ISSUE BRIEF

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*Considering a US Carbon Tax: Economic Analysis and Dialogue on Carbon Pricing Options*
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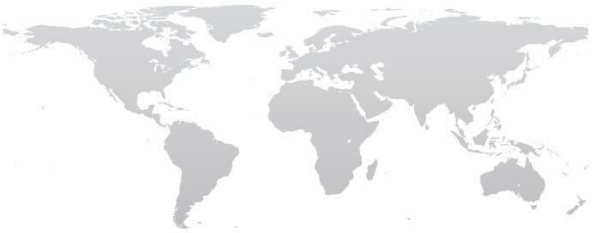

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## Introduction

In June 2015, Senators Sheldon Whitehouse (D-RI) and Brian Schatz (D-HI) released proposed legislation, the American Opportunity Carbon Fee Act, that would levy a fee (tax) on US greenhouse gas (GHG) emissions, largely on carbon dioxide ($CO_2$). Senator Whitehouse remarked that the act would significantly lower GHG emissions in the United States while generating substantial revenue—all of which would be returned to the American people.

The proposed bill includes the following $CO_2$ fee elements.

- The fee would be assessed on fossil fuels when mined, extracted, or imported; on large emitters of non-fossil-fuel-based greenhouse gases, and on producers and importers of industrial gases with high global warming potential.
- The fee would start at the administration's central social cost of carbon estimate ($45 per metric ton in 2016) and increase annually by a real 2 percent, ensuring emitters would be held responsible for the harm they are offloading onto the American people.
- When emissions fall below the target level—80 percent below 2005 emissions—the annual adjustment would fall to inflation.
- The fee on fossil fuels would be increased to account for the amount of methane—a potent greenhouse gas—that escapes during the extraction and distribution of these fuels.

### Key Points

- Under the carbon fee scenario in the proposed American Opportunity Carbon Fee Act, emissions in 2030 are projected to be 55% of the business-as-usual baseline—that is, emissions fall almost 45% from 2015 to 2030.
- With respect to the commonly used 2005 benchmark year, emissions in 2030 would be almost half the emissions in 2005.
- The US pledge under the UN Framework Convention on Climate Change promises emissions levels 26–28% below 2005 by 2025. Modeling suggests the American Opportunity Carbon Fee Act would yield considerably more reductions in 2025 than outlined in the pledge.
- Although the carbon fee levied by the proposed bill would be applied to the carbon content of all fossil fuels, including petroleum, 75% of the emissions reductions emanate from the electricity generation sector.

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- The US Department of the Treasury would assess and collect the fee, consulting the US Environmental Protection Agency and Energy Information Administration to ensure the best methods and data.

Just prior to the release of the proposed legislation, we utilized a large-scale, computable general equilibrium model of the US economy—the Goulder-Hafstead Energy-Environment-Economy (E3) CGE Model—to assess the reduction in domestic $CO_2$ emissions that would result from the imposition of the tax.

## Model Characteristics

The E3 model is an economy-wide model of the United States with international trade. Production is divided into 25 industries, with a particular emphasis on energy-related industries such as oil and natural gas extraction, coal mining, electric power (represented by four industries), petroleum refining, and natural gas distribution. The model is unique, with a detailed tax treatment that allows for interactions of environmental policy and preexisting taxes on capital and labor, and special attention to capital dynamics, which are important for analyzing how policies impact the economy over time. The model is solved at yearly intervals beginning in 2010.

The E3 model has been used to model cap-and-trade programs, carbon taxes, and clean energy standards. It has been featured in two peer reviewed journal articles, is participating in Stanford's Energy Modeling Forum (EMF) 32: Inter-model Comparison of US Greenhouse Gas Reduction Policy Options, and is the focus of a forthcoming book, *US Climate Policy Options: A General Equilibrium Assessment*, from Columbia University Press.

The E3 model is described in an RFF discussion paper, Tax Reform and Environmental Policy: Options for Recycling Revenue from a Tax on Carbon Dioxide.

## Terms of Reference for the Analysis

The model analysis of the American Opportunity Carbon Fee Act was structured by the specific elements below.

- The fee is imposed on all fossil fuels (coal, petroleum, and natural gas) combusted within the United States.
- The fee is based on the carbon content of these fuels.
- Only the impact of the fee on $CO_2$ emissions is modeled. Emissions of the other five main greenhouse gases (methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) are not included in this analysis.
- The fee is applied at a rate $42 per ton of $CO_2$ emitted in the combustion process.
    - The legislation as released this past June raised the initial tax rate to $45 per ton. We believe the estimates from the E3 model are reasonably linear between $42 and $45, and therefore those results can be linearly extrapolated.
- The fee is initially imposed in 2016.
- The bill defines the national emissions target attainment year (NEAY) as a year in which US emissions of all greenhouse gases do not exceed 20 percent below 2005 emissions. We

define a new NEAY that includes only $CO_2$ emissions rather than all GHG emissions, such that all $CO_2$ emissions do not exceed 20 percent below the emissions of $CO_2$ in 2005.

- The tax rate rises each year by 2 percent plus an adjustment for inflation for each successive year following a year that was not a NEAY.
    - In other words, if emissions in any calendar year fall below 20 percent of the 2005 emissions level, the tax rate does not rise.
- The same fee is imposed on $CO_2$ emissions from sources emitting more than 25,000 tons annually where the emissions arise from processes other than combustion.
    - The model is only able to capture emissions arising from the use of fossil fuels.
- Revenue from the carbon fees is recycled as equal lump-sum rebates to all households.

## Results

Although the E3 model is capable of addressing a great many questions concerning the use of carbon fees as a policy to reduce $CO_2$ emissions, the current analysis focuses solely on the magnitude of the emissions reductions over a 15-year time frame (2016 to 2030). E3 model results are presented in Table 1 below.

Model results by year are reflected in the table rows. The second column presents US emissions under a business as usual (BAU) baseline. The third column presents the modeled emissions under the carbon fee scenario, and the fourth column presents the levels of the fee. The fifth and sixth columns present the emissions under the carbon fee relative to the BAU path of emissions and relative to benchmark year 2005 emissions.

The tax rises from $42 in 2016 to just over $55 in 2030. Emissions under the carbon fee scenario in 2030 are projected to be 55 percent of the BAU baseline—that is, emissions fall almost 45 percent from 2015 to 2030. With respect to the commonly used 2005 benchmark year, emissions in 2030 are almost half the emissions in 2005.

Recall, the recent US pledge under the United Nations Framework Convention on Climate Change, referred to as an Intended Nationally Determined Contribution (INDC), was 26 to 28 percent below 2005 by 2025. E3 modeling of the American Opportunity Carbon Fee Act suggests the bill's carbon fee approach would yield considerably more reductions in 2025 than those contained in the US INDC pledge.

While the carbon fee levied by the Whitehouse-Schatz proposed legislation would be applied to the carbon content of all fossil fuels including petroleum, the bulk of the emissions reductions are derived from the electricity generation sector. Indeed, as displayed in Table 2 below, 75 percent of the emissions reductions emanate from the electricity generation sector.

**Table 1. Emissions Reductions under the American Opportunity Carbon Fee Act**

| Year | BAU emissions (billion metric tons) | Tax emissions (billion metric tons) | Carbon tax (2010$) | Emissions relative to BAU | Emissions relative to 2005 |
|---|---|---|---|---|---|
| 2016 | 5.56 | 3.80 | $42.00 | 68% | 62% |
| 2017 | 5.56 | 3.74 | $42.84 | 67% | 61% |
| 2018 | 5.57 | 3.69 | $43.70 | 66% | 60% |
| 2019 | 5.58 | 3.64 | $44.57 | 65% | 59% |
| 2020 | 5.60 | 3.59 | $45.46 | 64% | 58% |
| 2021 | 5.61 | 3.54 | $46.37 | 63% | 58% |
| 2022 | 5.63 | 3.50 | $47.30 | 62% | 57% |
| 2023 | 5.64 | 3.46 | $48.24 | 61% | 56% |
| 2024 | 5.66 | 3.41 | $49.21 | 60% | 55% |
| 2025 | 5.68 | 3.38 | $50.19 | 59% | 55% |
| 2026 | 5.70 | 3.34 | $51.20 | 59% | 54% |
| 2027 | 5.72 | 3.30 | $52.22 | 58% | 54% |
| 2028 | 5.74 | 3.26 | $53.27 | 57% | 53% |
| 2029 | 5.76 | 3.22 | $54.33 | 56% | 52% |
| 2030 | 5.78 | 3.19 | $55.42 | 55% | 52% |

**Table 2. Emissions from the Electricity Generation Sector under the American Opportunity Carbon Fee Act**

| Year | BAU electricity emissions (billion metric tons) | Tax emissions (billion metric tons) | Electricity emissions reductions as % of total emissions reductions |
|---|---|---|---|
| 2016 | 2.45 | 1.34 | 63% |
| 2017 | 2.48 | 1.31 | 65% |
| 2018 | 2.51 | 1.28 | 66% |
| 2019 | 2.55 | 1.25 | 67% |
| 2020 | 2.58 | 1.22 | 68% |
| 2021 | 2.61 | 1.19 | 69% |
| 2022 | 2.64 | 1.16 | 70% |
| 2023 | 2.68 | 1.14 | 70% |
| 2024 | 2.71 | 1.11 | 71% |
| 2025 | 2.74 | 1.09 | 72% |
| 2026 | 2.77 | 1.06 | 72% |
| 2027 | 2.81 | 1.04 | 73% |
| 2028 | 2.84 | 1.02 | 73% |
| 2029 | 2.87 | 1.00 | 74% |
| 2030 | 2.90 | 0.97 | 74% |