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Joseph Aldy
Harvard Kennedy School

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Designing and Updating a US Carbon Tax in an Uncertain World

Joseph E. Aldy
Harvard Kennedy School
Resources for the Future
National Bureau of Economic Research
Center for Strategic and International Studies

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Abstract

A carbon tax provides certainty about the price of emissions, but it does so in a context characterized by uncertainty about its environmental benefits, economic costs, and international relations implications. Given current knowledge, suppose that the government sets a carbon tax schedule. In the future, a higher (lower) carbon tax could be justified by the resolution of uncertainty along the following ways: climate change turns out to be worse (better) than current projections; the economic costs of a carbon tax are lower (higher) than expected; other major economies implement more (less) ambitious carbon mitigation programs. This paper describes the design of a predictable process for updating the carbon tax in light of new information. Under this “structured discretion” approach, every five years the president would recommend an adjustment to the carbon tax based on analyses by the Environmental Protection Agency, the Department of the Treasury, and the Department of State on the environmental, economic, and diplomatic dimensions of climate policy. Similar to the expedited, streamlined consideration of regulations under the Congressional Review Act and trade deals under trade promotion authority, Congress would vote up or down on the presidential recommendation for a carbon tax adjustment, without the prospect of filibuster or amendment. This process could be synchronized with the timing of updating of nationally determined contributions under the Paris Agreement in a manner to leverage greater emissions mitigation ambition by other countries in future pledging rounds. The communication of guiding information and the latest data and analysis could serve as “forward guidance” for carbon tax adjustments, akin to the Federal Reserve Board’s communication strategy.

Key words: carbon tax, nationally determined contributions, international environmental agreements, retrospective review

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1. Introduction

A carbon tax can provide clear, strong incentives for investment and consumption decisions that result in lower carbon dioxide emissions. One of the appeals of a carbon tax is that it delivers certainty about the carbon price, in contrast to conventional regulatory approaches or cap-and-trade programs (Aldy and Stavins 2012). The carbon price certainty translates into greater certainty about the returns to investments—developing a wind farm, buying a fuel-efficient car, living near mass transit, undertaking advanced battery research and development—which in turn can result in more, climate-friendly investment.¹

Designing an emissions mitigation program with a focus on price certainty, however, occurs in a policy context characterized by environmental, international relations, and economic uncertainties. With opportunities for learning over time that can reduce, or at least change, the uncertainties along these three dimensions, an effective mitigation program would permit an updating of the carbon price. Indeed, scholars have long advocated for an emissions mitigation strategy that incorporates learning and updating of the mitigation instruments (Manne and Richels 1992).

For example, if the risks posed by climate change appear greater than what previous scientific research had indicated, a more ambitious mitigation effort driven by a higher carbon tax would be merited. If other countries pursue more ambitious mitigation efforts, then reciprocating through a higher carbon tax could be called for. If the economic costs are lower or the distributional impacts less adverse than anticipated, then a higher tax could be

¹ For a general discussion about the role of uncertainty in investment, see Bernanke (1983) and Dixit and Pindyck (1994).

justified on political grounds.² Of course, new information going in the opposite direction of these three illustrations would suggest a lower carbon tax.

Policy updating occurs naturally under conventional regulatory approaches. Many statutes provide guidance to regulators on the periodicity of rulemaking as well as on the criteria for setting and revising standards. For example, Congress directed the Department of Energy to review minimum energy efficiency standards for appliances every six years under the 2007 Energy Independence and Security Act.³ Under this review process, the secretary of energy must either publish a notice indicating that no new standard is necessary or propose a new regulation for a new standard. In addition, the Clean Air Act requires a standard to reflect the extent to which emissions reduction technologies have “been adequately demonstrated,”⁴ which evolves over time as innovation progresses. As a result, many standards are set through a specified date, and the regulator has discretion to update the standard for compliance periods beyond the initial target date.

In contrast to the regulatory contexts in which Congress has delegated updating authority to regulators, Congress cannot delegate the setting of taxes to the executive branch. Congress may set a tax or a tax schedule to run through a specified date (e.g., a sunset provision) or indefinitely in a given bill. Congress may create a simple or complex schedule that the Department of Treasury would implement, such as setting income tax rates conditional on a taxpayer’s level of realized income or a carbon tax rate conditional on past carbon dioxide emissions (see discussion below). Any subsequent changes to that

² If the politics framing the initial creation of the carbon tax results in a tax rate less than the marginal benefit of abating carbon dioxide emissions, then a higher tax rate would be justified on economic grounds as well.

³ Energy Independence and Security Act of 2007, H.R. 6, Sec. 305(a), 110th Congress.

⁴ 42 U.S.C. 7411(a)(1).

tax schedule by the Department of the Treasury (aside from technical adjustments, such as for inflation) can occur only through new legislation. The uncertainty about the timing of legislative updates could have adverse economic, environmental, and diplomatic consequences. There could be long periods between updates because of congressional gridlock—such as the 13-year gap between the 1992 and 2005 energy bills—or potentially short periods because of change of control of the US Congress, such as the 2-year gap between the 2005 and 2007 energy bills.

The lack of predictability in the carbon price over time could undermine business and household planning and investment. This could increase the costs associated with a carbon tax and potentially reduce the environmental benefits (emissions abatement) for a given carbon tax if it is characterized by meaningful uncertainty. Moreover, uncertainty in the timing of updates may mean that the carbon tax does not adjust in response to new information and research about the environmental damages associated with climate change. Finally, idiosyncratic updates of the carbon tax could undermine a country's negotiating strategy in the international climate talks, especially in the periodic updating of national emissions mitigation pledges.

One approach to address these uncertainties would be to craft a carbon tax schedule in law that permits tax adjustments if specific conditions are realized. For example, Metcalf (2009) proposed a Responsive Emissions Autonomous Carbon Tax that would increase the growth rate in the carbon tax over time if US emissions fail to fall below specified benchmark targets. Hafstead et al. (2016) advanced this idea with their Tax Adjustment Mechanism for Policy Pre-Commitment, which would also modify the carbon tax rate in light of realized emissions performance. Likewise, Murray et al. (2016) discuss various

ways of increasing emissions certainty under a carbon tax, including through automatic tax rate adjustments given emissions outcomes. In my proposal, I take an alternative approach. Given the challenge in specifying the full suite of conditions that reflect all important elements of uncertainty in a tax schedule, I propose a structured discretionary approach instead of the rule-based approach in Metcalf (2009) and Hafstead et al. (2016). Although these are two distinct approaches to addressing uncertainty, they are not necessarily mutually exclusive. An adjustment schedule based on emissions could be coupled with the broader review and updating considered in this paper.

Before providing details about the updating proposal, let me offer a simple, illustrative carbon tax. Consider a tax that is established on the carbon content of fossil fuels, say \$X per metric ton of carbon dioxide. In addition, let us assume that tax will increase Y% plus a measure of inflation (say, the urban Consumer Price Index) each year. Several congressional bills introduced over the past three years take this form. For example, the Climate Protection and Justice Act of 2015 would set a “carbon pollution fee” of \$15 per metric ton of carbon dioxide in 2017 that increases a specified amount each year through 2035 and then 5% plus the rate of inflation annually thereafter.⁵ The Tax Pollution, Not Profits Act would set a carbon tax of \$30 per metric ton of carbon dioxide in 2016 that increases 4% plus the rate of inflation each year.⁶ The American Opportunity Carbon Fee Act sets a fee of \$42 per metric ton of carbon dioxide in 2015 that increases 2% plus the rate of inflation each year.⁷ For further details on the design of a carbon tax, refer to Aldy (2016b).

⁵ S. 2399, 114th Congress, Sec. 101.

⁶ H.R. 2202, 114th Congress, Sec. 2.

⁷ S. 1548, 113th Congress, Sec. 2.

To make concrete how a carbon tax could be updated, the next section describes a proposal for institutionalizing periodic review and updating of the carbon tax. Sections 3 through 5 elaborate how the review of climate science, international relations, and economics would inform the updating of the carbon tax. The next two sections address how such an approach can leverage greater emissions mitigation ambition by international partners under the Paris Agreement, provide greater predictability to the private sector, and ensure that the carbon tax mitigates the risks posed by climate change. The final section concludes.

2. The Proposal: Updating the Carbon Tax

The proposed carbon tax updating occurs in three steps: reporting, proposing a congressional resolution, and taking legislative action. For the purposes of illustration, let us assume that the consideration of carbon tax updating occurs on a five-year cycle.

To inform the American public and the policy debate over updating of the carbon tax, the US Environmental Protection Agency (EPA), Department of the Treasury, and Department of State would undertake analysis and submit reports to the Congress. The EPA report would focus on climate science, surveying the latest research, highlighting key uncertainties, and noting how the science has evolved since the carbon tax policy was last set. The Treasury report would focus on the carbon tax's economic costs and benefits (net social benefits as well as distributional impacts), its cost-effectiveness, the revenue implications of the carbon tax, and the effect of the tax on carbon dioxide emissions. The State Department report would focus on the emissions mitigation efforts in other countries, the plans of other nations to update their domestic mitigation programs, and progress

under the 2015 Paris Agreement. While each of these agencies would be the lead agency responsible for drafting and submitting its report to Congress, they would be expected to consult with and draw expertise from other government agencies in their assignments.

Based on the key findings in these reports, the president would submit a recommendation to Congress on whether and how to adjust the carbon tax. This recommendation would be constrained by (1) applying no earlier to the carbon tax schedule than five years in the future; and (2) applying to only the level of the tax rate (X), the annual percentage change (Y), or both. The recommendation would take the form of a resolution of Congress that would not be subject to amendment. Moreover, the statute authorizing the carbon tax and this updating process would specify the legislative mechanisms such that the updating resolution could come to the floor of each house of Congress without explicit action by congressional leadership or committees of jurisdiction. The authorizing statute could also specify the number of days by which the updating resolution must be subject to floor consideration. As a revenue-oriented piece of legislation, the resolution would need to originate in the House of Representatives. In the event that Congress votes down the resolution based on the president's proposal, then the status quo tax schedule would remain US law.

The statute authorizing this presidential recommendation would provide guidance on its frequency. Specifically, Congress could direct the executive branch to report on the findings and submit a resolution for proposed changes to the carbon tax on a schedule in line with the periodic review and updating of nations' emissions mitigation pledges (called

nationally determined contributions) under the Paris Agreement.⁸ This would result in a review and consideration of updates to the carbon tax every five years. The congressional guidance in the authorizing statute would also call on the president to recommend an updating proposal *before* the next round of emissions mitigation pledging in the climate change negotiations. In this case, the review of the carbon tax could be part of the broader review and updating of the United States' nationally determined contribution.

The president could request congressional consideration of the resolution *after* the most recent round of emissions mitigation pledging in the international climate talks. If the pledging round results in ambitious and comparable domestic mitigation contributions by other major parties to the negotiations, the president may offer a strong endorsement of the carbon tax updating proposal. If the pledging round results in less ambitious or noncomparable mitigation actions by other countries, then the president may suggest that Congress send a signal by voting down the proposal.

This approach to carbon tax updating would have several important analogues in existing regulatory, trade, and monetary policy. For example, the substantive reports from the executive branch to inform congressional action are the norm under the Congressional Review Act and trade promotion authority. Under the Congressional Review Act, agencies are required to submit the final rules and accompanying benefit-cost analysis for all "major" rules (typically based on surpassing an economic impact threshold). Members of Congress may review the rule and analysis before deciding whether to sponsor a resolution of disapproval that would effectively block the final rule from taking effect.

⁸ Article 4, Paragraph 9 of the Paris Agreement calls for parties to the agreement to communicate their national contributions every five years. <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>.

Under the Bipartisan Congressional Trade Priorities and Accountability Act of 2015,⁹ a number of reports to Congress are required in consideration of negotiated trade agreements. For example, in conjunction with the submission of a negotiated trade agreement for consideration by Congress, the president must also provide supporting information that explains and justifies the agreement in light of the trade policy objectives delineated by Congress in this statute. In addition, if the president requests a three-year extension of the trade authorities' procedures, then the president, the Advisory Committee for Trade Policy and Negotiations, and the International Trade Commission must submit reports to inform Congress in its oversight and consideration of whether to sponsor a resolution of disapproval.

To facilitate the predictability of these presidential recommendations, the law authorizing the carbon tax could also require EPA, Treasury, and State to issue principles for carbon tax adjustments and "forward guidance." These agencies would identify the data and analyses that they consult in formulating their recommendation to the president and, in periodic communications, would note how they are interpreting the evolving evidence. For example, if these agencies submit a major report every five years to accompany a presidential recommendation for a resolution, then they could also issue annual reports to inform the adjustment of expectations over time. Just as the Federal Reserve System's Federal Open Market Committee attempts to communicate its policy and the underlying evidentiary basis for its policy position so as to minimize surprises to the business and financial communities (Femia et al. 2013), these annual reports could permit firms to update expectations over the likely carbon tax proposal the president could make on the

⁹ Public Law 114-26.

five-year updating schedule. To guide the agency development of principles, Congress could also state key principles that the agencies should employ and, as necessary, elaborate. This would be akin to guidance on negotiating objectives in trade promotion authority legislation.

Constraining future legislative consideration of the carbon tax updating resolution is also analogous to how the Congressional Review Act and the Trade Act of 1974 constrain legislative consideration of regulations and trade deals. Under the Congressional Review Act, Congress may pass a disapproval resolution, which is based on a resolution template specified in the law, to preclude a regulation from taking effect.¹⁰ The disapproval resolution is time-limited, is not subject to amendment, and may be discharged out of committee without committee action. The law proscribes the use of the filibuster and limits the time for debate in the Senate. Since the mid-1970s, Congress has granted trade promotion authorities to the executive branch that allow for a trade deal to be automatically introduced through an implementing bill that would receive a vote on the floor of the Houses of Congress (Fergusson and Beth 2015). The most recent trade promotion authority law continues the use of the expedited process first authorized in the Trade Act of 1974, which requires a vote subject to a time limit, prohibits amendments to the proposed trade deal, and proscribes House Rules Committee and Senate filibuster options. In a similar way, a carbon tax statute could specify that the president's recommendation would automatically be introduced as implementing legislation based on a statutory template. The resolution would originate in the Ways and Means Committee of the House of Representatives, and just as in the case of the trade promotion authorities, the

¹⁰ 5 U.S.C. 802.

statute could specify the nature of the rules governing amendments, the need for committee discharge, the basis for floor consideration, the length of floor debate, and the potential role of the Senate filibuster.

The next three sections describe in greater detail the EPA, State, and Treasury reports that provide the basis for the presidential recommendation for updating the carbon tax and inform congressional deliberations of the updating proposal.

3. Incorporating and Communicating the Latest Insights from Climate Science

A carbon tax is intended to drive emissions reductions and mitigate the risks posed by climate change. While the effects of anthropogenic greenhouse gas emissions on the global climate are well understood in the relevant scientific disciplines, there are still important uncertainties about the timing, location, and severity of climate change impacts. As scientific research continues and the world warms in response to higher atmospheric concentrations of greenhouse gases, some of the uncertainties about climate change impacts will be resolved. Reviewing and synthesizing the latest insights from climate science can provide a key evidentiary basis for the carbon tax policy.

Learning about climate science could highlight whether the carbon tax and its trajectory under current law would be too high, too low, or about right. For example, if the innovations in climate science suggest that climate change is becoming worse than predicted based on our earlier understanding, then that would serve as the basis for calling for a higher carbon tax (or greater rate of annual increase). If climate research suggests the opposite, then it may motivate a decision for a lower carbon tax.

The review of climate science and impacts would also examine the efficacy and costs of adaptation. More effective adaptation efforts translate into lower climatic damages for a given amount of global warming. More extensive adaptation efforts also likely require greater resources. Characterizing adaptation response functions of individuals, firms, and governments may improve the understanding of and precision in estimating the benefits of emissions abatement under a carbon tax (Aldy 2015).

The review also provides an opportunity to communicate the climate change problem—and how government policy is addressing the problem—to the general public. This could take the form of a report to Congress, which is then disseminated to the public through a variety of channels. Interactive websites could illustrate the insights from the latest climate science in an accessible and geographically specific manner. Scientific experts from the federal government could brief stakeholders and representatives of state and local governments. Outreach via field hearings, social media, educational materials, and op-eds could further serve to communicate climate science to the public. This could build on previous and ongoing efforts by the National Academy of Sciences and the US Global Change Research Program.¹¹ Moreover, this outreach should examine ways of best communicating information to grassroots stakeholders and the lay public.

4. Assessing Other Countries' Mitigation Efforts

¹¹ For example, refer to the NAS America's Climate Choices report and related outreach: <https://www.nap.edu/catalog/12781/americas-climate-choices> and <https://nas-sites.org/americasclimatechoices/other-reports-on-climate-change/sample-page/panel-reports/americas-climate-choices-final-report/>.

The 2015 Paris Agreement, representing the consensus of virtually every nation in the world,¹² reflects the culmination of a six-year pivot toward a “pledge and review” regime in global climate policy. The key elements of the Paris Agreement reflect long-standing US interests: a respect for sovereignty in how each country pledges voluntary emissions mitigation contributions to the global effort to combat climate change and a focus on transparency in implementation to assess whether all major partners undertake comparable efforts. In contrast to all previous international agreements, more than 180 nations have pledged to reduce their greenhouse gas emissions under the Paris framework.

Success of international climate change policy under the Paris Agreement is premised on the theory of mutually reinforcing successive ambition: if a country takes a step forward in mitigating its emissions *and* if it observes its peers, neighbors, and trading partners taking similarly meaningful steps, then it would be that much more likely to take an even more ambitious second step on mitigation. The outcome in Paris has enshrined the pledged contributions of countries for that first step. The task going forward will center on ensuring that there is credible transparency concerning the actions of peers, neighbors, and trading partners to give countries the confidence—and to address the concerns of their domestic stakeholders and publics—that they are moving in lockstep with the rest of the international community. If the implementation of the Paris Agreement can achieve this dynamic over time, then it will succeed in delivering progressively more ambitious emissions mitigation in the effort to combat climate change (Aldy 2016a).

¹² North Korea is the only UN member that is not a party to the UN Framework Convention on Climate Change, the foundational treaty for the Paris Agreement.

The Paris Agreement calls for a transparency mechanism to provide information on countries' performance in delivering on their mitigation pledges. The poor track record on transparency in the international climate negotiations (Thompson 2006; Breidenich and Bodansky 2009; Aldy 2014a) suggests that the transparency regime may be “incomplete” for quite some time. As a result, individual countries as well as nongovernmental entities—academics, civil society, the business community—may play an important role in filling in the gaps of this regime. In particular, US stakeholders and the general public may prefer a more rigorous evaluation by the US government rather than an incomplete review through the UN Framework Convention on Climate Change.

Such a review could serve as the model for an effective transparency mechanism. This could include a framework for comparing the mitigation effort of other countries with the US carbon tax and related implementation of its emissions mitigation pledge (Aldy and Pizer 2016). The use of a carbon tax as the primary tool to deliver emissions mitigation in the United States would facilitate the use of explicit and estimated carbon prices as the basis for comparing the ambition of mitigation implementation efforts in other countries. This would also have important implications for considerations of any adverse competitiveness impacts of differential domestic mitigation programs among the United States' major trade partners.

Finally, the review of other countries' mitigation efforts could be forward-looking in its assessment of what other countries may be expected to do in their respective domestic mitigation programs. This could provide a reference point or even a benchmark for any adjustments to the carbon tax.

5. Evaluating the Impacts of Domestic Carbon Tax Policy

The majority of US national environmental policy operates through regulations. Under presidential executive orders dating back to the Reagan administration, regulatory impact analyses (RIA) accompany major rulemakings.¹³ For example, EPA published a draft RIA with the proposed rulemaking for the Clean Power Plan in 2014 and a final RIA with the final Clean Power Plan rule in 2015. These analyses show the impacts of the rule on the targeted environmental problem (e.g., carbon dioxide emissions) and quantify the benefits and costs of realizing this outcome. The RIAs can illustrate whether a regulation will correct a market failure, such as pollution, and improve social welfare (i.e., increase net social benefits). Some analyses also show the uncertainties around these estimates, as well as their distributional impacts.¹⁴ The draft RIAs provide an opportunity for public comment on the methods, assumptions, and data inputs. The development of the RIAs also informs both the regulator as it is designing the rule and other agencies with a stake in the matter who participate in the interagency review of the rule coordinated by the Office of Management and Budget (OMB).

In contrast, there is no analogous review of the economic impacts of tax policy.

Aside from revenue estimates undertaken by the Treasury Department and the Joint Committee on Taxation, the government does not systematically analyze the efficacy, costs,

¹³ In 1981, President Reagan issued Executive Order (EO) 12291 on Federal Regulation, which established the norm for the use of benefit-cost analysis as an input to regulatory decisionmaking (see <https://www.archives.gov/federal-register/codification/executive-order/12291.html>). In 1993, President Clinton issued Executive Order 12866 on Regulatory Planning and Review, which supersedes EO 12291 (see <https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf>). Administrations since 1993 have used EO 12866 to guide their analysis and review of executive branch agency regulations.

¹⁴ Refer to the Office of Management and Budget (OMB) Circular A-4, at https://www.whitehouse.gov/omb/circulars_a004_a-4, and the OMB primer on regulatory impact analysis, at https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf.

and benefits of a change in tax policy. Even if a tax policy is motivated by the need to correct a market failure, there are no assessments of the policy's net social benefits. While economists may view cap and trade and a carbon tax as very similar instruments to implement carbon pricing (Aldy et al. 2010), the nature of the analysis, review, and transparency that they trigger under current government practice differs dramatically.

Thus the envisioned evaluation of the impacts of domestic carbon tax policy by the Treasury Department in this proposal would attempt to replicate the regulatory impact analysis typically associated with a rulemaking. Moreover, the evaluation of carbon tax policy performance would be akin to retrospective review of regulations—a process of ex post assessment of rules that has occurred idiosyncratically since the 1970s (Aldy 2014b). The review and analysis by Treasury could simultaneously serve as an ex post review of the carbon tax to date and an ex ante analysis of various alternatives for the carbon tax going forward, including the option of the carbon tax under current law. The Treasury analysis could follow the procedures that OMB recommends to agencies for the conduct of regulatory impact analyses under Circular A-4.¹⁵ Indeed, the norm for reports to Congress is for OMB to conduct an interagency review of the report, so this would be consistent with current practice.¹⁶

This proposal creates an approach to analysis and transparency of the impacts of a carbon tax relative that is parallel to what would occur under cap and trade or any other regulatory approach. Doing so, however, creates a distinction in analysis of this carbon tax instrument and other tax instruments. There could be a concern that imposing such

¹⁵ Refer to https://www.whitehouse.gov/omb/circulars_a004_a-4.

¹⁶ It should be noted that typically different parts of OMB coordinate the review of regulatory proposals and review of reports to Congress.

analytic requirements on a carbon tax, but not on other nonclimate tax provisions and revenue raisers, could place an undue burden on the carbon tax. While it is beyond the scope of this paper, the public and our democratic processes could benefit from a more transparent assessment of various tax provisions, especially those that target market failures and act as alternatives to regulatory approaches in correcting market failures.

The outputs from the Treasury analysis could inform the work of the State Department by providing key data inputs as State compares US mitigation efforts under the carbon tax with the mitigation efforts under other countries' domestic programs. Moreover, the Treasury work could feed into the multilateral transparency mechanism under the Paris Agreement and illustrate best-practice methods for reviewing and reporting on domestic climate policies.

6. Leveraging Greater Emissions Mitigation

Under the 2015 Paris Agreement, countries have pledged emissions mitigation goals through 2025 or 2030 and agreed to a process of reviewing and updating their pledges every five years. The process of reviewing and updating the domestic carbon tax could serve as a key component of a nation's consideration of an updated mitigation contribution. Moreover, the design of a carbon tax updating process in the United States would, by necessity, require congressional action. Integrating the constraints of domestic policy-making and politics on US participation in international negotiations could strengthen the US negotiating position (Putnam 1988).

This creates an opportunity for leveraging greater ambition by other countries. For example, the executive branch could propose a carbon tax before the next UNFCCC

pledging round but request congressional action be taken only *after* that round. If other countries pledge sufficiently ambitious mitigation contributions, then this could reassure domestic stakeholders and policymakers about the seriousness of our partners' efforts and intentions. In this case, the executive branch would advocate for support of the resolution to update the carbon tax. If others' pledges are weak and not comparable to the US pledge, then the executive branch could request the rejection of the resolution.

In the long term, such an approach could enable convergence in carbon pricing if the United States (and perhaps a few other major parties to the negotiations) focuses on the price of carbon as the standard for measuring and comparing mitigation ambition. Transparency and review of how the United States and other carbon tax countries increase their domestic price of carbon would serve as evidence of these countries ramping up their ambition. In addition, such carbon price convergence could square with how a price-oriented approach to mitigation contributions could enable broader and more robust international coordination (Cooper 2010; Weitzman 2015).

7. Promoting Predictable Carbon Pricing Policy

Ensuring a predictable carbon tax policy plays an important role in driving technological development and deployment. Firms will make better investment decisions, families and individuals will make plans that best suit their preferences, and innovators will focus efforts on carbon-oriented inventions when they can form expectations about how a climate policy will impact the quality, variation, and prices of goods and services. A predictable climate policy can increase the likelihood that their expectations are in line

with what is subsequently realized in markets. Moreover, a predictable policy is more likely to endure politically, since it is typically the surprises that motivate calls for policy reform.

This need for predictability suggests two elements of carbon tax design. First, a carbon tax should be designed so that the tax is known for many years into the future. As in past congressional bills, this could take the form of setting the tax in the first year, and then establishing an annual percentage change to the tax that applies in perpetuity or until changed by a future Congress. This differs from cap-and-trade and command-and-control regulations, in which prices are not known with certainty, and historical experience shows dramatic cap-and-trade allowance price volatility (Aldy and Viscusi 2014).

Second, a durable carbon tax should nonetheless be adjusted in light of new information. As the science of climate change risks improves, as we learn more about the costs of reducing greenhouse gas emissions, and as the United States continues to cooperate with other countries in international climate policy, there may be reasons to adjust the carbon tax. For example, if scientific research suggests that adverse climate change impacts are likely to be more severe than previously believed, then a higher carbon tax could be justified. If the costs to the economy of reducing emissions are greater than initially anticipated, then a lower carbon tax could be justified. If the rest of the global community implements ambitious emissions mitigation programs, then the United States could reciprocate by ramping up its carbon tax. Explicitly establishing these conditions as the basis for updating the carbon tax could ensure the predictability of US carbon tax policy.

8. Conclusions

A carbon tax provides a clear, predictable price signal to businesses and households. Nonetheless, the uncertainties that characterize the climate change problem suggest that the initial carbon tax level and trajectory may not be appropriate as more information is acquired about the impacts of climate change, the efforts of other countries to tackle climate change, and the domestic economic impacts of the carbon tax.

The primary objective of a carbon tax is to drive emissions abatement in order to mitigate climate change risks. The global nature of the problem, however, requires emissions reduction efforts around the world. Structuring the US climate change policy program in the way described above can both send the necessary price signals throughout the economy to reduce US carbon dioxide emissions and create the incentives to leverage meaningful mitigation efforts by other countries. Moreover, the updating of the carbon tax to account for advances in our understanding of climate change ensures that a tax rate is set that is appropriate to the challenge. This approach provides the opportunity—and creates the transparency and associated accountability—for the government to update the carbon tax based on the evidence.

The reporting process called for in this proposal provides regular opportunities for public engagement on the setting and updating of the US carbon tax. Each report could tap into expertise in other federal agencies, and a standard OMB coordinated interagency review of the report could also enable experts on the climate science, international relations, and economic impacts to weigh in with their contributions. Moreover, the government could issue draft reports—such as what OMB does with its annual report to Congress on the benefits and costs of government regulations—and solicit formal peer review by nongovernmental experts, as well as feedback from the public.

This approach to reviewing and updating the carbon tax could likewise inform a policy updating process exclusive to the executive branch. For example, the Managed Carbon Price Act of 2014 envisioned a “permit fee” that would apply to carbon dioxide emissions.¹⁷ This permit fee would be periodically updated under the bill. It would be straightforward to formalize the EPA, State, and Treasury reviews envisioned here as a part of the permit fee updating process.

This structured discretionary approach could complement or substitute for a rules-based approach to addressing uncertainty, such as the Metcalf (2009) and Hafstead et al. (2016) proposals. The rules-based approaches have the appeal of implementing automatic adjustments in response to new information, such as the failure of national emissions to meet a specified emissions goal. The limitation of rules-based approaches, however, is that they cannot address all types of uncertainty. For example, the adjustments envisioned in Hafstead et al. would address downside uncertainty in the mitigation response to a given carbon tax. These adjustments would not reflect fundamental changes in climate science and climate change damages. In theory, one could expand the dimensions of the carbon tax schedule to account for additional types of uncertainty, but such complexity risks complicating and undermining the administrative simplicity and predictability of a carbon tax. Given the fundamental problem of uncertainty, it is impossible for a policymaker to imagine all possible states of the world that we could realize in the future and establish conditional tax rates for each of these possibilities. A structured discretionary approach could be more flexible to address various types of uncertainty and to do so on a predictable schedule. Since the structured discretionary approach depends on a recommendation of

¹⁷ H.R. 4754, 113th Congress.

the president and affirmative action by each chamber of Congress, various political factors could influence the evolution of the carbon tax beyond simply the fundamentals reviewed in the EPA, Treasury, and State reports to Congress. A reluctant president or Congress could opt against raising the tax rate (level or annual growth rate), even if this would occur in the presence of a rules-based approach.

This updating proposal aims to balance the predictability of the carbon price with the need to account for new information on the impacts of climate policy. Given the considerable uncertainties about the severity and timing of the risks posed by climate change, the economic impacts of a carbon tax, and the efforts by other countries in mitigating their emissions, policymakers and the public will want to adjust climate policy as these uncertainties are resolved (at least partially). Structuring the discretion through the scheduled reporting and presidential recommendation process can ensure that businesses and households can anticipate and credibly predict the evolution of US carbon tax policy.

References

Aldy, Joseph E. 2014a. The Crucial Role of Policy Surveillance in International Climate Policy. *Climatic Change* 126 (3–4): 279–92.

Aldy, Joseph E. 2014b. Learning from Experience: An Assessment of the Retrospective Reviews of Agency Rules and the Evidence for Improving the Design and Implementation of Regulatory Policy. Report commissioned by the Administrative Conference of the United States. October 17 Draft.

www.acus.gov/sites/default/files/documents/Aldy%2520Retro%2520Review%2520Draft%252011-17-2014.pdf.

Aldy, Joseph E. 2015. Pricing Climate Risk Mitigation. *Nature Climate Change* 5: 396–98.

Aldy, Joseph E. 2016a. Living Mitigation Plans: The Co-evolution of Mitigation Pledge and Review. Harvard Project on Climate Agreements. Discussion Paper ES 16-05. October. http://belfercenter.ksg.harvard.edu/files/es-05_aldy2.pdf.

Aldy, Joseph E. 2016b. Long-Term Carbon Policy: The Great Swap. Report prepared for the Progressive Policy Institute. November. <http://www.progressivepolicy.org/wp-content/uploads/2016/11/The-Great-Swap-1.pdf>.

Aldy, Joseph E., Alan J. Krupnick, Richard G. Newell, Ian W. H. Parry, and William A. Pizer. 2010. Designing Climate Mitigation Policy. *Journal of Economic Literature* 48 (4): 903–34.

Aldy, Joseph E., and William A. Pizer. 2016. Alternative Metrics for Comparing Domestic Climate Change Mitigation Efforts and the Emerging International Climate Policy Architecture. *Review of Environmental Economics and Policy* 10: 3–24.

Aldy, Joseph E., and Robert N. Stavins. 2012. Using the Market to Address Climate Change: Insights from Theory and Experience. *Daedalus* 141 (2): 45–60.

Aldy, Joseph E., and W. Kip Viscusi. 2014. Environmental Risk and Uncertainty. In *Handbook of the Economics of Risk and Uncertainty*, vol. 1, edited by M. J. Machina and W. K. Viscusi, eds., 601–49. Oxford, UK: Elsevier.

Bernanke, Ben S. 1983. Irreversibility, Uncertainty, and Cyclical Investment. *Quarterly Journal of Economics* 98 (1): 85–106.

Breidenich, Clare, and Daniel Bodansky. 2009. Measurement, Reporting and Verification in a Post-2012 Climate Agreement. Pew Center on Global Climate Change Report, April. Arlington, VA: Pew Center.

Cooper, Richard N. 2010. The Case for Charges on Greenhouse Gases. In *Post-Kyoto International Climate Policy: Implementing Architectures for Agreement*, edited by J. E. Aldy and R. N. Stavins, 151–78. Cambridge: Cambridge University Press.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty*. Princeton, NJ: Princeton University Press.

Femia, Katherine, Steven Friedman, and Brian Sack. 2013. The Effects of Policy Guidance on Perceptions of the Fed's Reaction Function. Federal Reserve Bank of New York Staff Report no. 652. November.
http://www.lexissecuritiesmosaic.com/gateway/FEDRES/SPEECHES/staff_reports_sr652.pdf.

Fergusson, Ian F., and Richard S. Beth. 2015. Trade Promotion Authority (TPA): Frequently Asked Questions. Congressional Research Service Report R43491. July 2.
<https://fas.org/sgp/crs/misc/R43491.pdf>.

Hafstead, Marc, Gilbert E. Metcalf, and Robertson C. Williams III. 2016. Adding Quantity Certainty to a Carbon Tax: The Role of a Tax Adjustment Mechanism for Policy Pre-Commitment. Discussion paper 16-43. Washington, DC: Resources for the Future.

Manne, Alan S., and Richard G. Richels. 1992. *Buying Greenhouse Insurance: The Economic Costs of Carbon Dioxide Emission Limits*. Cambridge, MA: MIT Press.

Metcalf, Gilbert E. 2009. Cost Containment in Climate Change Policy: Alternative Approaches to Mitigating Price Volatility. *Virginia Tax Review* 29: 381–405.

Murray, Brian, William A. Pizer, and Christina Reichert. 2016. Increasing Emissions Certainty under a Carbon Tax. Nicholas Institution for Environmental Policy Solutions Policy Brief 16-03. Duke University. October.
<https://nicholasinstitute.duke.edu/climate/publications/increasing-emissions-certainty-under-carbon-tax>.

Putnam, Robert D. 1988. Diplomacy and Domestic Politics: The Logic of Two-Level Games. *International Organization* 42 (3): 427–60.

Thompson, Alexander. 2006. Management under Anarchy: The International Politics of Climate Change. *Climatic Change* 78: 7–29.

Weitzman, Martin L. 2015. Internalizing the Climate Externality: Can a Uniform Price Commitment Help? *Economics of Energy and Environmental Policy* 4 (2): 37–50.