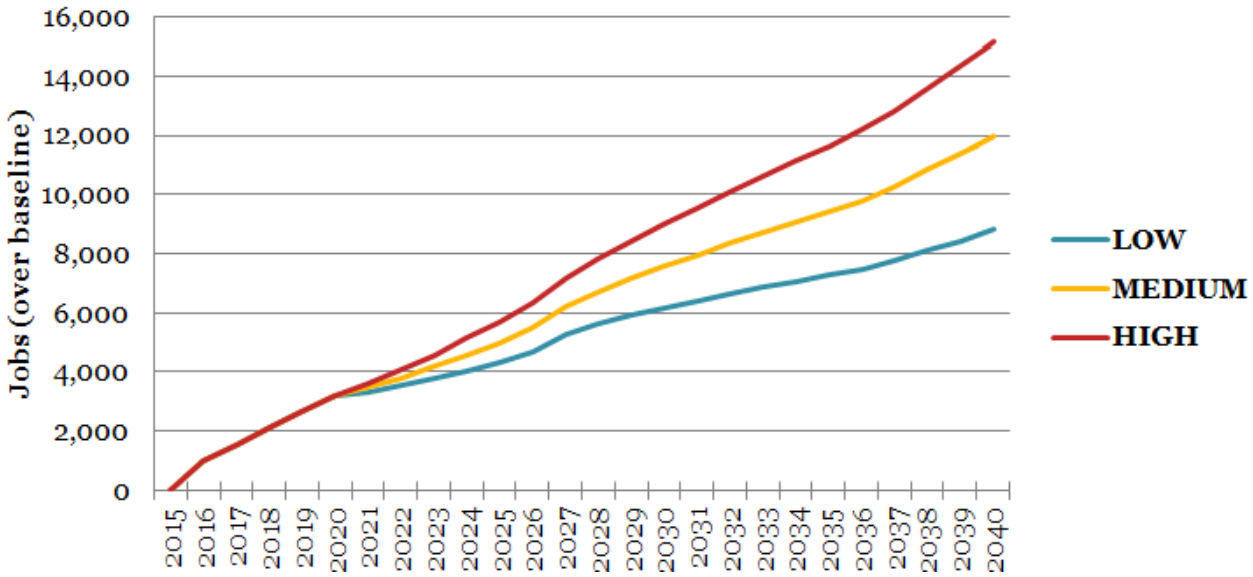
Two options were run for returning revenue to households: either equal rebates per household or equal rebates per individual person. Two options were also tested for returning revenues to businesses, non-profit organizations, and governments: payments based on either a firm/organization/government's share of total state payrolls or total state employment. While the revenue recycling mechanism does have relevance for the distribution of the impacts, it has only a small influence on the macroeconomic impact.

Overall, the carbon fee/tax has small but positive impacts on the Massachusetts economy. These include:

- **Jobs:** 2,000 to 4,000 additional jobs by 2020 and 6,000 to 15,000 by 2040; additional jobs and output would be concentrated in the service and technology sectors that already form the backbone of the Massachusetts state economy
- **Personal income:** greater real personal income in most of the scenarios tested, even adjusting for a higher cost of living

Figure ES-3: Total Employment Change versus Baseline

With three scenarios for the rate of increase in the carbon tax after year five, as shown in the previous graph: the low scenario reaches $50/ton in 2040, the medium scenario $75/ton, and the high scenario $100/ton. All three scenarios provide equal rebates per household and give rebates to businesses and other institutions in proportion to their number of employees.



There are two main reasons Massachusetts performs well with a carbon fee and rebate. Foremost, Massachusetts imports nearly all of its fossil energy resources. Gasoline imports alone cost the state around $8 billion every year, which equals 1.75% of the state economy. Total energy imports are closer to 5% or 6% of the state economy. With the state having no oil and gas extraction and no petroleum refining, much of the negative impact on the fossil energy industry from the carbon tax "exports" itself to other parts of North America and the rest of the world.

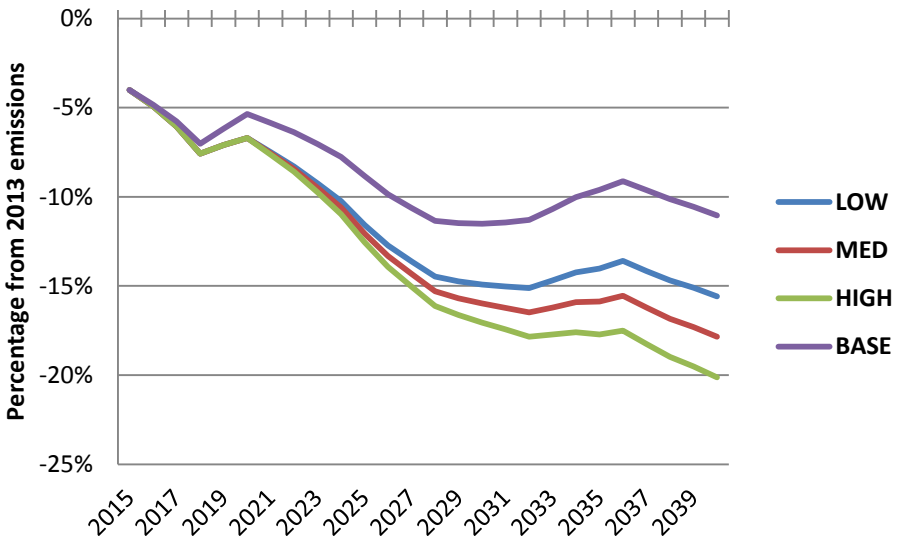
Those dollars then stay in the Massachusetts economy and lead to increased spending on other industries where much more of the money pays for in-state labor, services, and other costs.

Second, the service and information sectors that dominate the Massachusetts economy tend to generate more jobs per dollar of output than do the capital-intensive industries related to energy production and distribution, which helps lead to additional jobs relative to the baseline. While these incremental jobs are a positive effect, they would be a small impact relative to a state economy of over $450 billion and with 4.3 million jobs at present.

V. Carbon Dioxide Emissions Impact

The effects on carbon dioxide emissions are greater than those on the state economy. The price incentive provided by the carbon tax would reduce state GHG emissions to a larger degree than most other Massachusetts programs that currently operate for this purpose. Emissions would fall by up to six million metric tons per year, or 5% to 10% of current levels. Most of the pollution reductions would come from cuts in consumption of transportation fuels

Figure ES-4: Carbon Dioxide Emissions (percentage change from 2013)



Factors explaining the degree of emissions reduction

There are several reasons why the drop in carbon dioxide emissions relative to the baseline is moderate in size, but not as dramatic as some advocates of a carbon fee/tax would hope:

- **Relatively small price increases for fossil fuels** – For example, at $30/ton, the tax raises gasoline prices by 27 cents per gallon, a 7.7% increase if the current price is $3.50 per gallon. Average annual natural gas prices for heating would rise by about 12%.

- **Inelastic demand for energy** – energy is an essential product, and as such demand is somewhat resistant to price changes. For example, a 10% increase in gasoline prices is estimated to cause about a 6.7% drop in sales by the end of 10 years. For residential sales of natural gas, a 10% price increase is estimated to yield a 3.8% drop in sales.
- **Combining relatively small price increases with inelastic demand results in moderate drops in carbon dioxide emissions** - for natural gas, multiplying the 12% increase in its price by a demand elasticity of -0.38 yields an expected drop in demand of 4.6% after ten years. Even a $100 per metric ton tax in 2040 raises residential natural gas prices by 29.3%, which yields an expected drop in total demand for the fuel of around 10%.

In addition, Massachusetts is already a relatively low-carbon state, with the economy dominated by service and information industries that are not energy-intensive. In addition, unlike many states, natural gas (which has lower CO2 emissions than oil or coal when burned for electricity) has been gaining market share in Massachusetts for many years, and is leading to the elimination of coal-fired electricity generation in the state.

Significance of emissions reduction

Nevertheless, the reductions of carbon dioxide emissions by 5% to 10% in 2040 are larger than almost any of the state's other greenhouse gas reduction policies are projected to achieve, and so would be an important contribution to climate change mitigation in Massachusetts.

The carbon tax has most of its impact in reducing the demand for vehicle fuels, which existing state climate policies have not addressed to a great degree, even though gasoline and diesel fuel make up half of projected carbon tax revenues and 62% of expected CO_2 reductions by 2020. Since 1998, emissions from power generation in the state have fallen by a dramatic 46% while emissions from vehicular fuels have risen slightly by 0.3%. **Thus, an economy-wide carbon tax would greatly increase the state's efforts to address emissions from transportation, which is now the state's largest source of CO_2 emissions.**

Is the carbon charge a tax or a fee?

We have conducted only a preliminary review of this question. However, several sources, including the Massachusetts legislative drafting manual, the Washington State Department of Revenue, and two private think-tanks, provide criteria for deciding the question. The criteria given appear to support terming a revenue-neutral carbon charge a fee rather than a tax.