THE HAMILTON PROJECT

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A Carbon Tax Swap to Mitigate Global Climate Change

CONTROVERSIAL UNTIL RECENTLY, the proposition that human activity is altering the climate at an unprecedented rate is now widely accepted. Global annual temperatures are rising more rapidly as greenhouse gas emissions from human activity—most notably from the burning of fossil fuels—trap heat at the Earth's surface. The potential consequences—rising sea levels, extreme drought and flooding, water stress, and shorter growing seasons—could result in dramatic changes in our way of life and in long-term economic harm. Recent polls show that a majority of Americans think the government should do more to slow climate change.

But what? That's where the consensus ends. In a discussion paper for The Hamilton Project, economist Gilbert E. Metcalf of Tufts University proposes a carbon tax to reduce the greenhouse gas emissions that contribute to climate change. The tax would start at a low initial rate and increase gradually to give the economy time to adjust. Metcalf argues that this proposal would be economically efficient, providing businesses and consumers with incentives to reduce carbon emissions in the most cost-effective manner possible. To combat the regressive impact of higher energy prices, Metcalf proposes using the revenue from the carbon tax to pay for a progressive tax reduction—a policy he calls a "carbon tax swap."

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THE CHALLENGE

Climate change is a global phenomenon, with emissions from every part of the world contributing to the problem. The Intergovernmental Panel on Climate Change (IPCC) recently reported that global surface temperatures have increased 0.7°C in the past 100 years, and that warming has accelerated in the past 30 years. There is little doubt that rising emissions of greenhouse gases (GHGs) from human activities are playing a role in increasing the Earth's surface temperature and overall climate volatility. As the IPCC recently concluded:

> Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century (emphasis in original).

The IPCC predicts warming of almost 4°C over the next century if rapid economic growth powered by fossil fuels continues.

Like its causes, the human impact of climate change will be global, with the developing world hit hardest. Low-lying agricultural areas and coastal populations may experience flooding, while other areas may suffer drought and water shortages. Changing precipitation patterns could introduce new risks for the spread of water- and insect-borne diseases. Though average surface temperatures are expected to rise, some regions such as western Europe may enter cold spells as ocean currents carrying heat slow.

Governments have begun to recognize the need for a global solution to this global problem. But a global solution is unlikely unless the United States—the world's largest carbon emitter and its wealthiest nation—assumes leadership on the climate issue. And given that serious action on climate change could entail significant costs, the United States is unlikely to act unless it can develop a policy that reduces emissions cost-effectively and spreads the burden of these costs fairly across society.

In considering cost effectiveness, the United States must decide between two basic options for reducing GHG emissions: limiting them through direct regulation or putting a price on them using market incentives. Economists agree that market incentives are more efficient than direct regulation. When designed properly, market incentives produce the same reduction in emissions but at lower cost to society. Market mechanisms encourage firms and households to identify the most cost-effective ways to reduce emissions, while direct regulation drives up abatement costs by dictating when, how, and by whom emissions are to be reduced.

Distributional equity is a distinct but equally important concern in designing climate policy. Any policy that raises energy prices—even the cost-effective market mechanisms—would place a disproportionate burden on low-income consumers, who spend a greater percentage of their income on energy than higher-income consumers. According to the Department of Energy, low-income households spend about 14 percent of their income on energy, compared to the national average of 3.5 percent. The regressive impact of higher energy prices thus presents a challenge to adopting an environmentally effective, yet distributionally fair, climate policy.

A global solution is unlikely unless the United States—the largest carbon emitter and wealthiest nation—assumes leadership on the climate issue

A NEW APPROACH

Confronting this challenge, Gilbert Metcalf proposes a carbon tax that would reduce greenhouse gas emissions while also addressing concerns about economic efficiency and distributional equity. Arguing for market incentives over direct regulation, Metcalf identifies two market mechanisms that have been proposed to reduce GHG emissions: a cap-and-trade system, in which the government issues a limited amount of tradable rights to emit greenhouse gases, and a tax on emissions of carbon dioxide (CO_2) and other GHGs.

> A gradually increasing tax on greenhouse gas emissions would encourage consumers and firms to reduce emissions while giving the economy time to adjust.

Metcalf favors a carbon tax. The goal is to set the amount of the tax such that firms reduce emissions until the cost of further reductions equals the potential damage of extra emissions. Unfortunately, he writes, cost estimates of potential damage from climate change vary widely, from $3 to $95 per ton of CO_2 emissions. Much of this variation arises from uncertainty about the optimal stabilized GHG concentration, which many scientists place around 450 to 550 parts per million. An analysis at MIT predicts that a carbon tax with an initial rate of $18 per ton and an increase of 4 percent per year would yield a target concentration of 550 parts per million by 2100 as long as other countries adopted climate mitigation policies as well. Given the uncertainty of the target CO_2 concentration, Metcalf argues for a lower initial tax rate of $15 per ton of CO_2, with a gradual increase to give the economy time to adjust to carbon pricing.

For simplicity's sake, the tax would be imposed at the producer level: for example, at the nation's 1,415 functioning coal mines, 150 oil refineries, and about 110,000 wells (that produce 90 percent of its natural gas). This "upstream" tax—at the producer level rather than the consumer level—would have the advantage of easier enforcement and collection. However, Metcalf recognizes that producers should be rewarded for capturing carbon downstream if "carbon capture" technology becomes viable in the future. He proposes offering a refundable tax credit to producers who can bury GHGs or otherwise keep them out of the atmosphere.

The initial $15 carbon tax would have varying effects on the prices paid by consumers for different commodities (see Table 1). The price of gasoline at the pump would rise by just under 9 percent. Metcalf observes that this 25¢ increase is smaller than the natural fluctuation of gasoline prices, which varied by as much as $1.44 on a weekly basis between January 2005 and May 2007. The most significant effect of the carbon tax would be on electricity and natural gas prices, which would rise by about 14 percent. Metcalf's model predicts minimal price increases for commodities besides electricity and heating, in the range of 0.3 to 1.0 percent.

Metcalf recognizes that these changes in energy prices would have a disproportionate impact on low-

TABLE 1

Consumer Price Impacts of a Carbon Tax

Commodity	Price increase (%)
Electricity and natural gas	14.1
Home heating	10.9
Gasoline	8.8
Air travel	2.2
Other commodities	0.3 to 1.0

Source: Author's calculations.

Key Highlights

The Challenge

Climate policy must target the environmental problem of climate change while considering efficiency and distributional concerns:

- **Greenhouse gas emissions from human activity are contributing to climate change,** resulting in severe weather, higher sea levels, flooding and drought.
- **Direct regulation of greenhouse gas emissions is unnecessarily inefficient** because it requires firms to reduce emissions regardless of abatement costs.
- **Increases in energy prices hurt low-income consumers,** who spend a larger percentage of their income on energy than higher-income consumers.
- **International cooperation is necessary but difficult.** Significant reductions in emissions require participation from major emitting nations, but countries have little incentive to act because the benefits of action accrue mostly to other countries.

A New Approach

Metcalf's carbon tax proposal would confront the climate challenge by:

- **Pricing greenhouse gas emissions.** A gradually increasing tax on greenhouse gas emissions would encourage firms and consumers to reduce emissions while giving the economy time to adjust.
- **Encouraging economic efficiency.** The carbon tax would promote cost-effective abatement by providing flexibility on when, how, and by whom emissions are reduced.
- **Offering an environmental tax credit.** Revenue from the tax would fund the environmental tax credit. Low-income taxpayers, who are affected most by the carbon tax, would receive the largest refunds as a percentage of income.
- **Promoting United States leadership.** Serious action by the United States, the world's largest energy consumer and its wealthiest nation, would encourage other nations to act.

income consumers. As seen in Table 2, the carbon tax would cut real disposable income for households in the lowest decile by 3.4 percent, while reducing the income of households in the top decile by just 0.8 percent. To offset this regressive impact, Metcalf proposes a carbon tax swap in which revenue from the carbon tax would fund an environmental tax credit based on earnings. He estimates that revenue from the initial $15 per ton carbon tax would be about $82.5 billion after firms and consumers undertook initial efforts to reduce emissions. Metcalf would use this revenue to provide all workers with a refundable income tax credit equal to their 15.3 percent payroll tax up to a maximum credit of $560.[1] Under this progressive structure, individuals with annual wages of $5,000 would receive a credit equal to nearly three-quarters of their total payroll taxes, while upper-income individuals earning $90,000 or more would receive a refund of at most 4 percent of payroll taxes. Although the carbon tax by itself would be regressive, combining it with a credit to offset the payroll tax would largely preserve distributional neutrality.

Metcalf argues that besides being efficient and distributionally neutral, his carbon tax swap would most importantly be effective in reducing greenhouse gas emissions. His estimates indicate that GHG emissions would fall by 14 percent in response to the initial $15 per ton CO_2 tax. A steady increase in the carbon tax, Metcalf argues, would help ensure a gradual but definite reduction in GHG emissions.

Why Not Cap and Trade?

Another commonly discussed method to raise the cost of emitting CO_2 is by implementing a "cap-and-trade" system. Such a system is already in place in Europe to limit CO_2 emissions and in the United States to reduce sulfur dioxide emissions. In the case

1. The 15.3 percent payroll tax includes the 7.65 percent employee contribution plus the 7.65 percent employer contribution, which economists argue is passed through to the worker in the form of lower wages.

TABLE 2

Distributional Impacts of the Carbon Tax Swap

	Change in household disposable income (%)		
Income group (decile)	Carbon tax	Tax credit	Net
1 (lowest)	–3.4	2.7	–0.7
2	–3.1	2.1	–1.0
3	–2.4	2.2	–0.2
4	–2.0	2.1	0.1
5	–1.8	1.9	0.1
6	–1.5	1.8	0.3
7	–1.4	1.6	0.2
8	–1.2	1.4	0.2
9	–1.1	1.1	0.0
10 (highest)	–0.8	0.8	0.0

Source: Author's calculations. The lowest decile includes households in the 5th to 10th percentiles. Mean tax changes within each decile are reported. The columns titled "Carbon tax" report the change in household income following price changes arising from carbon tax. The columns titled "Tax credit" report the change in household income arising from new tax credit, which equals up to $560 for each worker in a household.

of GHGs, the government would decide on a target emissions level and issue a corresponding number of permits granting firms the right to pollute. The government could choose either to distribute permits freely or to sell them in an auction. Firms that could not reduce emissions easily could buy more permits from firms with excess permits. The price of permits would be set by the market according to their scarcity. Regardless of whether firms bought permits or received them for free, most of the cost of the allowances would be passed on to consumers as firms surrendered these valuable assets in exchange for the right to emit greenhouse gases.

Cap-and-trade systems have many salient free-market features, but Metcalf argues that they fall short of a carbon tax in several important ways. First, Metcalf argues that a carbon tax would deal more sensibly with the uncertainty regarding the cost of reducing carbon emissions. If policy makers had perfect information, a cap-and-trade system and a carbon tax would achieve identical prices of carbon and quantities of carbon reduction. Given uncertainty, however, Metcalf argues that issuing a limited number of permits would result in volatile permit prices and introduce economic distortions. In Europe, for example, futures prices for CO_2 permits fell from €30 to €10 ($43 to $14) in April 2006 and began plunging again in September 2006 to their current price of around €0.10 ($0.14). In contrast, a carbon tax would set the carbon price, thereby limiting economic uncertainty, in exchange for what Metcalf argues is the tolerable cost of more annual variation in carbon emissions. Since carbon emissions stay in the atmosphere for decades and even centuries, minor fluctuations in emissions are unlikely to exacerbate climate change. Metcalf acknowledges that many cap-and-trade proposals include a "safety-valve" provision that would set a price ceiling on permits to mitigate upward price volatility. If permit prices rose to that ceiling, the government would sell additional permits to firms. In that case, however, the safety valve would effectively function as a carbon tax.

Second, the United States has a decades-old administrative structure for collecting taxes already in place. It has less experience running cap-and-trade programs, especially on the scale that a carbon policy would require. A carbon tax would make use of the existing tax structure, while a cap-and-trade system would require a new accounting scheme on the part of government and firms.

Finally, Metcalf argues that the political economy of a carbon tax is more sound. Metcalf says that if a cap-and-trade system were adopted, Congress might succumb to political pressure to give away rather than auction off permits, as happened in the sulfur dioxide market. Free allocation results in a large transfer of wealth from government and taxpayers to politically influential industries. In the case of carbon permits, it could result in windfall profits for favored firms as they increased consumer prices to account for the indirect costs of using valuable permits. With free allocation, moreover, the gov-

> Metcalf proposes using the revenue from the tax to fund the environmental tax credit, an income tax refund that would prevent undue burden on low-income consumers.

ernment would receive no revenue with which to ease the burden on low-income consumers. In addition, utilities and other industries that needed permits from the government would lobby hard for them—a generally wasteful activity.

Concerns with a Carbon Tax

A carbon tax is not without objections. Commentators have raised a number of concerns, some that apply solely to the carbon tax and some that apply equally to any policy that would raise energy prices, including cap-and-trade systems. Metcalf addresses both types of objections.

Would a carbon tax lower emissions sufficiently?

Unlike a cap-and-trade system, which caps emissions at a set level, a carbon tax does not guarantee a particular reduction in GHG emissions. True enough, Metcalf writes, but science has not yet identified—and may never identify—the exact emissions level that would stabilize surface temperatures or guarantee safety from climate change. Given these uncertainties, it may be more effective to have a stable price target than a specific quantity target. Metcalf shows that his proposed tax results in substantial emissions reductions that, coupled with similar action by the rest of the world, would lead to global CO_2 concentrations roughly on par with what scientists recommend.

Would a carbon tax yield a reliable revenue stream?

Another concern that applies particularly to the carbon tax is that the revenue stream from the tax might not be predictable. Using historic emissions from 1959 to 2005, Metcalf demonstrates that carbon tax revenue would have been more reliable over that period than was payroll tax revenue. Some critics say that a very effective carbon tax could result in a substantial reduction in emissions and falling revenues. Under Metcalf's proposal, however, the carbon tax rate rises over time, leading to dependable revenues as a percent of GDP.

Would carbon pricing hurt the economy?

Most industries would feel minimal effects from carbon pricing. The environmental tax credit would largely offset the burden of higher prices on consumers, making the policy a tax swap rather than a tax increase. Metcalf acknowledges that some carbon-intensive industries, notably coal mining, would feel the burden of the tax more acutely. However, Metcalf argues, the United States simply cannot reduce emissions unless it reduces its coal consumption or develops viable carbon capture technology.

Should the United States take action without international cooperation?

Some observers say that the United States should not act without cooperation from the developing world because such action would put U.S. companies at a competitive disadvantage. They also note that developing countries will account for most of the expected increase in emissions in the coming decades. Future carbon emissions from these countries, especially China, India, and the Middle East, have the potential to swamp any reductions made by the United States. Metcalf argues that no developing country is likely to act before the United States acts, especially since the U.S. has been burning fossil fuels for decades to grow its economy. To preserve U.S. competitiveness, Metcalf suggests that the United States consider a tax

on energy-intensive imports based on their carbon content so that imports are treated the same as domestically produced goods.

Would some segments of the population still be hurt by a carbon tax swap?

Although the tax swap would be broadly distributionally neutral, there would still be winners and losers. Of particular concern are those individuals who are not working, including the very poor and the elderly, and thus would not qualify for the tax relief. In addition, workers in certain regions and sectors of the economy could be adversely affected by the transition to new industries. However, Metcalf shows that a policy that includes increased Social Security benefits or a lump sum transfer could be even more progressive and could mitigate the effect on vulnerable families.

CONCLUSION

With the inclusion of the environmental tax credit, Metcalf's proposal succeeds where other carbon tax proposals have fallen short. For a tax to gain support in the current political landscape, Metcalf argues, it must have a clearly defined purpose and address distributional concerns. Metcalf proposes reductions in the income tax to offset the regressivity of the carbon tax and prevent undue burden on low-income consumers. He also provides a clear rationale for the tax by presenting the mounting evidence for climate change, the need for U.S. leadership, and the efficiency of carbon pricing over direct regulation.

In an economy whose lifeblood is fossil fuel, the costs of reducing greenhouse gas emissions could be great. But the costs of inaction may prove even greater. With the effects of climate change uncertain, the United States has all the more reason to undertake early and gradual action now rather than drastic and costly action later. Metcalf proposes a policy that would allow the United States to provide global leadership on climate policy while also respecting the goals of efficiency and fairness.

Learn More About This Proposal

This policy brief is based on The Hamilton Project discussion paper, *A Carbon Tax Swap to Mitigate Global Climate Change,* which was authored by:

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  This discussion paper proposes a cap-and-trade system for carbon emissions that would achieve specific emissions reduction targets using market mechanisms. The paper develops the details of an environmentally sound, cost effective, and distributionally fair cap-and-trade system.

- **Inducing Innovation to Address Climate Change and Energy Security**
  Technological innovation is essential for decreasing the cost of greenhouse gas emission reductions. This paper examines how government can efficiently and effectively target its support for research, development, and deployment of new technologies.

- **An Economic Strategy to Address Climate Change and Promote Energy Security**
  The United States needs a comprehensive strategy to reduce its emissions and encourage global climate cooperation while also improving energy security through reduced oil consumption. This strategy paper argues that the U.S. should start by using market mechanisms to put a price on carbon, providing incentives to reduce emissions and develop clean technologies. It should then implement a targeted approach to R&D policy.

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