Pro-Growth Carbon Tax: A Catalyst for Regulatory and Tax Reform

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Executive Summary

- The United States faces a **fundamental policy choice** if it is to transition to a clean-energy economy. One path—the one we are currently on—is regulatory. This path is costly, complex and inefficient, with widely differing mandates by sector and across federal, state, and local levels.

- The alternative path would be **market-based**, relying on the principle that the most efficient approach places an economy-wide price on carbon emissions but allows economic actors the freedom to decide how to respond to that price. The simplest way to do this, a carbon tax, **provides incentives** for businesses and consumers to find the least-cost way to reduce carbon emissions. The tax leads businesses to innovate, use cleaner energy sources, and invest in more carbon-efficient production techniques, and it provides an incentive for households to conserve on their consumption of goods and services broadly in relation to those items' carbon-intensiveness.

- The market-oriented approach would **make unnecessary the more costly regulatory approach to addressing climate change** advanced by the Obama administration, including the proposed power plant regulations put on hold by the Supreme Court.

- A carbon tax could be levied at an upstream stage of the production process, generally where energy enters the economy. This would be highly **administratively efficient**, with approximately 80% of U.S. emissions covered by collecting the tax from a relatively small number of sources, around 2,300. Close to 90% coverage can be achieved at an acceptable cost by levying the tax on approximately 6,000 sources.

- The carbon tax would be levied per ton of CO_2-equivalent, with the tax per ton set into the future, typically rising over time on a specified path (though there could be periodic adjustments, over a long time cycle, for changes in science or economics). This would **provide more certainty for businesses** to adapt their activities to the new regime and spur innovation such as carbon-reducing technologies.

- The experience of carbon taxes and similar approaches in other countries, supported by economic research, suggests that a carbon tax would make a meaningful and, arguably, appropriate contribution toward reducing U.S. carbon emissions and accelerating the transition to a clean energy economy at a lower cost to society than through complex regulations.

- Adding trade rules in conjunction with a U.S. carbon tax could **help accelerate the needed movement by other nations** to develop their own carbon pricing mechanisms, in a way that regulations cannot. Such trade rules would also **allow U.S. firms to compete on a level playing field** against firms in countries that do not have a carbon tax or other restrictions on carbon emissions.

- The revenue generated by the carbon tax **could also be the key to unlocking pro-growth tax reform**. Under most proposals, a carbon tax would generate around $100 billion per year in the first decade and more in subsequent years. This could allow for a reduction in the corporate tax rate that would offset all or most of the impact of the carbon tax on GDP. Indeed, many studies find that the economic benefits of tax reform outweigh the impacts of the carbon tax, resulting in a net increase in overall income.

- Using a relatively small share of the tax revenue to help offset the impacts on lower-income families and on affected regions such as coal communities could be done while still leaving sufficient resources to allow for meaningful pro-growth tax reform.

The Choices We Face

The United States faces a fundamental policy choice if it is to transition to a clean-energy and low-carbon economy. The current path attempts to achieve this transition through complex and costly regulatory mandates and subsidies. The existing, proposed, and expected command-and-control regulations are inflexible and costlier than the market-friendly carbon tax, even while falling short of the Obama administration's own climate goals.

An alternative approach is to place a price on carbon emissions and allow economic actors the freedom to decide how to respond to the price. The simplest way to do this is through a carbon tax, which is a market-friendly approach that provides incentives for businesses and consumers to find the least-cost way to reduce carbon emissions. The tax leads businesses to innovate, use cleaner energy sources, and invest in more carbon-efficient production techniques, and it provides an incentive for consumers to conserve on the consumption of goods and services broadly in relation to their carbon-intensiveness. This market-oriented approach would make unnecessary the more costly regulatory approach to addressing climate change advanced by the Obama administration, including the proposed power plant regulations put on hold by the Supreme Court.

The carbon tax answers the policy challenge to find the least-costly way to reduce greenhouse gases emissions; that is, to devise policies that give the most emission reduction "bang" for the economic "buck." In many ways, the policy choice resembles the debate of earlier days between whether a free-market economy or a command economy offers the best prospects for economic prosperity. The free market relies on the price system to convey information about supply and demand, and for consumers and producers to respond accordingly. Both economic theory and the historical experience of the 20th century indicate that this diffusion of information through market prices—and the decentralized response that occurs through the economic transactions across the vast market—leads to more efficient outcomes than central planning in which a select few attempt to control the allocation of resources.

The free-market system falls short, however, when a voluntary transaction between two parties involves a negative spillover onto a third party, such as what happens when the use of energy causes greenhouse gas emissions that harm the broader population. This is known as the problem of an externality, and at its heart is a problem of a lack of property rights. If someone *owned* the right to the clean air, then any market transaction that resulted in polluting the air would require the owner's consent, which would be granted only if the polluter paid compensation for the damage. This compensation would establish a price for the use of the clean air, and the free-market system could account for the harm caused by greenhouse gas emissions.

The cost-effective way of addressing such a negative externality is by establishing a price to reflect the cost of emitting greenhouse gases (that is, of using the clean air), in the form of a tax on pollution. This provides a mechanism under which businesses and families decide how best to respond to economic incentives, with the price signal ensuring that all market participants consider the cost of their emissions in making their decisions. Goods and services that are produced with relatively high amounts of carbon emissions or activities that generate relatively large carbon emissions would face a larger carbon tax than other activities and production processes that involve less carbon. Businesses would include the cost of pollution in their plans for production, and consumer purchases would be based on prices that account for the pollution impact. This decentralized, market-friendly approach harnesses the benefits of an open economy grounded in property rights, providing incentives for innovation and conservation in order to transition to a clean-energy economy.

There is ample evidence that consumers and businesses adjust their energy use in response to price changes. Lutz (2008) concludes from a survey of the literature that a 10 percent increase in energy prices leads to a 4.5 percent reduction in energy demand, with the strongest responses for gasoline, heating oil, and coal. Metcalf (2007) finds a negative correlation between gasoline prices and use across 27 developed countries, implying that gasoline consumption would decline in response to higher prices. Small and Van Dender (2007) estimate that a 10 percent increase in the price of gasoline decreases gasoline demand by over three percent over time.

A price signal also encourages private sector innovation and capital investment, including the development of new technologies for clean energy and conservation, and could provide an incentive for other technologies such as carbon sequestration. The long time horizon over which these decisions are made highlights the importance of a stable and transparent framework—something achievable with a carbon tax but not through the regulatory approach—under which businesses and households understand the future path of the carbon price. Popp, Newell, and Jaffe (2010) review the research literature on the relationship between innovation and energy or environmental regulations, finding that higher energy prices lead to increased innovation as measured by patent activity—they conclude that "over one-half of the full effect of an energy price increase on patenting will have been experienced after just five years." Popp (2006) and Johnstone, Hascic, and Popp (2008) likewise find that taxes and other market-oriented measures to decrease pollution brought about statistically significant increases in patent activity for renewable energy. Newell, Jaffe, and Stavins (1999) find that rising energy prices starting in the early 1970s led to technological change that brought about significant improvements in the efficiency of air conditioning and water heating through the 1990s. Popp (2010) notes that the global diffusion of climate-oriented technological innovation is vital for allowing lower-income countries to transition to clean-energy economies. A carbon tax in the United States would thus drive innovation that eventually will help all countries adapt clean energy sources.

The market-friendly approach of a price signal through a carbon tax contrasts with the approach taken by U.S. policy to date of reducing emissions through inflexible regulatory mandates and targeted subsidies such as loan guarantees that favor particular firms and technologies. Mandates are a costlier approach than a price signal because they limit the flexibility by which consumers and businesses can determine the lowest-cost way to reduce emissions. Mandates include government-prescribed minimum energy efficiency standards for vehicles, appliances, and light bulbs, or government requirements that transportation fuels contain minimum amounts of renewable fuels. These requirements reduce consumers' and businesses' choices. The carbon tax instead ensures that people take into account the social costs imposed by greenhouse gas emissions but lets them choose how to adjust their activities rather than having the government decide.

Indeed, policies such as mandates and targeted subsidies rely on the view that government decision-making is superior to the decentralized decision-making of market mechanisms. With targeted subsidies, government officials determine the best environmental use for each tax dollar. Given the diverse and ever-changing number of decisions involved with energy use, the decentralized approach of raising the market price for pollution-intensive activities and allowing market actors to adjust accordingly is much more cost-effective than having the government pick supposedly promising cleaner energy alternatives—especially when this choice inevitably is influenced by special-interest politics. Moreover, limits on firms' flexibility, such as forcing firms to use particular technologies favored by regulators rather than devising their own most cost-effective response, will impose additional costs compared to a carbon tax.

A policy that sets an economy-wide price on greenhouse gas emissions would take the form of a charge, or simple excise tax, on the carbon content of fossil fuels combusted in the United States and on select other sources of greenhouse gas emissions. (We will henceforth refer to this charge as a carbon tax, with the rate applied per ton of carbon dioxide-equivalents, or CO_2e.) The tax would lead to higher prices for carbon-intensive goods and services (in particular, relative to the prices of goods and services that use carbon less intensively), and consequently to changes in the composition and amounts of energy production and consumption. These changes in turn would affect longer-term decisions regarding investment and innovation, spurring the transition to a clean-energy economy. The existence of a carbon tax also would make many regulatory policies such as mandates and subsidies redundant. A carbon tax could therefore be coupled with broader regulatory reform to eliminate or reduce existing costly regulations and subsidies that are largely superseded by a carbon tax. A carbon tax is thus both more cost-effective than the current approach of command-and-control government regulations and targeted government subsidies and would allow these relatively costly policies to be removed while more efficiently transitioning the United States to a cleaner-energy economy.

Even though a carbon tax is a more cost-effective way to foster a transition to a clean energy economy than current policies, a carbon tax by itself would still impose an economic cost as the tax leads to higher prices for carbon-intensive goods and services. But the revenue from a carbon tax offers an opportunity to enact tax reform to improve U.S. economic growth, reducing the overall cost of the carbon tax and possibly more than fully offsetting it to end up with a net increase in societal income. Our current tax system is economically harmful, complex, and unpredictable. A carbon tax would allow progress to be made on a reform to make the U.S. tax system simpler and more pro-growth.

In particular, the corporate income tax entails a large negative impact on economic growth because it imposes an especially high tax burden on saving and investment. This reduces capital formation, which in turn hinders worker productivity and thus over time acts as a drag on wages and incomes. According to the Organization for Economic Co-operation and Development (2008), "corporate income taxes appear to have a particularly negative impact on GDP per capita." The concern is particularly acute in the United States, which has the highest statutory corporate tax rate in the developed world.

Using the revenue from a carbon tax to offset the revenue loss from lower U.S. corporate tax rates would spur investment and thus growth and job creation. A range of research finds that these positive effects of tax reform could exceed the negative impact of the new carbon tax on economic activity, but at the least would offset a meaningful part of the impact. Parry and Williams (2011), Rausch and Reilly (2012), McKibbin et al. (2012), and Jorgenson et. al. (2015) find that the corporate tax reform could offset all of the GDP impacts of the carbon tax or actually increase economic output—a result driven by a finding that taxes on capital income have a considerable impact in reducing saving and investment. Dinan and Lim Rogers (2002) find that a carbon tax that uses the revenues to reduce corporate tax rates offsets about 60 percent of the cost of reducing carbon emissions, making the remaining net impact less than half a percentage point of GDP per year. While estimates vary on the precise impact of a lower corporate tax on output, there is a strong consensus in the research literature of a meaningful impact.

Using carbon tax revenues to reduce corporate tax rates presents a distributional challenge, however, since the burden of the carbon tax would fall disproportionately on low-income households for whom energy represents a relatively large part of their spending (such as on gasoline) while the reduction of the corporate tax rate would especially benefit those with relatively high incomes, at least in the short run. One response would be to devote some of the revenue from the carbon tax to address the disparity rather than using all of the revenue to reduce the corporate tax. Economic research such as Mathur and Morris (2014a and b) suggests that using 11 percent of the revenue generated by the carbon tax as income support for low-income households would offset the adverse impacts on the bottom 20 percent of families, and 18 percent would be enough to protect the bottom thirty percent of families. This gives rise to the familiar tradeoff between equity and efficiency, since using carbon tax revenues to address distributional concerns would allow for less progress in offsetting the growth-reducing impacts of the carbon tax.

Alternatively, tax reform could also involve changes to taxes other than the corporate tax rate, including lowering income tax rates or payroll taxes. These other tax reforms generally would have distributional outcomes in which more of the gains from the tax reform go to middle- and lower-income households, but with the tradeoff of providing a smaller positive impact on economic growth and job creation and thus a much smaller offset to the economic drag from the carbon tax.

Regulatory and Tax Reform

Reducing or eliminating other carbon-related regulations and subsidies

A carbon tax coupled with comprehensive regulatory reform would improve the economic efficiency of a climate plan by reducing or eliminating costly regulations and subsidies that, while well-intended, are superseded by a carbon tax. The existing, proposed, and expected command-and-control regulations are inflexible and thus costlier than the market-friendly carbon tax, even while falling short of the Obama administration's own climate goals. The use of a carbon tax would make it possible to transition to a clean-energy economy without the need for further burdensome regulations.

There are two broad categories of command-and-control environmental regulations. The first is known as a technology standard, in which the government prescribes a particular pollution-reduction technology, leaving companies little or no latitude in how to achieve the desired pollution reduction and therefore little incentive to find innovative ways to reduce emissions. A somewhat less restrictive type of command-and-control regulation is known as a performance standard, in which the government prescribes a particular maximum emissions rate such as a maximum amount of pollution allowed per unit of production. A performance standard based on emissions per unit of output is inefficient because firms cannot meet the standard of reduced emissions by decreasing production of the regulated items. This sort of inflexible regulation is avoided by a carbon tax.

Recent years have seen the proliferation of a particular form of emission rate regulation known as energy-efficiency mandates that involve government-prescribed minimum energy efficiency standards for such things as vehicles, appliances, and light bulbs. Efficiency mandates reduce the choices to consumers and businesses, and result in higher costs while doing little to reduce carbon emissions. The failure to achieve the emissions goal is in part because these mandates provide an incentive to retain older, less energy-efficient, products and use them more intensively—e.g. the mandate increases the cost of new appliances, so the old ones are left in place, increasing emissions. Efficiency mandates also fail to provide an incentive to conserve; indeed, there is some evidence—known as the rebound effect—that people use products more when they become more energy efficient. To justify these cost-ineffective standards, government agencies claim that they are needed to address irrational actions by consumers and businesses, who they purport are making incorrect purchasing decisions. In addition to promoting policies that are less cost-effective than a market-based approach such as a carbon tax, this reasoning allows agencies to justify regulations on the unsubstantiated premise that consumers and businesses (but not regulators) are irrational and must have their choices constrained by the expansive use of regulatory powers. A carbon tax addresses climate change and fosters a shift to a clean energy economy while allowing consumers and businesses to make their own decisions.

U.S. energy policy in recent years has also focused on targeted government subsidies for certain clean energy producers such as makers of solar panels, wind turbines, or batteries. Such subsidies must be financed by higher taxes, levied either now or in the future. Unlike the market-based approach of a carbon tax in which the price provides an incentive for market actors to innovate and conserve, targeted subsidies rely on the ability of government officials to determine the best environmental use for tax dollars. The centralized approach of having the government pick winning and losing technologies—a decision inevitably influenced by politics—is ill-suited to the diverse and ever-changing number of decisions involved with energy use.

The unnecessarily costly regulatory approach to climate change is exemplified in the Obama administration's proposed rulemaking to regulate carbon emissions from power plants under the Clean Air Act. These regulations, recently put on hold by the Supreme Court, would result in a plethora of state-specific mandates and regulations with significantly higher costs than under a carbon tax. The sector-by-sector approach proposed by the Obama administration—i.e., one set of regulations for power plants, another for transportation, etc.—likewise would mean much higher costs than the comprehensive approach of a uniform carbon tax. The proposed power plant rule, for example, aims to reduce emissions from power plants by 30 percent from

2005 levels (or about 20 percent from today's levels). But this translates into only a 6 percent reduction in overall emissions from current levels—far short of the administration's own goal of reducing overall emissions by 26 to 28 percent from 2005 levels by 2025. Using a carbon tax instead could achieve the overall goal without the welter of costly and disruptive existing and prospective regulatory actions.

A market-based approach to achieve a clean energy future would combine a carbon tax with a revocation, or at least a suspension, of the proposed Clean Air Act regulations covering greenhouse gases (with the suspension intended to remain in place until the efficacy of the tax is demonstrated, after which the regulations would be revoked). A host of other regulations could be eliminated or scaled back with the passage of a carbon tax. For example, a carbon tax would increase the price of electricity to reflect the external costs of its use, so there would be no need for restrictive mandates to increase the energy efficiency of products such as dryers, dishwashers, air conditioners, refrigerators, and light bulbs. The contribution of these items to climate change would be reflected in their prices, leading firms and consumers to adjust production and purchases. The carbon tax rather than government mandates would give the appropriate incentive for energy efficiency.

Similarly, a carbon tax would raise the price of gasoline, providing an incentive for the use of energy-efficient vehicles and for less driving. This would remove the rationale for corporate average fuel economy (CAFE) standards and for the renewable fuel standard (RFS) which requires renewable fuels to be blended into gasoline and provides a perverse incentive for energy-inefficient and environmentally-unfriendly corn ethanol. A carbon tax further provides incentives for the private sector to develop and use cost-effective technologies to reduce emissions, eliminating the need for subsidies for existing and near-commercial clean-energy technologies. According to Morris (2013), reducing or eliminating programs such as the renewable electricity production credit, tax credits for investment in advanced energy, tax preferences for nuclear energy, and other energy tax credits would result in annual savings of approximately $6 billion for the government. Again, the transition to a clean energy economy and the climate goal would be achieved by the carbon tax rather than government imposing mandates that effectively choose particular technologies or firms. With the carbon tax, the market would figure out the best way to move to a clean energy economy and address climate change rather than relying on the decisions of politicians or bureaucrats.

Carbon tax revenue and tax reform

The amount of tax revenue raised from a carbon tax depends on the sources and pollutants covered by the tax, the initial tax rate and annual increase in the tax rate, and other factors such as global energy prices. Any estimate of tax revenues from a carbon tax must rely on estimates of the responsiveness of market participants to the ensuing higher prices. Table 1 provides estimates from recent evaluations of different carbon tax policies, indicating that revenues over the first ten years can be expected to range from $1.2 to $1.5 trillion.

Table 1: Carbon Tax Revenue Estimates

Study	Tax Rate ($/tCO2e)	Annual Increase in Rate	Revenue in 1st Year	Revenue in 1st Ten Years
McKibbin et al. (2012)	$15	4 percent	$80 billion	$1.1 trillion
Metcalf (2007)	$15	4 percent	$90-100 billion	N/A
Congressional Budget Office (2011)	$20	5.6 percent	$88 billion	$1.2 trillion
Rausch and Reilly (2012)	$20	4 percent	$117 billion	$1.5 trillion
Bipartisan Pollicy Center (2010)	$23	5.8 percent	N/A	$1.1 trillion (7 years)
Jorgenson et al. (2015)	$50	5 percent	N/A	$3.5 trillion

In 2011, the Congressional Budget Office (CBO) estimated the expected tax revenue from a carbon price that started at $20 per ton of CO_2e in 2012 and increased 5.6 percent annually. (The CBO evaluated a cap-and-trade program in which the emission allowances are auctioned, a policy analogous to a carbon tax set at the auction-clearing market price.) According to the CBO, this policy would raise about $88 billion in revenues the first year, $500 billion in revenues over the first five years, and about $1.2 trillion over the first ten years.

In 2010, the Bipartisan Policy Center's Debt Reduction Task Force (chaired by Pete Domenici and Alice Rivlin) considered a carbon tax as a means of reducing the deficit. This task force estimated that a tax of $23 per ton of CO_2e starting in 2018 and increasing 5.8 percent annually would generate approximately $1.1 trillion in tax revenues through 2025.

McKibbin et al. (2012) evaluated a carbon tax starting at $15 per ton of CO_2e and rising by 4 percent more than the inflation rate each year (thus typically by 6 percent) through 2050.

They estimated that such a carbon tax would generate $80 billion in the first year, rising to $170 billion in 2030 and $310 billion by 2050. The tax would generate approximately $1.1 trillion in tax revenues in the first 10 years and approximately $2.7 trillion in tax revenues over the first 20 years.

Rausch and Reilly (2012) evaluated a carbon tax starting at $20 per ton of CO_2e and rising 4 percent annually. They estimated that such a carbon tax would generate about $117 billion in revenue the first year and about $1.5 trillion over the first ten years. Metcalf (2007a) estimated that a carbon tax starting at $15 per ton of CO_2e and rising 4 percent annually would generate $90 to $100 billion in revenue the first year. Jorgenson et al (2015) analyze a range of carbon taxes from $10 to $50, estimating revenue of $1.6 trillion for a tax that starts at $20 per ton of CO_2e, and revenue of just under $3.5 trillion for a tax that starts at $50 per ton (both rising at 5 percent annually).

Taken together, the various estimates suggest we could expect about $100 billion in annual tax revenue over the first ten years of a carbon tax (assuming an initial value of $20 per ton of carbon equivalent), an amount equal to around 2.4 percent of annual federal tax revenue. By way of comparison for this $100 billion in annual revenue expected from the carbon tax, Table 2 shows estimates (for 2015) of the expected revenue collected from select other taxes, the cost of major tax expenditures such as the deductibility of interest on mortgages and tax paid to state and local governments, and federal spending on some government programs. For example, the $100 billion in revenue from a carbon tax is on par with the revenue from federal excise taxes and with federal spending on transportation, about 35 to 40 percent more than the revenue loss from the mortgage interest deduction and spending on education, training, employment, and social services. Put differently, the 2016 budget deficit is projected at $544 billion, so the $100 billion in carbon tax revenue would be enough to reduce the projected 2016 deficit by almost 20 percent, amounting to a decrease from 2.9 percent of GDP to 2.5 percent of GDP.

Table 2: Potential Carbon Tax Revenue Compared to Existing Selected Taxes, Tax Expenditures, and Spending		
Select Taxes	**Estimated Revenue or Expenditure (2015)**	**$100bn carbon tax revenue, %**
Individual income taxes	$1.5 trillion	7
Corporate income taxes	$342 billion	29
Excise taxes	$96 billion	104
Estate and gift taxes	$20 billion	500
Select Tax Expenditures		
Mortgage interest deduction	$71 billion	141
Deduction of property taxes	$32 billion	313
Tax exclusion for municipal bonds	$26 billion	385
Deduction of state and local taxes	$62 billion	161
Select Expenditures		
National defense	$598 billion	17
International affairs	$55 billion	182
Transportation	$93 billion	108
Education, training, employment, and social services	$137 billion	73

A revenue-neutral approach would be to use the revenue from the carbon tax to reduce other taxes, whether by reducing corporate income tax rates, individual income tax rates, or the payroll tax. Revenues could also be redistributed through a lump-sum rebate to households. McKibbin et al. (2012) estimate that the revenue from a carbon tax ($15 rising by 4 percent above inflation) could reduce the labor tax rate by about 0.9 percentage points and the capital tax rate by about 5 percentage points in the long term. Morris (2013) estimates that reducing the corporate income tax rate by 7 percentage points would cost about $800 billion over ten years in tax revenue, suggesting that a carbon tax as described above could achieve this corporate tax reduction and still leave considerable revenue for other purposes such as protecting the poorest households and deficit reduction. Similarly, Marron and Toder (2013) estimated that reducing corporate tax rates by 7 percentage points would lower federal revenues by about $800 billion over ten years and reducing rates by 10 percentage points would lower federal revenues by about $1.15 trillion, suggesting that a carbon tax would provide enough revenue for corporate rate reductions in this range. Tuladhar et al. (2015) examine both a $15 and $25 carbon tax and estimate that the resulting revenue could reduce the average income tax rate by about 4 to 5 percent. Metcalf (2007) estimates that a $15 carbon tax could lower payroll tax revenues by about eleven percent by providing a tax cut of $560 per worker, implemented as a credit equal to the taxes on the first $3,660 of covered workers' earnings. This cap on the tax cut per worker ensures that low-income workers receive the largest tax cut relative to earnings—the $560 would be a 12 percent reduction in the payroll taxes of someone making $30,000 per year compared to a 4 percent payroll tax cut for someone making $90,000 per year.

Economic Impacts

The carbon tax would have important impacts on the U.S. economy, affecting prices, wages, incomes, and employment for both individual families and for entire regions. Indeed, these impacts are intentional—the point of the carbon tax is to affect the production, consumption and investment choices made by households and businesses in a way that moves the United States to a clean energy economy and thus addresses the challenge posed by climate change.

Most directly, energy prices will rise with the carbon tax (without accounting for the price reduction expected from eliminating any regulations at the same time as the carbon tax is put in place). Metcalf (2007) calculates that a carbon tax starting at $15 per ton and rising by 4 percent over inflation would raise gas prices by just under 9 percent, and increase the prices paid by consumers for electricity, natural gas, and other fuels for home heating by 10 to 15 percent. The price of air travel would rise by 2.2 percent (taking into account the increase in fuel costs and the share of fuel in aviation costs), while prices for other household items would rise by much less—1 percent at most.

Without including the benefits of the tax reform using the carbon tax revenue, and leaving aside any impacts from removing inefficient regulations at the same time as the carbon tax is put in place, the higher prices from the carbon tax examined alone would affect households' purchasing power because more of their income will be used for purchases of carbon-intensive items such as energy. Metcalf calculates that the carbon tax would be equivalent to a reduction in disposable incomes by 2.4 to 3.4 percent for households with incomes in the lowest 30 percent of the income distribution, by 1.4 to 2.0 percent for the middle 40 percent, and by 0.8 to 1.2 percent for households with incomes in the top 30 percent. Again, these impacts are from the carbon tax in isolation and do not include the benefits of tax reform or of removing other inefficient regulations and mandates.

While the percentage changes in disposable incomes are largest at the bottom, the impact of the carbon tax in reducing the dollars of disposable income would be considerably larger for high-income households. For example, the impact of the carbon tax on families in the 80^{th} and 90^{th} percentiles of the income distribution would be twice as large in dollars as the impact on families in the 20^{th} and 30^{th} percentiles. The larger impact in dollars at the top straightforwardly reflects income inequality, while the larger percent impact at the bottom reflects the relative salience of carbon-intensive goods and services in the spending of low-income families—notably energy for transportation, heating, and electricity. Put simply, gas is a much bigger share of the household budget for a low- and moderate-income family than for a high-income family, and thus a carbon tax would have a disproportionately large impact on low- and moderate-income families compared to high-income families.

The choice of how to use the resulting revenue has a significant impact on the net economic effects of the carbon tax, both for the overall economy and for the distributional impacts across different incomes. The key tradeoff is the usual one in economic policy between equity and efficiency: the tax reform that most increases economic growth, a reduction in the tax on capital income, is the one that also widens inequality. Other tax changes such as lowering taxes on wages rather on capital income have markedly smaller impacts in terms of increasing growth, leaving in place nearly all of the economic drag from the carbon tax. A middle approach would be to focus tax reform on lower capital taxes to best improve growth while using part of the revenue generated by the carbon tax to address distributional concerns. As an example, some carbon tax revenues could be used to provide income subsidies to low-income families who are disproportionately impacted by the carbon tax and would see little near-term direct benefit from the capital income tax cut (though even low-income families would expect to gain over time from the economic impacts of a pro-growth tax reform).

All studies find that using the carbon tax revenues to reduce tax rates on capital income (for example, by reducing corporate tax rates) considerably lowers the economic cost of the tax, in many cases resulting in a positive net gain to the economy (in addition to the benefits from reducing harmful emissions). This finding of a relatively large impact of a cut in tax on capital comes about because of the resulting increase in the long-term capital stock. Lowering the tax on capital income results in an increase in the share of income that is saved and invested rather than consumed. This means a larger capital stock over time, and thus higher labor productivity because the increased capital makes workers more productive (a worker is more productive with a bulldozer than with a shovel). In turn, increased productivity for workers leads to higher wages and incomes. As noted above, a wide range of economic research indicates that the increase in living standards from a reduction in corporate tax rates will counteract the economic impacts of the carbon tax, potentially resulting in a net GDP gain as the growth benefits of tax reform outweigh the impacts of the carbon tax.

As found by Metcalf (2007), Mathur and Morris (2014a), Marron, Toder, and Austin (2015), and other studies, a carbon tax will have relatively larger impacts on low-income households, since a greater share of their income is spent on products such as energy, whose prices will rise with the tax. At the same time, it is important to note that the impact even on low-income households will be equal to less than one percent of their income. Coupling a carbon tax with a reduction in corporate tax rates magnifies this regressive effect. Table 3—reproduced from Marron, Toder, and Austin (2015)—shows the distributional effects of a $20 carbon tax considering different uses for the carbon tax revenue. The first column shows that a carbon tax alone would reduce pre-tax income for households in the lowest fifth of the income distribution by 0.8 percent, while lowering the pre-tax income for households in the top one percent of the income distribution by only 0.3 percent.

Table 3: The Distributional Effects of a Carbon Tax with Different Uses for the Revenue (Percent of Pre-tax Income)

		Carbon Tax with Revenue Recycled Through:			
Tax units ranked by income percentile	**Carbon tax alone**	**Refundable credit (equal per capita)**	**Payroll tax rate**	**Corporate income tax rate**	**Personal income tax rates (equal percent)**
0-20th	0.8	-1.1	0.2	0.6	0.8
20-40th	0.7	-0.8	0.1	0.5	0.6
40-60th	0.7	-0.2	0.0	0.4	0.4
60-80th	0.6	0.1	-0.1	0.2	0.2
80-90th	0.6	0.2	-0.2	0.1	0.1
90-95th	0.6	0.3	-0.1	0.0	-0.1
95-99th	0.5	0.3	0.0	-0.2	-0.4
Top 1 percent	0.3	0.3	0.2	-0.9	-0.9
All	0.6	0.0	0.0	0.0	0.0

Source: Marron, Toder, and Austin (2015)

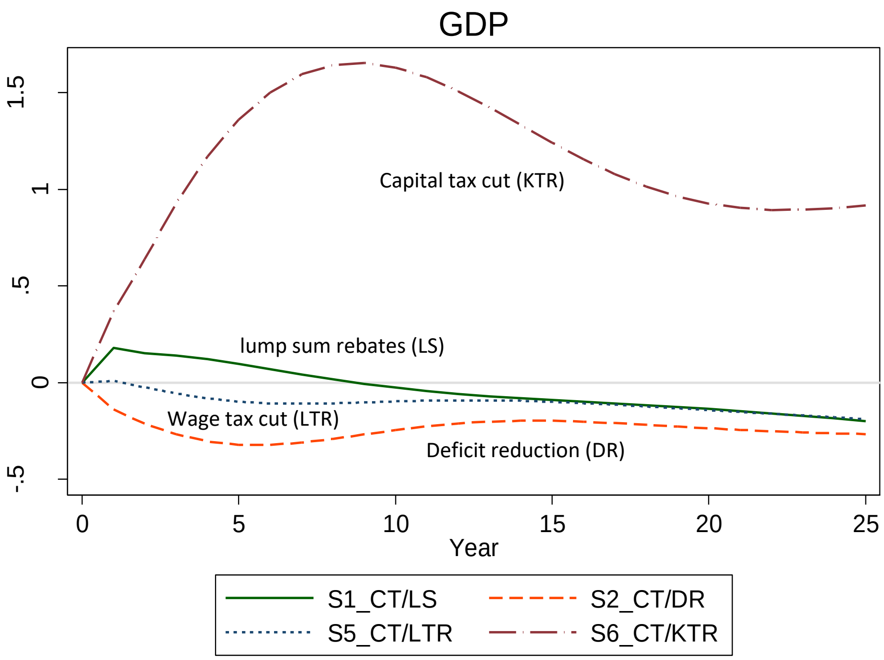
If, instead, the carbon tax revenue were used to lower corporate tax rates—increasing growth and thus substantially reducing the economic cost of the carbon tax—the bottom 20 percent would see a decrease in pre-tax income of 0.6 percent while the top one percent would see an increase in pre-tax income of 0.9 percent. While the largest benefits of the corporate tax cut go to higher-income workers, low-income workers still have some gains because the tax cut leads to higher economy-wide wages. Indeed, in principle, lower taxes on capital income should lead to even larger gains in wages over time, as increased capital formation raises worker productivity. The benefits of lower capital taxes thus would be more evenly distributed over time—though perhaps involving a longer horizon than is relevant to the political process. Even in the short-run, however, the change in income for low-income households is less than one percent—the impact of the carbon tax is modest.

In contrast to the corporate tax cut, using the carbon tax revenue to lower the payroll tax would give a result that is close to distributionally neutral. And if the revenue were refunded on a per-capita basis—an equal amount given to every person—the bottom twenty percent of households would see an increase in pre-tax income of 1.1 percent. The tradeoff, however, is that these other types of tax cuts using the revenues from the carbon tax provide a considerably smaller positive impact in terms of boosting growth and thus offset much less of the economic drag from the carbon tax.

Indeed, the research literature is clear that the biggest gains to GDP would result from using the carbon tax revenues to reduce corporate tax rates. For example, Figure 1—reproduced from McKibbin et al. (2012)—shows the effect on GDP of a $15 carbon tax in which the revenue is used to 1) provide a lump-sum per capita check (S1/LS), 2) reduce the deficit (S2/DR), 3) lower taxes on labor (S5/LTR), or lower taxes on capital (S6/KTR). Lowering taxes on capital results in an increase in GDP that outweighs the negative GDP impact of the carbon tax, leading to a net gain in addition to the benefits of moving to a clean energy economy with lower greenhouse gas emissions. If the carbon tax revenues are instead simply refunded equally to all families each year (LS), this offsets some of the impact of the carbon tax on family budgets but does not improve economic incentives to save, invest, or work. The net result from the carbon tax and annual rebate checks is lower GDP (on the order of 0.4 percent in 2013). Using the carbon tax revenues to reduce wage taxes (LTR, such as the payroll taxes that fund Medicare and

Social Security), leads to a growth impact only modestly better than the lump sum rebates and considerably less than the growth impact from reducing taxes on capital. Again, the reason is that the capital tax cut focuses reform on the features of the U.S. tax code that most detract from long-term economic growth—the relatively high U.S. tax rates on saving and investment.

Figure 1: Estimated Impacts on GDP from a Carbon Tax with Various Uses of the Tax Revenue

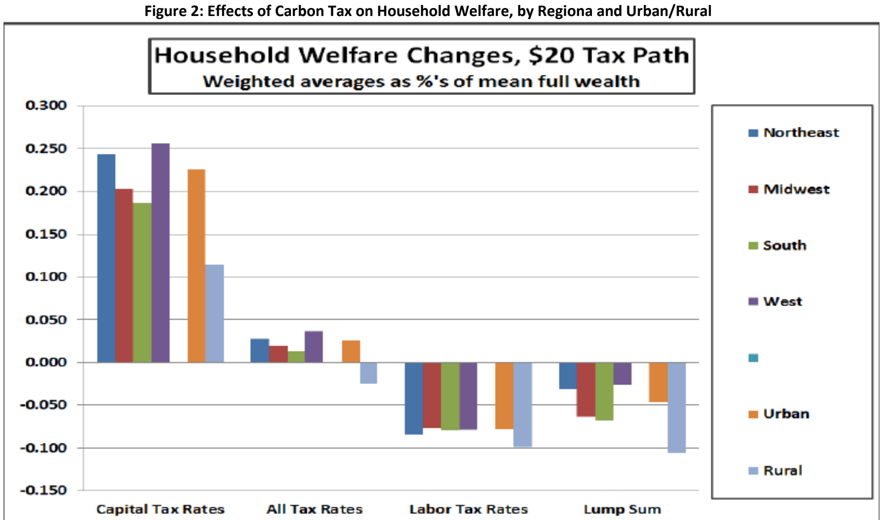


Source: McKibbin et al. (2012)

Jorgenson et al. (2015) show similar findings, estimating that a $40 carbon tax rising 5 percent faster than inflation each year and with all of the revenues used to reduce corporate taxes would result in a net gain in GDP, as the increased economic activity from the tax reform outweighs the drag from the carbon tax. In contrast, they find that using the revenues for lump-sum redistribution results in a significant net reduction in GDP because the drag from the carbon tax dominates. Parry and Williams (2011) examine a carbon tax that leads to an 8.2 percent reduction in emissions in 2020. They find that using the revenues to reduce taxes on capital leads to a net economic gain by 2020. In each of these studies, the economic benefits from the pro-growth tax reform funded by the carbon tax revenues are in addition to the benefits brought about by the carbon tax in terms of moving to a clean energy economy with lower greenhouse gas emissions.

Figure 2—reproduced from Jorgenson et al. (2015)—also shows the effects on household well-being for a carbon tax combined with varying types of tax reform, and examines the impacts by region and by urban vs. rural. Using the carbon tax revenue to lower taxes on capital provides substantial welfare gains across all regions and for both urban and rural areas. The gains are largest for the West and Northeast (and smallest for the middle of the country and the south), and the gains are larger for urban areas than for rural areas—but all areas still come out ahead on net. In contrast, using the carbon tax revenue to reduce taxes on labor or to provide lump-sum transfers (rebate checks) results in a net reduction in GDP.

Figure 2: Effects of Carbon Tax on Household Welfare, by Regiona and Urban/Rural



Source: Jorgenson, et al. 2015.

These findings again underscore the consequential tradeoffs involved with the use of the carbon tax revenue. There is a tradeoff between growth and equality, since the tax change with the greatest impact in improving economic growth (and thus offsetting the drag from the carbon tax) provides the most tax relief to high-income households. Targeting the revenue to reduce the most economically harmful taxes leads to considerably lower net economic costs (indeed, economic gains in most analyses) relative to other uses of the carbon tax revenue such as a lump-sum refundable credit to everyone or a payroll tax rate reduction. However, this efficient use of the revenue is more regressive, since the benefits of the lower tax rate on corporate income accrue disproportionately to higher-income families.

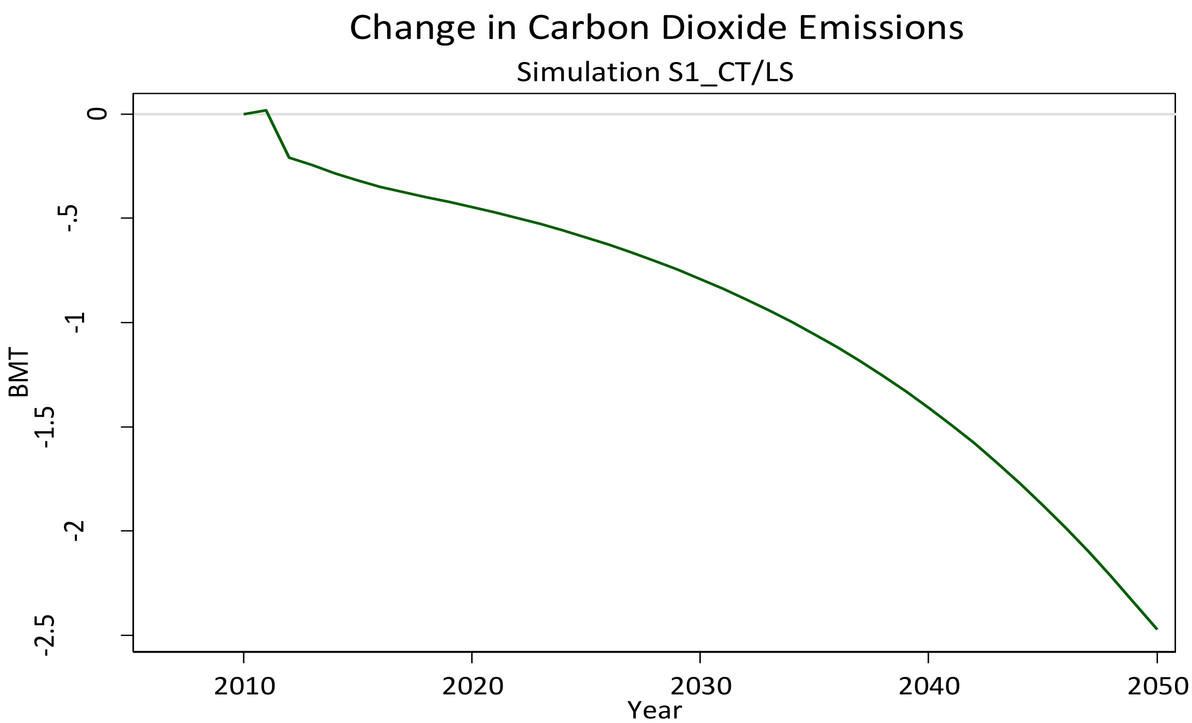
To achieve a net benefit, the revenue from the carbon tax should be divided between growth and distributional purposes. Some revenues could be used to fund capital tax cuts to spur growth and offset the drag from the carbon tax, while another part of the revenue could be used as income subsidies for low-income households or to support regions and industries especially affected by the carbon tax. As noted above, Mathur and Morris (2014a and b) calculate that using 11 percent of the carbon tax revenue as income support would offset the adverse impacts on the bottom 20 percent of families, while using 18 percent of the carbon tax revenue would be enough to protect the bottom thirty percent of families. Other portions of the revenue could be set for industry- and region-specific purposes—though these other uses imply a tradeoff with a smaller tax reform and thus less impact in terms of offsetting the drag from the carbon tax.

Impacts on Greenhouse Gas Emissions

The United States accounts for less than one-fifth of global carbon emissions, so any reduction in domestic emissions—absent coordinated global actions—would have only a modest effect on the Earth's climate. As discussed below, however, action in the United States would provide a considerable incentive for other countries without carbon prices to follow suit. Nordhaus (2015), for example, advocates for a "Climate Club" in which countries with a carbon regime impose penalties on non-participants, and suggests that a relatively low penalty would induce participation as long as the carbon tax is not too high. In particular, trade rules could be put in place that effectively allow the United States to collect the carbon tax on items produced in countries without a carbon price but sold in the United States. The prospect of losing this revenue to the United States and other countries with carbon regimes would provide an incentive for countries to put their own carbon price in place.

Moreover, a comprehensive, nationwide carbon tax would reduce greenhouse gas emissions in the United States, mitigating to some degree the risk of damage from climate change. There are a number of estimates of the expected reduction in emissions from various carbon tax proposals. For example, the Congressional Budget Office (2013) estimates that a $25 carbon tax on electricity generation, manufacturing, and transportation—with the tax rate rising 2 percent faster than inflation each year—would result in emissions falling from the sources subject to the tax by roughly 10 percent in the first decade. Jorgensen et al. (2015) estimate that a $20 carbon tax, rising 5 percent faster than inflation each year, would reduce emissions over 20 percent in its 15^{th} year and over 30 percent in its 35^{th} year. Figure 3—reproduced from McKibbin et al. (2012)—shows that a $15 carbon tax, rising 4 percent faster than inflation each year, would reduce emissions by about 34 percent, or 2.5 billion metric tons, by 2050, and result in a cumulative reduction of 40 billion metric tons through 2050.

Figure 3: Emission Reductions from a $15 Carbon Tax, Rising 4 Percent Faster Than Inflation Each Year



Source: McKibbin et al. (2012)

Taken together, these estimates suggest a carbon tax starting at $25 per ton of CO_2e and rising 4 percent faster than inflation each year would reduce emissions considerably more than the Obama administration's proposed power plant regulations, in particular because the carbon tax would cover more sources than just electricity generation. Moreover, the carbon tax would replace other less efficient climate-related regulations already in place, proposed, or planned, achieving the emissions reductions in a more cost-effective way than the present U.S. policy trajectory.

Design Choices

In what follows, we describe the design and implementation issues for establishing a carbon tax to reduce emissions, scaling back many of the existing, more expensive and less effective regulatory approaches, and using the revenues to reduce economically harmful corporate tax rates.

What Tax Base?

Putting a carbon tax in place requires making practical decisions about the way in which the tax is collected. The question of where to impose the tax and which pollutants to tax involves weighing the benefits of a broader base that captures more sources of climate externalities against the administrative cost savings of a narrower base covering fewer pollutants and sources of emissions. Anthropogenic climate change is widely acknowledged to be caused by the emissions of greenhouse gases, generated by millions of sources throughout the economy. Carbon dioxide is the primary greenhouse gas, but climate change is also driven by emissions of methane, nitrous oxides, sulfur hexafluoride, and others. In principle, one approach would be to tax each business and family based on their emissions of carbon and other greenhouse gases. Applying a carbon tax to all sources and all greenhouse gases, however, would present prohibitively high administrative costs.

Two principles can substantially reduce the administrative costs of applying a relatively broad-based carbon tax. The first principle is that the economic impact of a tax is independent of which source has the legal obligation to pay the tax. A tax levied on businesses that emit greenhouse gases (e.g., aluminum producers) gets passed on, in part, to consumers (e.g., people who buy soda packaged in aluminum cans). Similarly, the same tax levied on consumers gets passed on, in part, to producers because the tax affects consumers' purchases. Either approach results in the same economic burden to consumers and producers. Therefore, we can levy the tax at an "upstream" stage of the production process in which fossil fuels are first sold following extraction or refining, rather than at a "downstream" stage in which the fuel is combusted and the emissions are actually released into the atmosphere. The choice of taxing upstream or downstream affects the administrative burden but does not alter the economic incentives to reduce emissions. A tax on upstream sources will fall on a manageable number of entities such as coal mines, power plants, petroleum refineries and importers, and natural gas processors and importers, rather than on millions of downstream sources such as vehicles, households, commercial buildings, and industries that use fossil fuels.

The second principle is that a unit of fossil fuel will emit the same amount of carbon dioxide wherever and whenever it is burned. That is, there is a straightforward and perfect relationship between the carbon content of a fossil fuel and the resulting emissions when the fuel is burned. Therefore, we can tax the emissions input (e.g., the amount of coal), which is substantially easier to measure and monitor than the emissions output of carbon dioxide. According to the Congressional Research Service (2012), a tax on carbon emissions levied "upstream" on fossil fuels would cover approximately 80 percent of U.S. greenhouse gas emissions and apply to fewer than 2,300 entities.

The tradeoff between emission coverage and administrative burden becomes more severe as the tax base is expanded beyond carbon emissions from fossil fuels. For example, methane emissions from livestock and landfills are more difficult to measure and monitor, but account for nearly 4 percent of U.S. greenhouse gas emissions. Similarly, carbon emissions from activities such as cement manufacturing and the production of iron and steel account for nearly 1.5 percent of U.S. greenhouse gas emissions. A balance must be struck by taxing the larger and more measurable sources of emissions without presenting an undue administrative burden. According to the Congressional Research Service (2012), in addition to the approximately 80 percent coverage of emissions from a tax on fewer than 2,300 entities' "upstream" emissions relating to fossil fuels, expanding the tax to include cement manufacturing, the production of iron and steel, and a select number of other greenhouse gas emissions such as methane from landfills, would allow the tax to cover close to 90 percent of U.S. greenhouse gas emissions. Even this expanded upstream tax base would still involve collecting the carbon tax from only approximately 6,000 sources.

The measurement issue raises another consideration, which is whether the carbon tax system should allow for tax credits for sequestration and carbon offsets. A carbon tax system should provide incentives for sequestration efforts such as carbon capture and storage, which is a technology to capture carbon emissions from coal combustion in electricity generators. This would prevent the emissions from contributing to climate change, and should be treated the same in the tax regime as not emitting carbon in the first place. This expansion of the tax system can be accomplished by allowing a (tradable) tax credit for approved sequestration activities from sources covered by the tax (e.g., electric utilities). Going further to provide credits for carbon offsets, which are reductions in emissions from sources that are not subject to the tax, creates a more challenging tradeoff. Allowing offsets would expand the opportunities for low-cost reductions, but create a measurement problem, in that it is more challenging to measure an emission *reduction* than an emission—it is hard to know if an action was needed in the first place to avoid any particular carbon emission. For example, allowing someone to claim a credit for not cutting down a forest is only valid if the forest would have been cut down absent the tax benefit. To maintain the integrity of the carbon tax program, any allowable offsets must be both *additional* (meaning they would not have happened absent the carbon tax) and *permanent* (meaning they would not be unwound after receiving the credit). As with the question of which emissions to tax, there is a fundamental tradeoff between achieving low-cost emissions reductions by allowing more offsets and the cost of administering a system that prevents fraudulent reductions. Giving offsets credit for activities outside the United States would greatly increase both administrative costs and the risk of allowing inauthentic reductions in emissions. Indeed, there is a long track record of carbon regimes in other countries that permit bogus offsets.

What Tax Rate?

The fundamental problem of an externality stems from an absence of property rights, which results in a zero price for using the good in question. In the case of climate change, since there is no property right for the clean air, no price is charged for polluting. A carbon tax addresses this problem by establishing a price where one currently does not exist, and by extension, the optimal carbon tax should be set at the value that reflects the societal costs associated with polluting the air. Stated more precisely, the carbon tax rate should be set equal to the social marginal damage from an additional unit of emissions, a monetary amount frequently referred to as the social cost of carbon (SCC).

The challenge is in estimating the social cost of carbon, since this entails assessing the likelihood of different climate scenarios, predicting the ensuing climate change impacts, converting these impacts into dollar equivalents—which in itself requires placing monetary values on human health and environmental degradation—and applying the appropriate discount rate to reflect society's willingness to pay costs today in exchange for benefits in the future including of a reduced likelihood of catastrophic damage to our planet. Not surprisingly, reflecting this great challenge, there is a wide range of estimates of the social cost of carbon, in turn suggesting a wide range for the optimal carbon tax rate. For example, the Intergovernmental Panel on Climate Change synthesis report in 2014 stated that the range of estimates for the social cost of carbon "lie between a few dollars and several hundreds of dollars per tonne of carbon in 2000 to 2015."

In recent years, an interagency working group of the U.S. government used three different models and three different discount rates to arrive at estimates of the global social cost of carbon per ton of carbon dioxide of $5, $21, $35, and $65 (measured in 2007 dollars) per ton of CO_2e. Other governments have similar ranges for the social cost of carbon. The UK, for 2014, calculated low, central, and high estimates of £0, £4.48, and £12.38 (roughly $0, $7, and $19) per ton of CO_2e (Department of Energy and Climate Change, 2014). The European Union in setting out energy performance requirements for the construction of new buildings (EU Commission Delegated Regulation No. 244/2012, Annex II) uses projections that "currently assume a price per tonne of EUR 20 until 2025, EUR 35 until 2030 and EUR 50 beyond 2030, measured in real and constant prices EUR 2008." (These amounts correspond to roughly $25, $42, and $60 in 2015 prices). Australia enacted a carbon tax based on its international emissions reduction targets set at $23 per ton of carbon in 2013 and $24.15 in 2014—a figure consistent with the global social cost of carbon estimates used by the Obama Administration (Swoboda and Talberg, 2014). The tax was repealed in July 2014, in part because of the lack of an international trading system for carbon reductions.

Given the difficulty of measuring the social cost of carbon, another approach is to determine the tax rate projected to achieve a desired level of emissions reductions or total emissions in the atmosphere. This approach separates the decision into two parts: 1) a determination of what level of greenhouse gases to achieve, perhaps linked to international climate agreements, and 2) the tax rate to achieve this level of emissions. This approach typically arrives at carbon tax rates similar to the approach of setting the rates based on current estimates of the social cost of carbon.

In addition to setting the initial carbon tax level, one must also consider how to change the rate over time. Since the optimal tax is one set at the social cost of carbon, then as the cost changes over time with economic or climate developments, or even as our understanding of the social cost of carbon changes over time with improved estimates, it would be natural to adjust the tax accordingly. Similarly, if the goal is to achieve a certain emissions level, this would suggest adjusting the tax over time if it winds up over- or under-shooting the target.

The question then would be who and how to decide on these future changes. A drawback of allowing changes in the first place is that this introduces the possibility of substantial price volatility, reducing the certainty that might be especially valuable for businesses looking to adjust their production and research plans to the new carbon regime. Moreover, a governmental panel charged with periodically reevaluating the carbon tax rate could be susceptible to political pressure, undermining the future of the policy and again increasing the uncertainty faced by market participants. Establishing a carbon tax with a pre-determined annual rate of increase would provide price stability and allow businesses to plan capital decisions, including long-term investments in low-carbon technologies. Any mechanism to allow changes should involve stringent conditions against over-tinkering.

If the goal is to establish carbon tax rates over time that achieve a certain fixed amount of emissions in the atmosphere, then the tax rate should grow at the rate of return of low-risk capital assets. This again reflects the nature of a carbon tax addressing the lack of property rights. With property rights, clean air would be an asset. Holders of the clean air asset would save it for later use if its value went up faster than the rate of return on other assets and would use it sooner if its value went up more slowly than other assets. In equilibrium, the price of the clean air asset would increase at the rate of return on other forms of capital—the return here is meant to be of relatively low-risk assets on the assumption that the carbon tax regime will be durable and so market participants can have confidence that the underlying asset will have value into the future.

A difficult philosophical issue is whether the price of carbon in a U.S.-only system should reflect the cost that carbon emissions impose on the entire world, or instead only the share of the cost borne by the United States. Greenstone, Kopits, and Wolverton (2013), for example, calculate that the United States bears only 7 to 23 percent of the worldwide impact of a marginal unit of carbon.

International Considerations

A carbon tax can be implemented in a way that provides incentives for other countries to adopt a carbon regime such as a tax, while helping create a level playing field for U.S. companies faced with competition from firms in countries that do not impose a carbon tax. Indeed, absent a global regime, imposing a carbon tax only in the United States without taking the international dimension into account could pose challenges to American businesses that compete against firms producing in countries without a carbon tax or other carbon-related restrictions. The result could be both economic harm in the United States and the undermining of the climate benefits as some production shifts from the United States to other countries. Indeed, there could conceivably be a net increase in emissions if production shifts to countries that rely on more carbon-intensive energy sources. Cement production, for example, is carbon-intensive, so a U.S. carbon tax in isolation could lead production to shift to other countries, increasing transport costs for U.S. construction but not reducing global levels of carbon (or possibly increasing them if the cement is produced in countries that rely heavily on coal-generated electricity).

A way to create a level playing field between U.S. and foreign activities would be to impose border-adjustments on the carbon tax, so that imports into the United States from countries without a carbon tax or other carbon restrictions would be charged the U.S. tax, and American firms would be given a rebate on the tax associated with exports to such countries. In principle, this system would ensure that all products sold in the United States, whether produced domestically or imported, pay the carbon tax, while relieving U.S. firms of the competitive drag of the tax in countries whose firms do not face one. In effect, foreign countries without carbon prices would see their firms pay tax to the United States while foreign countries with carbon prices would collect the revenue themselves. This would provide the incentive along the lines discussed by Nordhaus (2015) for countries that do not impose a price on carbon to do so. The tradeoff would be a reduced effectiveness of the carbon regime for items that are both carbon-intensive and sold in countries without a carbon price, because these items would not face the carbon tax.

There are a number of complications with this approach, both legal and administrative (Metcalf and Weisbach, 2009). The good news is that border adjustment would be relatively straightforward for U.S. trade in energy products such as oil imports and gasoline exports, since the carbon content of these items can be ascertained and the appropriate import tax or export rebate applied. While WTO rules are not clear, Metcalf and Weisbach explain that a good case can be made that a tariff on energy imports that is equivalent to the carbon levy on the same products in the United States complies with WTO rules.

A more difficult set of challenges relate, however, to trade in products such as steel, aluminum, or cement that are carbon-intensive but for which the carbon content is not uniform as with petroleum or other energy sources. For these items, the tax in theory should depend on the carbon involved in production, but this will depend on both the nature of the particular item and the method of production. An aluminum bar from one country might have been produced in a factory powered by coal-generated electricity, while the competing U.S. producer uses a renewable power source such as wind and thus faces a relatively low burden from the carbon tax. Applying the relatively low carbon tax that applies to the U.S. producer to more carbon-intensive imports would give an advantage to the foreign items, possibly leading to cross-border shifts in production and thus higher emissions. At the same time, it would be administratively burdensome to calculate the specific carbon content of all such imports. Moreover, applying a different carbon tax to imports than to U.S. products likely would violate WTO rules. A compromise approach to avoid putting U.S. manufacturers of energy-intensive items at a competitive disadvantage would be to apply a uniform carbon tax to a specified set of U.S. and foreign products, even while recognizing the imperfect result. Again, the key point is that a global carbon regime is desirable, but measures can be put in place to lessen the competitive harms to U.S. firms even in the absence of a global system. Moreover, Americans firms, including cement and aluminum producers, would benefit from the pro-growth tax reform discussed above that would be funded with the carbon tax revenue. Cement and aluminum producers would be hit harder by the overall carbon regime than, say, restaurants, but the impact of the carbon policy for these and all other U.S. firms would be balanced with a beneficial tax reform.

Carbon Regimes around the World

Imposing an economy-wide carbon tax would be a new policy for the United States, but many other countries and regions have instituted carbon prices either directly as taxes or indirectly as cap and trade. The Emission Trading Scheme in the European Union, the largest carbon regime, illustrates the potential and the pitfalls of this approach. The trading scheme took effect in January 2005, covering roughly half of EU carbon emissions, with the tax collected at around 11,000 power plants, factories, and other large sources of carbon. These emitters were given allowances to emit a certain amount of carbon and then required to purchase allowances or fund carbon offsets to cover additional emissions. The trading system has worked in the sense that the price of carbon is determined in the market system. But the number of allowances provided to firms and offsets recognized under the system has been so large, and the reduction in carbon emissions more rapid than expected, that the market price has been lower than expected, including zero at times, suggesting that the cap on emissions has been too loose (or carbon offsets too easily obtained).

Several European countries impose taxes on energy products not covered by the EU-wide system. France, for example, introduced a tax in 2014 on gasoline, fuel oil, and coal (not covered by the EU scheme since electricity in France is generated with nuclear power). The tax rate was equivalent to $25 dollars in 2016. Denmark, Ireland, and Sweden likewise impose a tax on fuels not covered by the EU-wide trading scheme, while Norway (which is not an EU member) has its own emissions trading scheme on electricity and a fuel tax based on carbon content.

Mexico taxes the carbon content of fuel for emissions above those generated by natural gas (which is not taxed). Costa Rica has taxed carbon since 1997 through a tax on fossil fuels, while Chile is set to levy a carbon tax starting in 2018.

The Canadian Province of British Columbia implemented a carbon regime, with a tax applied since 2008 to fuels purchased within the province. The revenue from the carbon tax is recycled to reduce other taxes, with about two-thirds going to lower corporate taxes. The carbon tax rose from $5 (Canadian) in 2008 to $30 since 2013 (equal to $23.50 US dollar), even while per capital income in British Columbia has continued to rise.

Global coordination of carbon regimes has the potential to broaden the coverage of the carbon regime, allowing for greater efficiency in that a lower tax rate could achieve a desired amount of reduction of emissions. Coordination would further provide an incentive for countries outside the regime to join, particularly if a border adjustment is imposed by which imports from countries that do not impose a carbon tax are subject to the tax. As noted above, this in effect would mean that firms in countries without a carbon tax would be paying the tax on their exports but the destination country would collect the revenue through the carbon tax on imports.

Adding China, the world's largest source of carbon emissions, would be especially important for a carbon regime. The discussion above on the upstream implementation of a carbon tax would apply to China—it would be much easier for the national government to collect a carbon tax on energy as it enters the economy rather than attempting to police the millions of factories within the nation that use fossil fuels and emit carbon. A difficulty in the Chinese context would be ensuring that local sources of coal are subject to the tax, especially since there would be a considerable incentive for small mines to evade the relatively high tax on this carbon-intensive fuel source.

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