THE HAMILTON PROJECT

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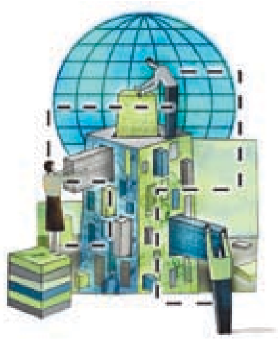
POLICY BRIEF NO. 2007-13 OCTOBER 2007

A U.S. Cap-and-Trade System to Address Global Climate Change



IN JUST A FEW SHORT YEARS, mounting scientific evidence has transformed Americans' perception of climate change. The proposition that human activity is contributing to the climate problem has gained consensus across the nation, from environmental scientists, to religious groups, to those intrigued by Al Gore's documentary, "An Inconvenient Truth." The question is no longer whether human activity is contributing to climate change, but what public policy can do about it. Science has succeeded in posing the problem. The debate now is over how to design a response that is environmentally effective, cost-effective, and distributionally fair.

In a discussion paper for The Hamilton Project, economist Robert N. Stavins of Harvard University's John F. Kennedy School of Government proposes a cap-and-trade system in the United States to regulate carbon dioxide (CO_2), the principal greenhouse gas (GHG). In Stavins' proposal, the federal government would cap total U.S. CO_2 emissions by issuing a limited number of emissions allowances that firms could then trade among themselves. Tradable permits would lead to cost-effective emissions reductions by encouraging the largest reductions from firms that can do so at a lower cost. Firms that cannot cut back emissions as inexpensively would instead purchase allowances from firms that exceeded their reduction goals. Initially, some fraction of the allowances would be allocated for free, but the government would gradually increase the proportion sold at auction. The cap-and-trade system would thus enforce the government-mandated emissions ceiling, while providing flexibility to firms to decide how and by whom those caps are met.

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THE CHALLENGE

The problems resulting from climate change have been predicted for at least two decades. Scientists know that the Earth's average annual surface temperature has risen about 0.7 degrees Celsius in the last 150 years, with most of the increase occurring since 1970. Further warming could lead to an increasingly volatile global climate, characterized by changes in precipitation and runoff, a significant rise in sea levels, and increased frequency of severe weather.

To reduce the odds of a climate disaster, humans must lower their emissions of GHGs into the atmosphere. Because climate change results from the accumulation of GHG emissions over many decades, the key is to stabilize the total atmospheric concentration of these gases over time rather than to regulate the quantity of emissions in any one period. A consensus is emerging that the target should be stabilized concentrations of CO_2 at 450 to 550 parts per million (ppm). A concentration in that range would be nearly double pre-industrial levels but, it is believed, would avoid the direst outcomes. Without policy changes, concentrations would rise from just below 400 ppm today to approximately 800 ppm by the end of this century, according to the Intergovernmental Panel on Climate Change.

> The U.S. needs a response to climate change that is environmentally effective, cost-effective, and distributionally fair.

The question then is how to achieve this target. Climate change is a global problem that requires a global solution; it will not be enough for one or a few countries to reduce emissions. But how might countries be persuaded to cooperate on reducing emissions? And what policy mechanism or mechanisms should they use?

The Kyoto Protocol was a first, tentative step forward. Signed in Kyoto, Japan, in December 1997, the Protocol is an international accord to reduce greenhouse emissions. The United States has not ratified the Protocol, and many economists have criticized the accord for imposing too heavy an economic burden for the modest reductions in emissions it would accomplish.

To comply with its Kyoto emissions target, the European Union created the Emissions Trading Scheme (ETS), the world's largest program to date for trading CO_2 allowances. The scheme covers about half of all sources of carbon emissions in the participating countries, including electricity generators, oil refineries and steel, cement, and other major manufacturers—but not transportation, residential, or commercial emitters. The program has generated a functioning market in emissions since it took effect in 2005, but it initially suffered from price volatility and low allowance prices after governments gave away more allowances than businesses needed.

The design of the EU ETS limited the program's effectiveness in what Stavins argues are the three most important criteria for success: environmental effectiveness, cost effectiveness, and distributional equity. By exempting half of all GHG sources, the ETS limited from the outset the amount of emissions reduction that could be achieved, and increased the cost of attaining any given level of reduction. Its reliance on downstream regulation—regulation of energy consumers rather than producers—means that a much larger number of entities must be monitored. The process for setting caps and allowances is left up to the member states, often resulting in all the allowances being given away for free rather than auctioned or sold. This restricts distributional equity, benefiting industrial polluters without attempting to address the regressive impacts on low income individuals. Finally, the ETS lacks any mechanism to stabilize allowance prices.

Stavins argues that America can do better—and must do better because the framework established today could last for many decades. In addition, success at achieving global cooperation on climate change requires that the United States accept an equitable share of the burden. Stavins believes a cap-and-trade system is the best available policy, but proper design is key. He argues that his plan lays the foundation for an environmentally effective, cost-effective, and distributionally fair approach.

A NEW APPROACH

Prospective solutions to the challenge of climate change fall into two categories: direct governmental regulation (often referred to as "command and control") and indirect regulation through market forces. Stavins, like most economists, generally favors market-based approaches because they mandate a particular goal—in this case, a targeted reduction in emissions—while offering firms and consumers flexibility in choosing the means to achieve this goal. This approach minimizes distortions and costs.

Among market-based approaches to climate change, two are preeminent: a tax on GHG emissions and a cap-and-trade system. Stavins argues that well-designed versions of both systems have much in common, but he prefers a cap-and-trade system for both economic and political reasons.

Citing historical experience as well as economic theory, Stavins identifies several key design elements for an optimal cap-and-trade system in the United States. These elements are chosen for their ability to promote environmental effectiveness, cost effectiveness, and distributional equity.

> As a market-based program, a cap-and-trade system would establish a specific cap while providing flexibility to firms over how to meet the cap.

A Gradually Increasing Trajectory of Emissions Reductions Over Time

The long-term nature of the climate problem offers significant flexibility in the timing of emission reductions without sacrificing environmental benefit. Instead of advocating stringent and costly action immediately, Stavins' proposal takes advantage of this flexibility by gradually increasing the level of mandated emissions reductions. This strategy encourages the development of new technologies that will make it easier to meet the caps as they become tighter.

Tradable Allowances

Under Stavins' cap-and-trade system, firms would have to surrender an emission allowance for every ton of CO_2 they release into the atmosphere. Those firms that could cheaply reduce their emissions and thus had allowances left over could sell them to firms that needed extra allowances. Trading in this market for allowances would establish the price that firms would have to pay to pollute. This mechanism would ensure environmental effectiveness—total emissions would be fixed by the cap—while reducing costs by maintaining flexibility.

Proposal Highlights

Environmental Effectiveness

A cap-and-trade system is the only market mechanism that ensures a chosen level of emissions reduction. The government caps the level of carbon dioxide emissions by issuing a limited number of allowances. Polluting firms must surrender an allowance for each unit of CO_2 they emit.

Cost Effectiveness

Stavins argues that a cap-and-trade system must include the following five elements to minimize the economic cost of necessary reductions.

- **Emission allowances should be tradable,** ensuring that economy-wide emissions targets are met while giving firms flexibility in deciding how to do it.
- **The level of emissions reduction should increase gradually,** to give the economy time to adjust and provide incentives for the development of new cost-saving technology.
- **The point of regulation should be upstream**—on energy producers rather than energy consumers—decreasing the number of entities to monitor and ensuring economy-wide scope of coverage.
- **The system should include mechanisms to reduce cost uncertainty,** such as banking and borrowing of allowances along with a cost-containment mechanism that effectively places a ceiling on allowance prices.
- **The United States should eventually link with other cap-and-trade systems** to take advantage of lower abatement costs abroad.

Distributional Equity

The allocation of emissions allowances can be designed so as to ensure distributional equity. Stavins argues that initially giving away half of all allowances to firms disproportionately burdened by the policy is the best way to compensate them for their losses, while gradually moving toward 100 percent auctioning raises revenue that can be used to reduce the burden on low income consumers facing higher energy prices.

Upstream Regulation

In Stavins' proposed system the point of regulation, where the emission allowances would have to be surrendered, would be "upstream"—at the point of fossil fuel extraction, refining, distribution, or importation. Rather than require consumers to hold allowances for every tank of gasoline and every kilowatt-hour of electricity consumed, the proposal would require energy companies to hold the number of allowances corresponding to the carbon content of the fuels they produce. This is far more efficient because it drastically reduces the number of sources that the government must monitor, and because it facilitates economy-wide scope of coverage, which reduces costs. Stavins estimates that nearly all U.S. CO_2 emissions could be capped by regulating some 2,000 companies, many of which already report fossil fuel sales.

Even with upstream regulation, the cost of the allowances would be passed onto consumers, affecting their decisions about energy consumption. Pressure to reduce emissions would thus be felt economy-wide. Moreover, in the event that technology to collect and trap carbon emissions is developed (so-called "carbon capture"), an upstream approach would allow the government to credit companies for CO_2 emissions that are buried in the ground or otherwise kept out of the atmosphere.

Mechanisms to Reduce Cost Uncertainty

The distinctive feature of a cap-and-trade program is that it sets a desired level of emissions but lets the allowance price fluctuate. In essence, it achieves emissions certainty by accepting cost uncertainty. But a fluctuating price can have significant negative effects on the economy, eroding market confidence and dampening investment. To increase the cost effectiveness of a cap-and-trade program, Stavins proposes three steps to mitigate cost uncertainty.

First, firms should be able to "bank" their extra allowances, saving them against the possibility of a future spike in demand that drives the price much higher. Second, firms should be able to borrow emissions allowances from the government and repay them later. This cost-saving feature might shift emissions from earlier to later years, but it would not affect total emissions over time and therefore would not jeopardize the policy's environmental effectiveness.

Finally, the program should include a cost-containment provision to be exercised in the event of a sudden, unanticipated spike in prices. If prices reached a certain level, the government would issue more allowances at that price rather than allow the price to rise further. The money raised would be used exclusively to fund emissions reductions from other sources or to buy back allowances from future years, thus ensuring that cost containment does not undermine the program by allowing total emissions to increase.

Phasing In Full Auctioning

Stavins argues that eventually the government should auction off all of the annual allowances and recycle the revenue to achieve social objectives. This complete auction is critical to ensure that politically favored industries do not get a permanent windfall by receiving highly valuable permits for free. Stavins acknowledges, however, that some firms—including suppliers of primary fuels, electric power producers, and manufacturers of energy-intensive goods —would be adversely affected by the initial move to carbon pricing and should be compensated accordingly. To ease the burden on these firms, Stavins proposes that 50 percent of allowances be given to them for free in the initial rounds of allocation, but that the free allocation be phased out gradually over twenty-five years—the equivalent of freely allocating 15 percent of the allowances in perpetuity. Stavins shows that this allocation path would almost exactly offset any losses to these firms, thereby also increasing the likely political support for the program.

> Revenue from allowance auctions—starting at around $50 billion a year and growing to $400 billion by 2050—can be used to offset the regressive nature of energy price increases.

The gradual move to full auctioning of allowances would generate increasing and substantial government revenue: from at least $50 billion a year (in 2005 dollars) initially to around $400 billion a year by 2050. This revenue could be used for any of a number of worthwhile public purposes, including compensation for the impacts of higher energy costs on low-income individuals, public spending for related research and development, reduction of the federal deficit, or the reduction of other taxes.

Linkage with Other Cap-and-Trade Systems

A successful U.S. cap-and-trade program, Stavins argues, would include linkages with climate policies in force outside the United States. In the long run, linking the U.S. cap-and-trade system with similar systems in other countries would lower the total cost of reducing emissions. This should be done gradually, however, to allow time for the U.S. system to mature. In the short term the United States should promote linkage through programs such as the Kyoto Protocol's Clean Development Mechanism, which credits firms in one country for emissions reductions they fund in another.

Unlike a carbon tax, a cap-and-trade system can ensure specific emissions targets are met.

Environmental and Economic Impacts

To illustrate the cost effectiveness of his proposal, Stavins estimates its impact under two hypothetical trajectories of emissions caps. One entails stabilizing CO_2 emissions at their current level over the period from 2012 to 2050. A second, more stringent trajectory, would require reducing emissions to half their 1990 level over the same period. These trajectories are consistent with the end points of the frequently cited global goal of stabilizing atmospheric concentrations of CO_2 between 450 and 550 ppm, assuming that all nations take commensurate action.

These reductions will come at a cost. Overall economic output would be reduced, but only modestly. Output in 2050 would be about one-quarter to one-half a percent lower compared to business as usual. The effect on the annual rate of economic growth would be very small, equivalent to reducing average annual GDP growth of 2.901 percent by only 0.005 to 0.01 percentage point between 2012 and 2050.

The distribution of these costs within the economy is also important. Stavins finds that fossil fuel producers and electric power generators would bear 10 percent of the burden, business and industry 55 percent, and households 35 percent. Among households, the burden would fall disproportionately on the poor, who spend a greater share of their income on energy than the rich. Stavins therefore proposes that revenue from the allowance auctions be used to offset the regressive nature of energy price increases. This could be accomplished by cutting taxes on low-income households: the revenue generated by the auctions would pay for a tax cut of around $4,500 (in 2005 dollars) for an average family of four in 2050.

Why Not A Carbon Tax?

Although Stavins rejects all command-and-control alternatives to cap-and-trade as inefficient, he is not so dismissive of a carbon tax. A properly designed carbon tax could achieve results similar to those of a cap-and-trade system in a simple manner and with comparable flexibility.

According to Stavins, the most serious objection to cap-and-trade involves the price volatility that has plagued some regimes. He acknowledges that a carbon tax avoids this volatility—indeed, a fixed carbon tax rate offers virtual price certainty. But a carbon tax does not guarantee that the chosen emissions reduction goals will be met. By contrast, a cap-and-trade system can promise to achieve whatever emissions reduction it sets as the goal—but does so at a less certain cost.

Stavins' proposal includes three built-in mechanisms—banking, borrowing, and cost containment—to address this cost uncertainty. He admits that these mechanisms cannot eliminate price uncertainty, but he argues that they can reduce it to a manageable level. The residual uncertainty, he argues, is a small price to pay for the certainty of meeting emissions reduction targets.

Stavins goes on to identify what he sees as three clear advantages of cap-and-trade over a carbon tax. First, cap-and-trade focuses the debate more squarely on what ultimately matters for the environment —reducing emissions—rather than on what the exact price of carbon should be. Second, it is simple under a cap-and-trade system to directly compensate the industries most burdened by the policy: give them free allowances. For this reason, Stavins argues, a cap-and-trade system is more likely to be politically acceptable, thus increasing the chances that the necessary emissions reductions will occur. True, a carbon tax regime can mimic such compensation through exemptions and the like, but it is legislatively more complex and likely to lead to tax breaks for favored industries, undermining the effectiveness of the tax. Finally, Stavins points out that cap-and-trade systems have already been shown to work well in practice, the most notable examples being the market for sulfur dioxide created by the 1990 Clean Air Act Amendments and the phase out of leaded gasoline in the 1980s.

CONCLUSION

Stavins emphasizes that the ultimate goal of any carbon pricing policy should be to reduce greenhouse gas emissions. The only way to guarantee a significant reduction in emissions, Stavins argues, is to set an ambitious quantity target, and the most efficient way to do that is through a cap-and-trade system that includes features designed to reduce costs.

But even the most thoughtful and well-designed proposal would be for naught if it failed the test of political feasibility. For a market-based policy to gain support, Stavins says, those industries and consumers that the policy would disproportionately burden must be compensated accordingly. Here a cap-and-trade system is ideal because it can issue valuable allowances to companies for free and use revenue from auctioning the rest to compensate consumers, all without compromising environmental effectiveness. With these features, Stavins proposes a politically feasible climate policy that achieves both environmental effectiveness and economic efficiency.

Learn More About This Proposal

This policy brief is based on The Hamilton Project discussion paper, *A U.S. Cap-and-Trade System to Address Global Climate Change,* which was authored by:

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Additional Hamilton Project Proposals

Additional Hamilton Project discussion papers and policy briefs on energy and climate change can be found at www.hamiltonproject.org, including:

- **A Proposal for a U.S. Carbon Tax Swap: An Equitable Tax Reform to Address Global Climate Change**
  A tax on greenhouse gas emissions would give businesses and consumers incentives to reduce emissions cost-effectively. The proposal would use revenue from the tax to offset the burden of higher energy prices on low-income consumers.
- **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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