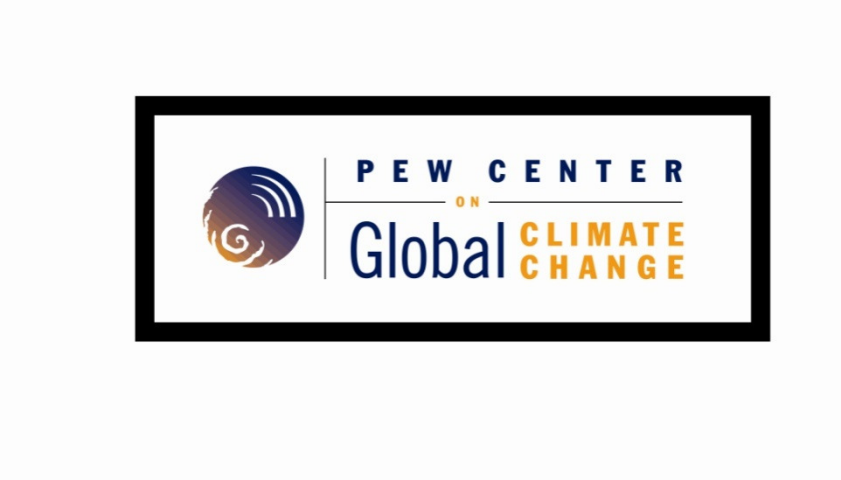


In Brief:

Meaningful and Cost Effective Climate Policy: The Case for Cap and Trade

By Janet Peace and Robert N. Stavins[1]

Introduction

There is broad consensus among those engaged in climate policy analysis—from academia, government, NGOs, and industry—that any domestic climate policy should include, at its core, market-based policy instruments targeting greenhouse gas (GHGs) emissions, because no other approach can do the job and do it at acceptable cost. By "putting a price on carbon," market-based polices harness the power of our free enterprise system to reduce pollution at the lowest costs. Recent concern, however, about the role of financial markets—and specific fraudulent investment vehicles—in the recent recession have raised questions among the public about the efficacy *and* functioning of markets. Not surprisingly, some have questioned the wisdom of employing market mechanisms to tackle climate change. Critics ask, how can market-based policy instruments be trusted to look after the public's welfare with regard to global-warming pollution (or anything else, for that matter)?

When it comes to climate change and environmental issues more generally, environmental economists recognize that the source of many problems is not markets *per se*, but the *absence* of markets for environmental goods and services, such as clean air and water. In the absence of prices (costs) associated with environmental damages, producers and consumers need not account for such damages in their activities and choices. Environmental damage is thus an unintentional by-product of decisions to produce or consume. Because these negative consequences are external to the firm or individual creating them, economists refer to them as externalities. They are one category of market failures; in this case, the failure of existing markets to price accurately the full costs to society of producing and consuming goods that create a pollution externality.

In the case of climate change, the burning of fossil fuels and other activities that release GHGs into the atmosphere are associated with increasing global temperatures. The costs of these impacts, including an increase in extreme weather events, rising sea levels, loss of biodiversity, and other effects, are borne by society as a whole, including future generations. In the absence of a price on carbon, these environmental costs are *not* included in the prices of GHG-based goods—thus there is no direct cost for emitting GHG pollution into the atmosphere. From a societal perspective, this leads to an inefficient use of resources, excessive emissions, and a buildup of excess concentrations of GHGs in the atmosphere.

The current *status quo* or "*laissez-faire*" approach to dealing (or rather failing to deal) with GHG pollution results in an outcome that is not in the interest of society. For this reason, many people have advocated putting a price on GHG emissions to cause market participants to confront or "internalize" the costs of their actions and choices. A policy instrument that puts a price on GHG emissions would, for example, raise the cost of coal-generated electricity, relative to electricity generated with natural gas, because coal as a fuel emits more carbon dioxide (CO_2) per unit of energy. Producers and consumers would take this relative cost differential into account when

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

deciding how much electricity to produce and what fuels to use in producing it. That is the point—to make the cost of emitting carbon explicit, so that it becomes part of the everyday decision-making process.

Two alternative market-based mechanisms can be used to put a price on emissions of GHGs—cap and trade and carbon taxes. With cap and trade, an upper limit or "cap" on emissions is established. Emission allowances that equal the cap are distributed (either freely or through auction) to regulated sources which are allowed to trade them; supply and demand for these allowances determine their price. Sources which face higher abatement costs have an incentive to reduce their abatement burden by purchasing additional allowances, and sources which face lower abatement costs have an incentive to reduce more and sell their excess allowances. Thus, the government establishes the environmental goal (the cap), but the market sets the price.

In contrast, a carbon tax sets a price on emissions, but leaves the environmental outcome uncertain. The tax creates an incentive for firms to reduce their emissions up to the point where the cost of reductions is equivalent to the tax. If the tax is low, fewer reductions will result; if the tax is high, more abatement effort will be forthcoming.[2] Given the real-world U.S. political context, the more promising of the two market-based approaches to addressing climate change is clearly cap and trade, which creates a market for GHG reductions.[3]

While the common sense justification for putting a price on carbon emissions seems straightforward, some of the public and even some policy makers are questioning whether creating a market for GHG reductions is a cure worse than the disease itself. Some questions and concerns include the following:

- Why employ market-based approaches to GHG emission reductions, when markets are subject to manipulation?
- Would a market-based approach to reducing GHG emissions be a corporate handout?
- Can markets be trusted to reduce emissions?
- Will a market-based approach, such as cap and trade, be too costly?
- Are other approaches—including conventional regulation and taxes—likely to be more effective and less complicated?

Our goal in this paper is to address the questions above, and—we hope—leave the reader with a better understanding of the issues, the rhetoric, and the fundamental reasons why cap and trade is the most promising approach to address the threat of climate change. We believe that past concerns

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

about how markets operate can be effectively addressed and result in a policy that is both environmentally and economically superior to alternative approaches.[4]

Why create a market for GHG emissions, when markets—in general—are subject to manipulation and are not perceived to be working?

With the U.S. economy experiencing its worst recession since the Great Depression, amidst corporate scandals, pyramid schemes, and a series of government bailouts, some members of the public as well as elected officials have come to question the ability of markets to perform their basic functions. Despite the past successes of market mechanisms to address environmental problems such as acid rain, leaded gasoline, and ozone depletion, this growing distrust of markets has led some to question whether market-based approaches are appropriate instruments to help tackle the exceptionally challenging problem of global climate change.

The storyline has variations, but goes roughly like this: establishing a "carbon market" for GHG emissions opens the door for financial intermediaries—banks and brokers—to be involved. Since we know that they cannot be trusted, and only care about making profits (and not about reducing emissions), how could any approach that involves them be part of an effective solution? In reality, of course, our recent economic turmoil does not mean that "markets" in any general sense do not work; only that markets require appropriate oversight. Our economy fundamentally is a market-based system, but oversight—including, where appropriate, effective rules and regulations—can be essential to ensure transparency and prevent manipulation.

With appropriate rules and oversight, markets have been shown to work exceptionally well to address environmental problems. They provide key flexibility to regulated entities to adopt least-cost approaches to emission reductions, while providing powerful incentives for technological innovation and diffusion, which serve to reduce costs over time. Real world experiences with using market-based instruments for

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

environmental protection include chlorofluorocarbon trading under the Montreal Protocol (to protect the ozone layer); sulfur dioxide (SO_2) allowance trading under the U.S. Clean Air Act Amendments of 1990 (to curb acid rain); nitrogen oxide trading (to control regional smog in the eastern U.S.); and eliminating lead from gasoline in the 1980s.

Studies that have evaluated the performance of these market-based approaches to environmental protection have found that they have achieved their environmental objectives and have done so at lower cost than conventional, command-and-control approaches. Estimates of cost savings range from seven percent to 96 percent, with more than half of studies showing that market-based programs cut the cost of regulation by well over 50 percent compared with command-and-control options. For example, the SO_2 allowance trading program resulted in 33 percent cost savings—on the order of $1 billion annually (Ellerman, 2000) while reducing power-sector emissions from 15.7 million tons in 1990 to 7.6 million tons in 2008 (U.S. Environmental Protection Agency, 2010). The phase-down of leaded gasoline in the 1980s, which employed trading of environmental credits, was also successful in meeting its environmental targets, while yielding cost savings of about $250 million per year (Stavins 2003).

The evidence is incontrovertible—market-based approach to environmental protection can work, effectively achieving environmental targets and keeping costs to a minimum. These approaches are not deregulation, but reformed and improved regulation. And like all markets, these environmental markets need rules and oversight. Substantial Congressional effort is currently underway to address regulatory and oversight issues in financial markets more broadly and many of these reforms, including more stringent requirements for transparency, position limits, and derivatives trading, will have implications for future carbon markets. With the right rules and oversight we can ensure that markets benefit "Main Street" America and not just "Wall Street."

Would a cap-and-trade approach to reduce GHG emissions be a corporate handout?

A cap-and-trade system establishes an overall limit or "cap" on emissions and distributes the "rights" to emit via permits or allowances.[5] The choice between giving these allowances away for free to covered firms (typically on the basis of some historical baseline) or requiring that those firms buy the allowances in an auction (or from others) does not influence a firm's production and emission reduction decisions (two policy-relevant exceptions are allocations to regulated utilities and "updating allocations"). Furthermore, how the freely allocated allowances are initially distributed among firms and sources has no effect on the ultimate equilibrium distribution after trading (as firms needing additional allowances will buy and those with excess will sell).[6] The method of distribution also has no effect on the overall environmental performance (the emissions limit determines the outcome), the location of emission reductions (those that can reduce at lowest cost will do so), or the aggregate social cost of the program. The independence between the method

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

of distribution and the performance of a cap-and-trade program is a key political reason why these systems have been employed and employed successfully. Specifically because of this independence, government can set the level of the overall cap (whether on a scientific, economic, or other basis), and then leave it up to the legislature to decide how and to whom allowances will be distributed (in a political system presumably with the goal of building support for the program) *without* affecting the system's environmental performance or overall costs.

> The evidence is incontrovertible—market-based approach to environmental protection can work, effectively achieving environmental targets and keeping costs to a minimum.

Despite the fact that the allowance distribution in general has no bearing on the environmental outcome or the economic cost of the program, it is nevertheless true that the allowances are valuable, and giving them for free to regulated entities strikes some as a "corporate handout" and possibly an undeserved "windfall gain." The charge of windfalls would be especially applicable when firms can pass along the value of these allowances in the prices of their products. Indeed, this is one of the critiques often made about the first and largest cap-and-trade system for GHGs, the European Union Emission Trading System (EU ETS).

Sharp increases in electricity prices during the first year of the initial pilot phase of the EU ETS (2005-2008) gave rise to concerns that even though utilities received allowances for free, they were charging higher prices to their customers and thus reaping windfall profits. A 2008 Pew study by Ellerman and Joskow, however, found that, in fact, much of the increase in EU electricity prices was due to increased fuel prices that utilities were paying, particularly for natural gas.

Nevertheless, there is nothing inherent in a cap-and-trade approach that requires that all allowances be freely allocated only to emitters. Because the allowance distribution does not affect the overall cost of the program but rather who bears those costs, allowances can be used to compensate those most financially burdened. A cap-and-trade approach allows politicians to address distributional issues, and provides a straight-forward means to compensate burdened sectors and address competitiveness concerns. By providing policy-makers with the option to mitigate economic impacts through the distribution of emissions allowances, this approach can help establish a consensus for a policy that achieves meaningful reductions. This has been validated by experiences with other market-based programs over the past two decades and more. While there is bound to be considerable debate on who should receive the allowances, this is part of the political process, and ultimately does not affect either the program's environmental performance or its cost effectiveness. A market-based approach to reducing GHG emissions is not a corporate

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

One of the reasons why market-based environmental policy instruments provide flexibility is that they do not dictate the use of specific control methods or technologies.

handout, but rather a tool to fairly distribute costs among consumers and businesses as we achieve a transformation from a high-carbon to a low-carbon economy.

Can markets be trusted to reduce emissions?

One of the reasons why market-based environmental policy instruments provide flexibility (and thereby reduce overall compliance costs) is that they do not dictate the use of specific control methods or technologies. Although aggregate emission reductions are achieved, the flexibility provided by market-based instruments can mean that some firms (sources) will reduce emissions more than others. For some observers, this flexibility raises concerns that overall emission reduction goals will not be met.

Specifically, critics point to "over-allocation" in Phase I of the EU program where the number of allowances distributed by the government exceeded emissions by sources covered by the program. In other words, the initial emissions cap was not binding. Ellerman and Buchner (2007) in their in-depth examination of the first phase explained that the non-binding cap was the result of a modest initial target (at most, the expected emission reduction goal for the EU as a whole during the pilot phase was less than two percent), and the fact that program administrators had incomplete historical emissions data on which to base their emissions cap. It is important to recognize that the primary purpose of the pilot phase was not to reduce emissions, but to gain experience with key elements of the trading system, in order to have a fully operational system for the period 2008-2012, when EU compliance with the Kyoto Protocol was required. Without a doubt, the purposes of the pilot phase were fulfilled—key elements of a trading regime were established and a functioning CO_2 allowance market emerged. In addition, estimates indicate that abatement did occur during the pilot phase (Ellerman and Joskow, 2008). Approximately 50 to 100 million tons of CO_2 were reduced annually in 2005 and 2006 (about 3-5 percent fewer emissions than would have occurred in the absence of the EU ETS).

Building on this first phase, the reduction target for the current phase (Phase II) is six percent below 2005 levels by 2012, and the target for Phase III is 21 percent below 2005 levels by 2020. With better data and tighter caps, over-allocation is no longer an issue. Of course, because of the global recession, the price of carbon allowances, like other commodities, in 2009 began a downward slide. Reduced economic activity means less energy production and less industrial activity, and hence lower emissions. This is not a problem with the cap-and-trade system, but rather validation of its efficacy. When emissions are lower because of reduced economic activity,

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

allowance prices will also be lower, reducing the burden on industry. In contrast, when the economy is expanding, emissions will be higher, as will allowance prices.

In other words, whether emissions have fallen as a result of intentional abatement or decreased economic activity due to recession does not obscure the fact that emissions are not exceeding the policy goal. The cap continues to provide a hard and declining upper bound on emissions that cannot be exceeded. The allowance price is the self-adjusting mechanism. The EU system worked as anticipated—firms are considering the price of carbon in their decisions. As for the level of that price, if it is not high enough to stimulate the level of innovation desired, regulators may decide that a future tightening of the cap or other intervention is in order. To this last point, however, it is important to remember that policy certainty and price expectations over much longer time horizons are what really matter for long-term investment decisions, such as those required to reduce GHG emissions dramatically over time.

Making gradual changes means we do not have to scrap still-productive power plants, but rather begin to move new investment in the right direction. The right transition plan will ensure that consumers are not severely affected.

So, can markets be trusted to result in lower emissions? Yes, experience is clear that well-designed cap-and-trade systems can ensure that emissions are held below required levels. The emissions cap or limit provides this certainty; the use of a market ensures the flexibility necessary for the policy to be cost effective.

Will a market-based approach, such as cap and trade, be too costly?

Some critics argue that the legislation passed in June of 2009 by the U.S. House of Representatives—to cut U.S. emissions 80 percent below 2005 levels by 2050—will mean big, disruptive changes to our infrastructure and untold economic damage. But they make a couple of basic errors. For one thing, they seem to think we would have to replace the entire energy-related infrastructure quickly, paying trillions of dollars to shift to cleaner power. But making gradual changes means we do not have to scrap still-productive power plants, but rather begin to move new investment in the right direction. The right transition plan that gradually increases the price that consumers pay for energy and provides incentives for reduced energy usage will ensure that consumers are not severely affected and will allow companies to make gradual, well-timed adjustments to their capital stock.

The key is to send price signals through the market—say, via a combination of national and multinational cap-and-trade systems—in order to make the use of less carbon-intensive fuels more

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

cost-competitive, providing incentives for energy efficiency and stimulating climate-friendly technological change, including methods of capturing and storing carbon. Critics are wary of raising energy prices, arguing that no nations have grown wealthy with expensive power. But historically, it is the scarcity and cost of energy that have prompted technological changes as well as the use of new forms of power.

In the short term, changing the energy mix will come at a cost, but this will hardly stop economic growth. The best economic analyses—including studies from the U.S. Congressional Budget Office (2009) and the U.S. Energy Information Administration (2009)—say such a policy in the United States would cost considerably less than one percent of gross domestic product per year in the long term, or up to $175 per household in 2020. In the end, we would be delaying reaching expected U.S. economic output in 2030 by no more than a few months. And bear in mind that previous environmental actions, such as attacking smog-forming air pollution and cutting acid rain, have consistently turned out to be much cheaper than predicted (Harrington, Morgenstern, and Nelson 1999).

Even though credible modeling has suggested that the costs would be relatively modest, some critics note that we are emerging from a deep recession and unemployment remains high—they thus argue that any additional cost would be too great. In this context, it is important to consider the costs of not acting to reduce emissions. That cost is far from zero.

First, consider the fact that despite the global recession, the world remains on a path to more than double GHG concentrations to 1,000 parts per million (ppm) in CO_2-equivalent terms by the end of the century, resulting in a likely average global temperature increase of six degrees Centigrade. But increased temperatures—which might well be welcome in some places—are only part of the story.

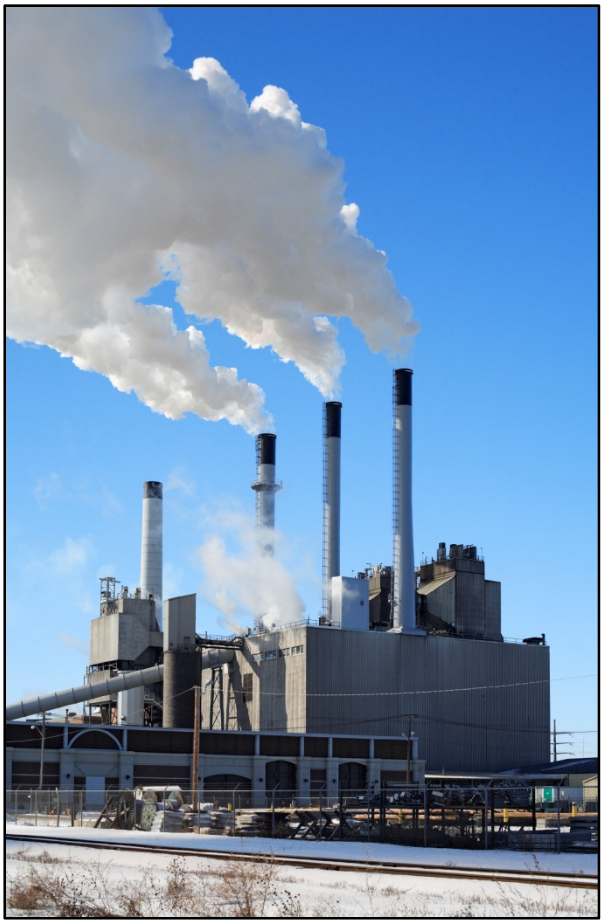
The most important consequences of climate change will be changes in precipitation, disappearance of glaciers throughout the world, droughts in mid to low latitudes, decreased productivity of cereal crops, increased sea level, loss of islands and 30 percent of global coastal wetlands, increased flooding, greater storm frequency and intensity, risk of massive species extinction, and significant spread of infectious disease (Intergovernmental Panel on Climate Change 2007a). On the other hand, climate change will also bring some health benefits to temperate areas, such as fewer deaths from cold exposure. But such benefits will be greatly outweighed by negative health effects from rising temperatures, especially in developing countries.

It is anticipated that these impacts will have severe economic, social, and political consequences for countries worldwide, ranging from malnutrition and mass migration (hundreds of millions of people displaced) to national security threats. Bottom-line, comprehensive estimates of economic impacts of unrestrained climate change vary, with most falling in the range of two to five percent of

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

world Gross Domestic Product per year by the middle of the century (Intergovernmental Panel on Climate Change 2007b). To have a 50-50 chance of keeping temperature increases below two degrees Centigrade[7]—the level at which the worst consequences of climate change can be avoided—it would be necessary to stabilize atmospheric concentrations at 450 ppm.[8] Consistent with the 450 ppm goal is a long-range target of cutting U.S. emissions 80 percent below 2005 levels by 2050, which is the target of the legislation passed by the U.S. House of Representatives, H.R. 2454, the Waxman-Markey bill.[9]

Clearly, stabilizing atmospheric concentrations at 450 ppm will require a radical transformation of the way the world produces and uses energy. But if there is a silver lining to the global recession, it is that by slowing emissions growth it will make it that much easier to achieve any given stabilization target. Of course, this is contingent on government action that takes advantage of this window of opportunity. Now is the time for policy to be put in place that puts the economy on a more carbon-friendly path as we emerge from the recession, and the pace of investment accelerates. Taking action now also avoids locking in more carbon intensive long-term investments that would only make the cost of addressing climate change more expensive in the future. The International Energy Agency (IEA) estimates that each year of delay adds on another half trillion dollars to the cost (IEA, 2009)



Addressing climate change by means of a market for GHG reductions need not damage the economy and is necessary to avoid much more costly and potentially irreversible climate impacts.

Are other approaches—including conventional regulation and taxes—likely to be more effective and less complicated?

So, while a market-based climate policy can cost-effectively deliver environmental performance, it will hardly stop economic growth. Still others argue that environmental outcomes with such policies are not certain and that market-based

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

policy instruments are too complex and cannot be easily explained to voters. Instead, these critics argue that other policies like, conventional regulation (e.g. technology or performance standards) or even taxes would be a more straightforward and simpler means of achieving emissions reductions. In truth, a conventional standards-based approach and taxes are useful policy tools, and both could potentially serve a role in addressing climate change. But neither a standards-based nor a tax approach is likely to be more effective or less complicated than a cap-and-trade system for achieving meaningful GHG emissions reductions.

Standards require firms and consumers to take particular actions that directly or indirectly reduce emissions. Examples include efficiency standards for appliances, vehicle fuel-economy standards, best available control technology standards for stationary and mobile sources of emissions, and renewable portfolio standards for electric power generators. The environmental outcome or the type of technology is essentially specified for each firm or even source. Environmental Protection Agency has been regulating conventional air pollutants under the Clean Air Act for decades using a standards-based approach.

There is little debate that standards tend to be more costly than market-based instruments, because their inflexibility means that they drive up costs in the face of the extremely wide variation in abatement costs that characterize the climate problem (and, for that matter, most other environmental problems). But, beyond this, the environmental effectiveness of a standards-based approach depends on the technical ability of policymakers to design and governments to implement a very wide array of standards sufficiently diverse to address the sources of GHG emissions in a modern economy. Because of the large number of sources and the differing types of technology, this would neither be easy nor quick.

Furthermore, because of practical limitations, most standards to address GHG emissions would likely only target energy use or emissions rates from new capital equipment, such as appliances, cars, or electric power plants. Retrofitting equipment to increase efficiency or reduce GHG emissions is often impractical and considerably more costly. To the extent that standards would not affect existing equipment that would significantly limit the opportunity for near-term emissions reductions. It also makes the level and timing of those reductions dependent on the rate of capital stock turnover, which is difficult to predict. Moreover, by increasing the cost of new capital stock but not the cost of using the existing capital stock, standards on new sources have the perverse effect of creating incentives to delay replacement of existing capital stock. This perverse incentive can significantly delay the achievement of emissions reductions (Stavins 2006). The New Source Review regulations (part of the Clean Air Act) are a prominent example of this effect.

As new technologies emerge and increasingly stringent emissions targets must be met, pursuit of a standards-based approach would also require continual adjustments to the standards, at a significant administrative (and political) cost, to ensure that responsibilities for emissions

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

reduction continue to be distributed across regulated sources in a reasonably cost-effective manner.

By contrast, under a carbon tax, only the tax would need to be updated. Firms and households will respond to emerging technologies and increasing carbon price signal by adopting those technologies, measures and efficiency improvements that offer the least costly emissions reductions (as with cap and trade). The environmental effectiveness of a tax, however, is uncertain. In theory, the tax could be adjusted until the level of reduction desired was achieved, but in reality, adjusting a tax would be politically difficult, if not impossible.

The fundamental reason why we face the threat of global climate change is that there is no price or cost for emitting GHGs.

More broadly, cap and trade avoids the likely battles over tax exemptions for vulnerable firms and sectors that would drive up the program's costs, as more and more sources are exempted from the program at the expense of environmental effectiveness. Instead, a cap-and-trade system leads to political battles over the allowance allocation, but these neither raise overall cost nor affect the climate impacts. Some observers seem to worry about the propensity of the political process under a cap-and-trade system to compensate sectors (through free allowance allocations) that successfully claim unfair burdens. But a carbon tax is sensitive to the same political pressures and may be expected to succumb in ways that are ultimately more dangerous: reducing environmental performance and driving up costs.

Summary and Conclusions

The fundamental reason why we face the threat of global climate change is that there is no price or cost for emitting GHGs. In the absence of a price, the damages associated with a changing climate are not considered by companies or individuals when they make their energy choices. A cap-and-trade policy creates this price by establishing a limit on the amount of GHG emissions and allowing firms covered by the program the flexibility to trade allowances. The environmental integrity of the program is ensured by the "cap" on emissions, and the costs of the program are kept as low as possible through the creation of a market (where firms can buy and sell allowances).

Recent concern about financial markets and fraudulent investment scams has created an atmosphere of distrust regarding the functioning and effectiveness of markets. By extension, questions have been raised about the wisdom of creating a market with a cap-and-trade program for controlling GHGs. In truth, appropriate oversight and regulation of carbon markets will be required. The problem has been the abuse of markets, not something fundamental about markets themselves.

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

A market can be used to reduce emissions effectively without causing significant damage to the economy. We know this from theory and more importantly, we know this from experience

A significant advantage of cap-and-trade policy is that specific control technologies for each sector or firm do not have to be identified. Instead, the system puts in place economic incentives for creating and using lower-emitting technology and less carbon-intensive energy. While policy makers do not dictate the technology mix, the environmental goal is assured because of the imposed emission limit.

Once the cap is set, emission allowances that just equal the capped level of emissions are distributed. How the (freely-allocated) allowances are distributed does not affect the system's environmental performance or its aggregate cost. Allowances or auction revenue can be given to emitters, non-emitters, or some combination. Cap and trade gives policy makers the discretion to address geographical equity and fairness issues through the distribution of allowances, and it provides a straightforward means to compensate specific sectors that are particularly burdened. Recent Congressional proposals notably have directed a very large percentage of the allowances (nearly 85 percent) be used for public purposes and to reward innovative technology.

Changing the energy mix of our economy will be a challenge but it does not have to happen overnight. The stringency of the program can and should increase over time, so that the economy has time to adjust and new technologies can be developed and adopted. Nevertheless, such a significant change will likely have a cost; and some sectors will lose jobs, while other sectors will gain jobs. When we transitioned from the horse-and-buggy to the automobile, buggy whip manufactures lost business over time, even as other industries obviously grew, and more than made up for any lost economic activity. Like the transition to the automobile, the transition to a lower carbon economy will have little adverse impact on economic growth. The best economic analyses suggest that such a policy would cost considerably less than 1 percent of gross domestic product per year, meaning that we would achieve the same economic output in 2050 a couple months later than without a climate policy.

A market can be used to reduce emissions effectively without causing significant damage to the economy. We know this from theory and more importantly, we know this from experience, because we have used this approach to address environmental problems many times in the past. This approach was successfully used to stop the acidification of lakes, reduce the hole in the stratospheric ozone layer, control smog forming pollution, phase-out lead in gasoline, and address wetland destruction. We have successfully used cap-and-trade systems for years, which is why this

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

approach has emerged as the preferred policy instrument to reduce GHG emissions throughout the industrialized world.

Climate change is a *real and pressing problem*. Strong government actions are required, as well as enlightened political leadership at the national and international levels. Creation of a market for GHG emissions can work, but is contingent on government action to establish this policy. Now is the time for a meaningful cap-and-trade policy to be put in place so that it can foster the right incentives to put our economy on a climate-friendly path.

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

Notes

[1] Peace is Vice President of Markets and Business Strategy at the Pew Center on Global Climate Change; and Stavins is the Albert Pratt Professor of Business and Government at the John F. Kennedy School of Government, Harvard University, Research Associate of the National Bureau of Economic Research, and University Fellow of Resources for the Future.

[2] For a more thorough discussion of these options, see: Revesz and Stavins (2007).

[3] For an analysis of the positive economy of instrument choice, see: Keohane, Revesz, and Stavins (1998); and for a normative assessment of taxes versus cap and trade in the context of climate policy, see: Stavins (2008).

[4] While cap-and-trade is subject of this paper, the authors acknowledge that this is likely not the only policy or policy type that is needed. For example, other market failures such as those associated with technology R&D and information asymmetries may require additional policy tools.

[5] Although we refer exclusively in this paper to (downstream) "emission trading," the point of regulation in a cap-and-trade system can also be upstream. In the case of climate change, this would mean trading in carbon rights (carbon content of coal, petroleum, and natural gas) among fossil fuel producers and importers (at the mine-mouth, well-head, and point of import). This was essentially the approach of the EPA leaded gasoline phase down in the 1980s, when refineries traded lead rights covering the leaded content of refined gasoline.

[6] There are some exceptions to this politically key rule of independence between the equilibrium allocation and the initial allocation. One exception is if allowances are distributed based on recent output; this distribution formula effectively provides a production subsidy which may influence output decisions and is thus not independent. Another exception is if an entity is a regulated utility which may not conform to the essential rules of profit maximization. For additional detail on the relationship between allowance distribution and the performance of cap and trade, see: Hahn and Stavins, 2010.

[7] The two degrees target was the goal agreed to by the Major Economies Forum in July 2009.

[8] International Scientific Steering Committee (2005).

[9] Even meeting the 450 ppm goal could result in significant sea-level rise, species loss, and increased frequency of extreme weather, according to the U.N. Intergovernmental Panel on Climate Change (2007a).

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

REFERENCES

Bovenberg, Lans A. and Lawrence H. Goulder. "Confronting industry-distributional concerns in U.S. climate-change policy." Discussion Paper (Les siminaires de l=Iddri no. 6), Institute on the Economics on the Environment and Sustainability, 2003.

Ellerman, Denny, Paul L. Joskow, Richard Schmalensee, and Juan-Pablo Montero. Markets for Clean Air: The U.S. Acid Rain Program. New York, NY: Cambridge University Press. 2000.

Ellerman, A. Denny and Barbara K. Buchner. "The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results." Review of Environmental Economics and Policy, volume 1, number 1, winter 2007, pp. 66-87.

Ellerman, A. Denny and Paul L. Joskow. "The European Union's Emissions Trading System in Perspective." Prepared for the Pew Center on Global Climate Change. May 2008. Available at: http://www.pewclimate.org/eu-ets. Accessed June 17, 2010.

Hahn, Robert W. and Robert N. Stavins. "The Effect of Allowance Allocations on Cap-and-Trade System Performance." National Bureau of Economic Research Working Paper 15854. Available at http://www.nber.org/papers/w15854. Accessed June 1, 2010.

Harrington, Winston, Richard D. Morgenstern, and Peter Nelson. "On the Accuracy of Regulatory Cost Estimates." RFF Discussion Paper 99-18. Washington, D.C.: Resources for the Future, January 1999.

Keohane, Nathaniel, Richard Revesz, and Robert Stavins. "The Choice of Regulatory Instruments in Environmental Policy." Harvard Environmental Law Review, volume 22, number 2, pp. 313-367, 1998.

Intergovernmental Panel on Climate Change. Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Cambridge, United Kingdom: Cambridge University Press, 2007a.

Intergovernmental Panel on Climate Change. Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the IPCC. Cambridge, United Kingdom: Cambridge University Press, 2007b.

International Energy Agency. "World Energy Outlook," Paris, France. 2009.

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

International Scientific Steering Committee. "Avoiding Dangerous Climate Change." Report of the International Scientific Steering Committee, International Symposium on the Stabilisation of Greenhouse Gas Concentrations, Hadley Centre, Met Office, Exeter, UK. Feb. 1-3. Available at: http://www.stabilisation2005.com/Steering_Commitee_Report.pdf. 2005.

Pizer, William, Dallas Burtraw, Winston Harrington, Richard Newell, and James Sanchirico. "Modeling Economy-wide vs. Sectoral Climate Policies Using Combined Aggregate-Sectoral Models." Energy Journal, Vol. 27, No. 3, pp. 135-168. (2006).

Revesz, Richard L. and Robert N. Stavins. "Environmental Law." Handbook of Law and Economics, Volume I, eds. A. Mitchell Polinsky and Steven Shavell, pp. 499-589. Amsterdam: Elsevier Science, 2007.

Richardson, Katherine. et al. Climate Change: Global Risks, Challenges and Decisions. Synthesis report from the conference, "Climate Change: Global Risks, Challenges and Decisions," held in Copenhagen March 10-12, 2009. University of Copenhagen: Copenhagen, Denmark. Available at: http://climatecongress.ku.dk/pdf/synthesisreport.

Smith, Anne, Martin Ross, and David Montgomery. "Implications of Trading Implementation Design for Equity-Efficiency Trade-offs in Carbon Permit Allocations." Working Paper, Charles River Associates, Washington, D.C., 2002.

Stavins, Robert N. "Experience with Market-Based Environmental Policy Instruments." Handbook of Environmental Economics, Volume I, eds. Karl-Göran Mäler and Jeffrey Vincent, Chapter 9, pp. 355-435. Amsterdam: Elsevier Science, 2003.

Stavins, Robert N. "Vintage-Differentiated Environmental Regulation." Stanford Environmental Law Journal, Volume 25, Number 1 (Winter 2006), pp. 29-63.

Stavins, Robert N. A U.S. Cap-and-Trade System to Address Global Climate Change. The Hamilton Project, Discussion Paper 2007-13. Washington, D.C.: The Brookings Institution, October 2007.

Stavins, Robert N. "Cap-and-Trade or a Carbon Tax." The Environmental Forum, Volume 25, Number 1, January/February, 2008, p. 16.

U.S. Congressional Budget Office. Cost Estimate of H.R. 2454, American Clean Energy and Security Act of 2009. Washington, D.C., June 5, 2009. Available at: http://www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf. Accessed Aug. 2009.

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

U.S. Energy Information Administration. Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009. Washington, D.C., August 2009. Available at: http://www.eia.doe.gov/oiaf/servicerpt/hr2454/pdf/sroiaf%282009%2905.pdf. Accessed August, 2009.

U.S. Environmental Protection Agency (EPA). Data from EPA website. Available at: http://www.epa.gov/airmarkt/progress/ARP_4.html. Accessed May 2010.

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone: 703.516.4146 Fax: 703.841.1422
www.pewclimate.org

Pew Center on Global Climate Change
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone (703) 516-4146
www.pewclimate.org

The Pew Center on Global Climate Change is a non-profit, non-partisan, independent organization dedicated to providing credible information, straight answers, and innovative solutions in the effort to address global climate change.