Joule

CellPress

COMMENTARY

A Federal US Carbon Tax: Major Design Decisions and Implications

Jason Bordoff[1] and Noah Kaufman[1,*]

Noah Kaufman is a Research Scholar at the Columbia SIPA Center on Global Energy Policy (CGEP) where he directs the Carbon Tax Research Initiative. He worked on energy and climate change policy for World Resources Institute, the White House Council on Environmental Quality, and NERA Economic Consulting.

Jason Bordoff is the Founding Director of the CGEP. Previously, he served as Special Assistant to the President and Senior Director for Energy and Climate Change on the Staff of the National Security Council, and prior to that he held senior policy positions on the White House's National Economic Council and Council on Environmental Quality.

Avoiding the most dangerous risks of climate change requires increased policy ambition around the world, including strong federal-level action in the United States. Economists have long pointed to a carbon tax as an important part of any cost-effective portfolio of climate policies.[1] A carbon tax would reduce emissions by raising the costs of carbon-intensive products, thus causing producers and consumers to factor the costs of climate change into their market decisions.

The purpose of this commentary is to describe the major design decisions associated with a federal carbon tax and their implications on US energy markets, emissions, and the economy. We rely on recent research from Columbia's Center on Global Energy Policy (CGEP)[2] and our partner organizations: Rhodium Group,[3] Rice University,[4] and Urban-Brookings Tax Policy Center.[5] We focus on two carbon tax scenarios that resemble federal legislation proposed in 2018, one by Democratic members of Congress led by Sheldon Whitehouse ("Democratic Proposal")[6] and one by Republican Congressmen led by Carlos Curbelo ("Republican Proposal").[7]

Design Decisions

In this section, we identify three major design decisions with important energy, economic, or emissions implications that differ across carbon tax proposals.[8] We summarize the trade-offs associated with each, and the choices made in the Democratic and Republican Proposals.

Carbon Tax Rates

A carbon tax requires policymakers to explicitly define the schedule of prices for CO_2 emissions, typically on an annual basis. Tax rates that are too low risk failing to accomplish the goals of the policy, which may be a combination of emissions reductions, revenue, and a price signal for investors.

The Democratic Proposal's carbon tax starts at $50/ton in 2020 and increases by 2% per year in inflation-adjusted terms. The Republican Proposal's carbon tax is about half as large, starting at $24/ton in 2020 and increasing at a similar rate. Under the Republican Proposal, the carbon tax is contingent on emissions outcomes—the tax rate is designed to increase by an additional $2/ton per year if annual emissions targets stipulated in the legislation are not met.

Revenue Use

Carbon tax payments become additional government revenue. Like other government resources, no consensus exists on how carbon tax revenue should be spent.

Revenues can be used to fund government spending that achieves additional emissions reductions or tackles other priorities (e.g., the Republican Proposal allocates most revenue to transportation infrastructure). Revenues can also

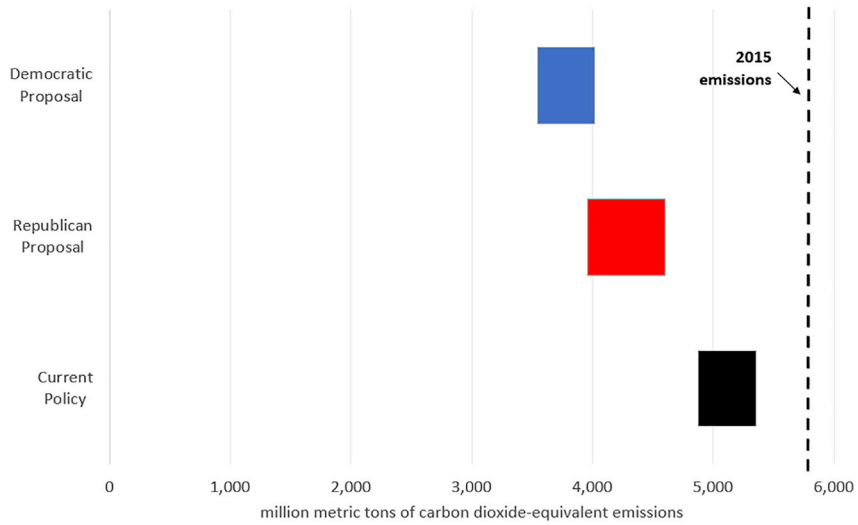

Figure 1. United States Net Economy-wide Greenhouse Gas Emissions in 2030

United States greenhouse gas (GHG) emissions are expected to decline modestly under current policies over the next decade, but a carbon tax could cause emissions to decline far more rapidly. Under the Republican Proposal, 2030 net economy-wide GHG emissions fall to 30%–40% below 2005 levels. Emissions fall further under the Democratic Proposal due to the higher carbon tax rates, to 39%–46% below 2005 levels. Sources: Larsen et al.,[3] Kaufman et al.[9]

be used for tax reform, based on the theory that government should raise money by taxing products we wish to discourage rather than encourage (e.g., the Democratic Proposal allocates most revenue to reducing taxes on workers). Finally, both the Democratic and Republican Proposals allocate funds to protect low-income Americans from energy price increases.

Other prominent groups, such as the Climate Leadership Council and Citizens' Climate Lobby, support returning all carbon tax revenues to Americans in the form of equal rebates.

Regulatory Changes

A carbon tax will not cover all sources of greenhouse gas (GHG) emissions, and does not address non-price-related barriers to reducing emissions. Additional climate policies are needed. Yet policymakers are justified in reconsidering the need for and stringency of existing policies with similar or overlapping objectives if a carbon tax were to be adopted. Therefore, carbon tax proposals commonly include additions, subtractions, or changes to other policies.

The Democratic Proposal retains all existing policies and authorities and adds a supplementary fee to cover other GHG emissions from fossil fuel supply chains. In contrast, the Republican Proposal places a moratorium on Environmental Protection Agency regulations of CO_2 emissions from stationary sources (which is lifted if emissions targets are not met) and repeals the federal excise taxes on motor vehicle and aviation fuels.

Other Design Decisions

Developing carbon tax legislation requires many additional design decisions. For example, recent carbon tax proposals, including the Democratic and Republican Proposals, make similar decisions with respect to the following design elements:

- *Which emission sources are taxed.* Policymakers must balance the benefits of a broader policy scope, which will lead to larger emissions reductions, with the administrative (e.g., monitoring) and political drawbacks associated with covering certain emissions sources. At a minimum, prominent carbon tax proposals typically cover virtually all CO_2 emissions from the energy system, which account for about 80% of US GHG emissions.
- *Point of taxation.* Regardless of where the carbon tax is imposed along the supply chain, firms will attempt to pass these costs through to consumers in the form of higher energy prices. Recent proposals structure the fee to minimize the number of taxed entities, which means at or near the point fossil fuels enter the economy.
- *International considerations.* A carbon tax could put manufacturers of carbon-intensive products at a disadvantage vis-à-vis competitors in countries without a comparably stringent policy. To avoid adverse impacts on the manufacturing sector and the transfer of emissions to other countries, recent proposals have included a border carbon adjustment requiring importers of carbon-intensive goods to pay a tax and providing a rebate to exporters of the same products.

Emissions, Energy Market, and Economic Outcomes

This section summarizes the potential emissions, energy market, and economic outcomes of a federal carbon tax, using scenarios that resemble the Democratic[3] and Republican Proposals[9] as illustrative examples.

Emissions Impacts

US GHG emissions have fallen in recent years and may continue to decline due to low-cost natural gas and carbon-free energy options. However, under current policies, emissions are likely to fall to just 18%–22% below 2005 levels

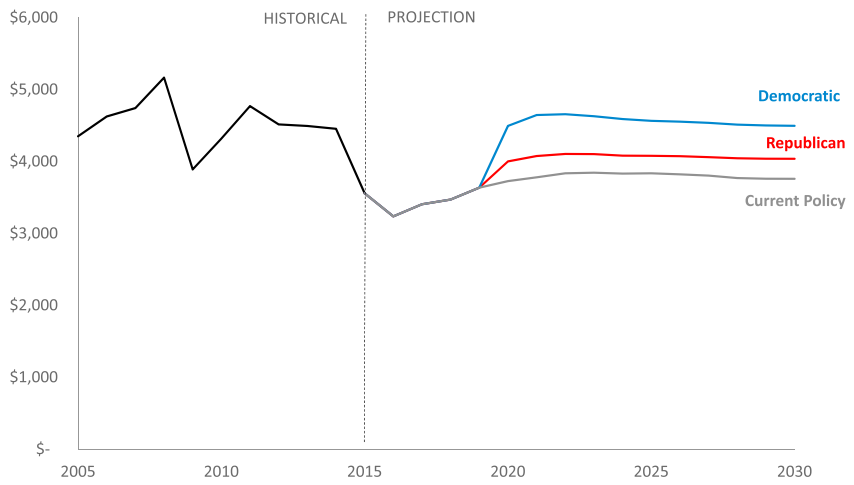

Figure 2. Per Capita Energy Expenditures

Carbon taxes increase energy prices. The Democratic Proposal would increase per capita energy expenditures by about 19% above the current policy scenario in 2025. The Republican Proposal would increase per capita energy expenditures by much less, by about 6% in 2025, due to its lower carbon tax rates and the elimination of the fuel excise taxes. Sources: Larsen et al.,[3] Kaufman et al.[9]

by 2025, far from the US commitment under the Paris agreement of 26%–28% reductions.

A carbon tax reduces emissions by providing economic incentives to use less carbon-intensive products and reduce energy consumption. Figure 1 displays estimates of US emissions in 2030 with the Democratic and Republican Proposals layered on top of a current policy scenario. The higher ends of the ranges reflect assumptions of relatively rapid progress in clean energy technologies, while the lower ends of the ranges reflect slower progress. By 2030, emissions under the Republican Proposal are 30%–40% below 2005 levels and 39%–46% lower under the Democratic Proposal.

While the Democratic Proposal's carbon tax rates are twice as large, emissions reductions do not differ by as much, reflecting the large amount of cost-effective reductions available at relatively low tax rates. In both cases, over two-thirds of the emissions reductions over this period come from the power sector, where low-cost and low-carbon alternatives to fossil fuels are most prevalent today.

Actual emissions could be higher or lower than the projections shown above, and these results should be interpreted with the following considerations in mind:

- Models capture only a subset of technologies and strategies consumers and producers will use to avoid the tax payments
- Models do not capture the accelerated innovation in low-carbon technologies caused by the carbon tax
- Models assume that consumers and producers respond to the price changes caused by a carbon tax in the same way that they respond to other comparable price changes, but a policy change may be more visible and permanent than day-to-day price fluctuations
- Models assume that consumers are rational and responsive to price signals, but some consumers will not observe or respond to the price changes caused by the carbon tax
- The carbon tax scenarios displayed above assume that a carbon tax is layered on top of a current policy scenario. Additional policies would increase the emissions reductions achieved by the carbon tax, while the elimination of existing policies would have the opposite effect.

Revenues

With gradually increasing carbon taxes, annual carbon tax payments over the first decade are roughly flat: the increasing annual carbon tax rates push revenue up over time, while the decrease in annual US emissions pushes revenues down.

A carbon tax affects other sources of government revenue as well. Carbon tax payments leave individuals and businesses with less income to pay other taxes and causes economic activity to shift to sectors taxed at different rates. Empirical estimates suggest that these additional effects are likely to reduce the net additional revenue from a carbon tax, perhaps by as much as a quarter of the carbon tax payments.

The Democratic Proposal increases annual government revenue by about $160 billion to $190 billion, which would be used primarily to offset employee payments of the payroll tax. The revenue increase under the Republican Proposal is much lower due to the lower tax rates and the repeal of the fuel excise taxes—about $55 billion to $70 billion annually.

Energy Market Impacts

A carbon tax increases energy prices in proportion to the tax rates and the carbon content of the energy sources: impacts are largest for coal, then petroleum, then natural gas.

Compared with a current policy scenario, and using our more conservative assumptions related to clean energy progress, average retail electricity prices increase in 2025 by about 9% and 22% under the Republican and Democratic Proposals, respectively; gasoline

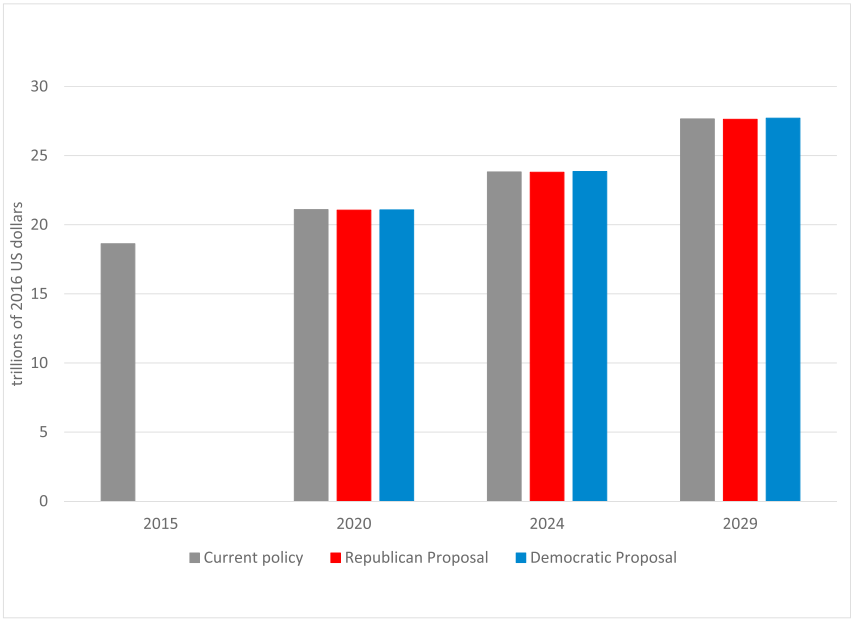

Figure 3. US Gross Domestic Product

The effects of a carbon tax on macroeconomic outcomes are small under both the Democratic and Republican Proposals. Estimated impacts on US gross domestic product range from slightly negative to slightly positive, and far less than 1% compared with the current policy scenarios in all years. These impacts exclude any economic benefits of emissions reductions. Sources: Diamond and Zodrow,[4] Kaufman et al.[9]

and diesel prices both increase by about 50 cents per gallon under the Democratic Proposal, but barely at all under the Republican Proposal due to the accompanying repeal of the gasoline tax; overall, energy expenditures per capita rise by about 6% and 19% under the Republican and Democratic Proposal, respectively, as displayed in Figure 2.

Such price changes cause shifts in energy production and consumption. Coal production falls precipitously by 2030 compared with the current policy scenario, by about 45% and 80% in the Republican and Democratic Proposals, respectively. Both proposals significantly accelerate the pace of deployment of renewable energy sources such as solar and wind; nuclear energy and carbon capture and storage technologies benefit from the carbon taxes as well. Both proposals cause US natural gas production to experience small increases in 2020 but small decreases below current policy levels by 2030. Neither proposal causes large changes in petroleum production or consumption by 2030.

Macroeconomic Impacts

A carbon tax leads to better economic outcomes than policies that focus on specific sectors, regions, or technologies because the carbon tax encourages low-cost emissions reductions and low-carbon innovation across the economy. Still, a carbon tax leads to higher prices throughout the economy, which adversely affects economic growth. Expenditures of the carbon tax revenues, however, push the economy in the opposite direction, putting more income in the pockets of Americans or providing them with additional government services. These offsetting effects, combined with the decreasing cost of clean energy, cause estimates of the macroeconomic effects of carbon tax to be relatively small.

Figure 3 displays projections of US gross domestic product (GDP) as an imperfect proxy for overall economic effects. The Democratic Proposal uses most revenue to reduce payroll taxes, which boosts the economy by encouraging work. Under that proposal, GDP is slightly lower than under the current policy scenario in the first year and slightly higher each year thereafter. Under the Republican Proposal, GDP is slightly lower than the current policy scenario. However, we note that the Republican Proposal's spending is in part to repair a declining transportation infrastructure system, and our current policy scenario does not factor in the economic impacts of that decline.

Impacts across the Income Distribution

A carbon tax is not an inherently regressive or progressive policy. Low-income households spend relatively large shares of their total expenditures on the products that are most affected by the carbon tax. Conversely, energy price increases also reduce the revenues of businesses, which is likely to disproportionately affect the wealthier households that own them, and many low-income households (particularly retirees) are shielded from energy price increases because payments they receive from Social Security and other government assistance programs increase with the price level.

The most important driver of impacts of a carbon tax across the income distribution is the use of the revenue: using carbon tax revenues for equal rebates creates a highly progressive policy (i.e., low- and middle-income households benefit more than high-income households), while using revenue for corporate income tax cuts creates a regressive policy.

The Democratic and Republican Proposals both lie between these extremes. With all revenues used to reduce payroll

taxes, the burden of a carbon tax is felt roughly proportionately across the income distribution, and the Democratic Proposal also sets aside at least $10 billion per year to compensate the most vulnerable Americans, including low-income households.

Similarly, the Republican Proposal sets aside 10% of revenues to support households at roughly the bottom quintile of the income distribution. Our analysis shows these payments alone (ignoring the remaining revenue use) are in the vast majority of cases more than sufficient to offset the adverse effects of the price increases for the households that receive them.

Conclusion

While the prospects for a federal carbon tax are unlikely today, there has been increased focus recently on advancing a carbon tax at both the federal and state level and on both sides of the aisle. This paper summarized major design decisions policymakers confront when considering a carbon tax and their implications on energy markets, emissions, and economic outcomes. Considerable additional detail can be found in the underlying reports available on CGEP's website. Various important implications were outside the scope of our analysis, such as the geographic distribution of policy impacts and ways to mitigate them.

1. Aldy, J.E., Krupnick, A.J., Newell, R.G., Parry, I.W., and Pizer, W.A. (2010). Designing climate mitigation policy. J. Econ. Lit. *48*, 903–934.

2. Kaufman, N., and Gordon, K. (2018). The energy, economic and emissions impacts of a Federal US carbon tax. Columbia SIPA Center on Global Energy Policy. https://energypolicy.columbia.edu/research/report/energy-economic-and-emissions-impacts-federal-us-carbon-tax.

3. Larsen, J., Mohan, S., Herndon, W., and Marsters, P. (2018). Energy and environmental implications of a carbon tax in the United States. Prepared by Rhodium Group for Columbia SIPA Center on Global Energy Policy. http://energypolicy.columbia.edu/our-work/topics/climate-change-environment/carbon-tax-research-initiative/carbon-tax-initiative-research.

4. Diamond, J., and Zodrow, G. (2018). The effects of carbon tax policies on the US economy and the welfare of households. Prepared by the Baker Institute for Public Policy at Rice University for Columbia SIPA Center on Global Energy Policy. http://energypolicy.columbia.edu/ourwork/topics/climatechange-environment/carbon-tax-researchinitiative/carbon-tax-initiative-research.

5. Rosenberg, J., Toder, E., and Lu, C. (2018). Distributional effects of taxing carbon. Prepared by the Tax Policy Center for Columbia SIPA Center on Global Energy Policy. http://energypolicy.columbia.edu/our-work/topics/climate-change-environment/carbon-tax-research-initiative/carbon-tax-initiative-research.

6. American Opportunity Carbon Fee Act of 2018. S. 2368. 115th Congress (2017-2018). https://www.congress.gov/bill/115th-congress/senate-bill/2368.

7. Market Choice Act. H.R. 6463. 115th Congress (2017-2018). https://www.congress.gov/bill/115th-congress/house-bill/6463.

8. Bordoff, J., and Larsen, J. (2018). US carbon tax design: options and implications. Columbia SIPA Center on Global Energy Policy. https://energypolicy.columbia.edu/research/report/us-carbon-tax-design-options-and-implications.

9. Kaufman, N., Larsen, J., Mohan, S., Herndon, W., Marsters, P., Diamond, J., and Zodrow, G. (2018). Emissions, energy, and economic implications of the Curbelo carbon tax proposal. Columbia SIPA Center on Global Energy Policy. https://energypolicy.columbia.edu/research/report/emissions-energy-and-economic-implications-curbelo-carbon-tax-proposal.

[1]SIPA Center on Global Energy Policy, Columbia University, New York, NY 10027, USA

*Correspondence: nk2792@sipa.columbia.edu

https://doi.org/10.1016/j.joule.2018.11.020

COMMENTARY

Hot Air Won't Fly: The New Climate Consensus That Carbon Pricing Isn't Cutting It

Jeffrey Ball[1,*]

Jeffrey Ball, a writer whose work focuses on energy and the environment, is the scholar-in-residence at Stanford University's Steyer-Taylor Center for Energy Policy and Finance and a lecturer at Stanford Law School. He

also is a nonresident senior fellow at the Brookings Institution. His writing has appeared in *Foreign Affairs*, *Fortune*, *Mother Jones*, *The Atlantic*, *New Republic*, *The New York Times*, and *The Wall Street Journal*, among other publications. Ball, previously *The Wall Street Journal*'s environment editor, focuses his Stanford research on improving the effectiveness of clean-energy investment, particularly in China.

In the history of climate change, 2018 will go down as a year when certain facts finally hit home, truths inconvenient for partisans on all sides. Those on the right, at least those who have been arguing that greenhouse-gas emissions aren't a significant problem, were forced to recognize that those emissions are causing real harm to real people right now. Those on the left, at least those who have put their faith in the promise of renewable energy to cool the planet, had to reckon with the reality that, even as those technologies boomed, carbon emissions continued to grow. And those across the political spectrum who had been calling for what seemed in theory a sensible climate policy—putting a price on carbon emissions—had to concede that their supposed solution isn't helping much at all.

No single event can be attributed to climate change, but scientists cite a