Environmental taxation in the United States are like virtue: much discussed but little practiced. This chapter surveys the use of environmental taxes in the United States. I note that our reliance on these taxes is much below the standards of other developed countries. Moreover, I note that the taxes Americans consider “environmental” are quite imperfect as instruments for protecting the environment, as they typically tax attributes correlated with but not coterminous with pollution.

In contrast, our theoretical understanding of environmental taxes in a second-best world made major advances in the past fifteen years. I review this recent literature and make some assessment of the most important policy lessons gleaned from this new knowledge. First, the use of revenues from an environmental tax has efficiency as well as distributional implications in a world with preexisting distortionary taxes (i.e., the real world). Using green tax revenues to lower particularly distortionary taxes can have important efficiency gains. Despite this fact, it is not necessarily the case that the optimal environmental tax should exceed the social marginal damages from pollution, as the double-dividend hypothesis suggests. In fact the relation between the optimal environmental tax increment and social marginal damages is sensitive to the particular reform under-taken and the consequent redistributions that are effected by that reform.

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The literature also provides a better understanding of the relation between environmental quality and the degree of distortions in the pre-existing tax system. A reading of the second-best literature on public good provision suggests that the optimal level of environmental quality would go down in a second-best world relative to a first-best world. In fact the opposite is likely to occur. While an increase in the supply of a public good requires additional public revenue (at potentially high social cost), an increase in the supply of environmental quality can generate additional public revenue through the tax on pollution that may finance a reduction in other distortionary taxes.

The literature also helps us better understand the distributional implications of environmental taxes. It shows that while environmental taxes might be distortionary, environmental tax reforms can be distributionally neutral or take on any degree of progressivity one desires. The point here is that any regressivity in environmental taxes can be undone with carefully designed tax reductions in a revenue-neutral reform. The literature offers further evidence that a lifetime distributional analysis blunts the regressivity of environmental taxes significantly. The regressivity of many environmental taxes appears to be blunted a bit in the long run in a general equilibrium setting.

Finally, I discuss the momentum that appears to be building in this country to institute some form of carbon pricing in order to reduce U.S. greenhouse gas emissions. Here the message is more optimistic. I argue that the advances that economists have made in their understanding of important efficiency and distributional issues have translated into significant policy advances in proposals wending their way through Congress.

The U.S. Experience with Environmental Taxes

I begin with a brief overview of environmental taxes in the United States and a comparison with other countries. The major environmental tax at the federal level is the motor fuels excise tax equal to 18.4¢ per gallon of gasoline. Of that, 0.1¢ is dedicated to the Leaking Underground Storage Tank Trust Fund and the remaining 18.3¢ to the Highway Trust Fund. Of that 18.3¢ per gallon, 2.86¢ is dedicated to the Mass Transit Account and the remaining 15.44¢ to the Highway Account.
The gas guzzler tax was enacted as part of the Energy Tax Act of 1978. It levies a tax on automobiles that obtain fuel mileage below 22.5 miles per gallon. Tax rates range from $1,000 to $7,700 per vehicle. In 2004 the tax collected $141 million (Guenther 2006). The gas guzzler tax explicitly excludes sport utility vehicles, minivans, and pickup trucks, which represented 51 percent of the new vehicle sales in 2006 (U.S. Census Bureau 2008, table 1027). Until recently, the light truck category (comprising SUVs, minivans, and pickup trucks) was the fastest-growing segment of the new vehicle market, with an annual growth rate of 2.5 percent between 1990 and 2006. In contrast, new car sales fell at an annual rate of 0.7 percent over that period. Recent high gas prices led to a sharp falloff in sales of these vehicles. Whether this trend will persist depends on the future direction of oil prices. As of November 2008, oil prices had fallen by over one-third from their peak.

The Energy Policy Act of 2005 (EPACT) resurrected the Oil Spill Liability Trust Fund tax at the original rate of 5¢ per barrel. This tax had previously been in effect from 1990 through 1994. The Joint Committee on Taxation estimates that this tax will raise $1.25 billion between 2005 and 2010 (U.S. Congress 2005). The tax is imposed on crude oil received at U.S. refineries as well as imported petroleum products. Domestic crude oil for export is also subject to the tax if the tax has not been previously paid.

The coal excise tax funds the Black Lung Disability Fund. It is levied on coal mined in the United States at a rate of 4.4 percent of the sales price up to a limit of $1.10 per ton of underground coal and $.55 per ton of surface-mined coal. According to the federal budget for fiscal year 2008, this tax raised $639 million in 2007.

Gasoline sold for sport motorboats is taxed at the same rate as highway gasoline and diesel fuel, and the funds are allocated to the Aquatic Resources Trust Fund (subject to an annual cap on transfers that effectively reduces the share of tax on motorboat fuels shifted to this trust fund). Finally, commercial vessels using the Inland Waterway System (barges for the most part) pay a fuel tax of 22.4¢ per gallon of fuel sold.

States levy a variety of environmental taxes, starting with a tax on motor fuels. Rates vary across states but averaged 18.2¢ per gallon as of the beginning of this year (American Petroleum Institute 2008). In addition to excise taxes, states levied on average an additional 10.4¢ per gallon,
typically through a general sales tax on gasoline purchases. State governments also levy a variety of pollution fees, hazardous waste charges, tire-disposal fees, and other assorted charges. U.S. Environmental Protection Agency (2001) describes these in considerable detail.

The Organisation for Economic Co-operation and Development (OECD) and European Environment Agency (EEA) maintain a database on instruments used for environmental policy. They report for the United States aggregate revenues of $74.9 billion from environmental taxes and charges in 2005. Of this, 94 percent is federal and state taxes on motor fuels (OECD/EEA 2008).

Comparing the use of environmental taxes across countries, we see that the United States ranks low in its reliance on these taxes. Figure 1-1 shows environmental tax collections as a percentage of GDP. The United States collects 0.9 percent of GDP in these taxes at the federal and state level. Only Mexico is lower, with a share of 0.8 percent. In contrast, the Czech Republic, Denmark, Finland, Italy, Luxembourg, the Netherlands, Portugal, and Turkey all collect more than 3 percent of GDP from environmental taxes and charges. The pattern does not change if taxes are reported as a percentage of total tax revenues (figure 1-2). The United States is still at the bottom of the pack, with environmental taxes equal to 3.5 percent of total tax collections. If the United States had relied on environmental taxes to the same extent as other OECD countries in 2005 (2.23 percent of GDP), it would have collected over $100 billion more in 2005 than it actually did, an increase of over 150 percent.

Since motor fuel taxes are such a dominant source of environmental tax revenues in all OECD countries, it is instructive to compare gasoline tax rates across these countries. Figure 1-3 shows the tax rate (in dollars per gallon) for various OECD countries as of the beginning of 2007. The total excise tax rate for the United States is over 40¢ per gallon.³ In contrast, the average unweighted tax on gasoline in the other countries exceeds $2.00 per gallon. The rate is particularly high in the UK, Germany, Turkey, and the Netherlands, where it exceeds $3.00 per gallon.

Below I discuss the treatment of carbon emissions in the European Union (EU) and the United States. A carbon pricing policy change under the next administration could change the relative importance of environmental taxes and charges (including the value of auctioned permits in a
**Figure 1-1**  
Environmental Taxes as a Percentage of GDP, 2005


**Figure 1-2**  
Environmental Taxes as a Percentage of Total Taxes, 2004

cap-and-trade system) in government budgets. But as of now, the summary data show that the United States is an outlier in its reliance on environmental revenues. In fact, one could make a case that taxes on motor fuels do not really count as an environmental tax, since they are for the most part earmarked in the United States for the Highway Trust Fund. That earmarking suggests they might better be characterized as a benefit tax.

Is the United States taxing pollution at the right level? Clearly not for those pollutants that are not currently taxed. Parry and Small (2005) consider the range of externalities associated with driving (congestion, tailpipe pollution, health problems, etc.) and conclude that the U.S. tax on gasoline is roughly half its optimal level. The tax in the United Kingdom, in contrast, is roughly twice as large as its optimal level.

Little work has been done on pollution taxes other than those on gasoline. A small literature exists on states’ use of fees for hazardous waste. Levinson (1999a, 1999b) considers how state-level taxes affect the interstate transport of hazardous waste and finds that in-state disposal is highly sensitive to taxes. Sigman (2003) reviews the literature on state-level hazardous waste taxes and argues that the taxes influence behavior, but—given the extant regulations and liability facing waste-generating
firms—may not be welfare-enhancing. The research suggests the benefits of both coordinated national legislation (as opposed to state-level legislation) and coordination among the various policy instruments used to discourage improper hazardous waste disposal.\(^5\)

In sum, the contrast between the United States and other OECD countries suggests considerable scope for increasing American reliance on environmental taxes.

**Advances in the Theory**

In this section I review recent advances in our understanding of efficiency and distributional issues associated with environmental taxes.

**Efficiency Considerations of Environmental Taxation.** A flurry of intellectual activity in the late 1990s led to some important advances in our understanding of the efficiency implications of environmental taxation and optimal design of environmental tax rates. These theoretical developments took as their point of departure the Pigouvian principle that the optimal tax rate on a pollutant is equal to its social marginal damages. Beginning in the mid-1980s, the concept of the environmental double-dividend hypothesis began to gain currency. The concept is straightforward: an environmental tax pays a dividend by discouraging polluting activities. It then pays a second dividend by raising revenue that can be used to lower other distorting taxes. So far so good. Therefore, policy activists concluded, it must be the case that the optimal tax on pollution should exceed the social marginal damages of the pollutant, since there is this extra dividend (or benefit) arising from the use of this tax.\(^6\)

This conclusion, while intuitively appealing, is incorrect. It ignores the fact that the environmental tax, though beneficial in discouraging pollution, adds to distortions in production or consumption and has a first-order excess burden in the presence of other distortionary taxes.\(^7\) The theory is rigorously laid out by Bovenberg and de Mooij (1994) and by Parry (1995).\(^8\)

Bovenberg and de Mooij’s model assumes a “clean” good, a “dirty” good, and endogenous labor supply. Taxes were levied on the dirty good and labor.
Fullerton (1997) points out that in a general equilibrium setting, identical tax outcomes can be achieved with different sets of instruments. Thus, Bovenberg and de Mooij could have obtained the same equilibrium with differential commodity tax rates and no tax on labor supply. While the equilibrium finding is unaffected, Fullerton notes, the finding that the optimal tax on pollution falls short of social marginal damages is affected. As Bovenberg notes in correspondence with Fullerton quoted in Fullerton's paper, the precise result is that the Pigouvian tax increment falls short of social marginal damages in the optimum. In other words, if Bovenberg and de Mooij's model considered commodity taxes rather than a tax on the dirty good and labor supply, the result would be that the difference in tax rates of the dirty good less that of the clean good was less than social marginal damages.

This result has been formalized in a number of papers as the finding that the second-best Pigouvian tax increment equals social marginal damages divided by the marginal cost of public funds (e.g., Bovenberg and van der Ploeg 1994). Since the marginal cost of public funds tends to exceed 1 in the presence of distortionary taxation, this gives the desired result. This result is found in a model with an income tax and no non-environmental commodity taxes. Williams (2001) generalizes the result to allow for a fully general linear system of income and commodity taxes. Changing the tax normalization changes the value (measured in dollars) of marginal social damages. But this is just a units issue. Williams shows that the ratio of the optimal tax differential to social marginal damages is constant across normalizations and less than 1 for a system of linear commodity and income taxes. This is reassuring, since the tax normalizations used in the literature are a far cry from the actual tax normalization in the actual tax code, with its complex combination of income and commodity taxes. It would be discomfiting if one needed to assess the environmental tax differential relative to social marginal damages using the actual U.S. tax code normalization.

An extra set of assumptions drives these results. Bovenberg and de Mooij (1994) as well as Fullerton (1997) assume homothetic subutility function for commodities that is weakly separable from leisure. With this assumption, it would be optimal to employ a uniform commodity tax in the absence of the externality. Therefore the point of departure in adding externalities is to compare the difference between the rates on the dirty
and clean goods. Parry (1995) considers a more general model in which the polluting consumption good is a relatively strong or weak substitute with leisure. The distortionary impact of the environmental tax is strengthened (weakened) to the extent that the dirty good is a relatively strong (weak) substitute with leisure.\(^{10}\) This is a straightforward application of the Corlett and Hague (1953) result—that where leisure cannot be taxed separately from the time endowment, it is desirable to tax goods that are complements of leisure.\(^{11}\)

While Parry focuses on consumption externalities, the Bovenberg and de Mooij result can be easily modified to allow for production-side externalities. Williams (2002) considers potential health impacts of pollution in a more expansive framework and notes that pollution's effect on health can have significant implications for the optimal tax rate. If the health impacts of pollution, for example, diminish labor productivity, then an additional benefit arises from reducing pollution. This suggests a higher tax rate on pollution than in the absence of the health impact. If, on the other hand, reducing pollution lowers medical expenses, consumers receive a positive income effect from the environmental tax that discourages labor supply (assuming leisure is a normal good). This leads to a lower optimal environmental tax than occurs in the absence of the health interaction. Williams terms this a benefit-side tax-interaction effect that has broader implications than health and pollution. It illustrates the important point that modeling the entire impact of pollution is important for determining the optimal second-best tax on pollution and its relation to the social marginal damages of pollution.

Kaplow (2006) notes that the various environmental tax reforms discussed in the literature above limit themselves to linear income taxes, and he suggests that an environmental tax reform should be thought of as a two-step process. In the first step, the income tax is adjusted so that the environmental tax reform cum income tax adjustment is distributionally neutral (taking into account the distribution of environmental benefits). In this first step, the first-best Pigouvian rule holds that the environmental tax rate should be set equal to social marginal damages. In the second step, the income tax is adjusted to obtain whatever income tax outcome actually occurs under the proposed environmental tax reform. Kaplow's conclusion is that the deviation of the environmental tax rate from the first-best
Pigouvian prescription stems from the increased redistribution arising from the reform, rather than from any preexisting tax distortions. Kaplow’s point is essentially one of interpretation. One can analyze environmental taxes in a distribution-free environment. Or one can recognize that general environmental tax reforms will induce redistribution and that this will affect the relationship between the Pigouvian tax increment and social marginal damages. The message from the Kaplow analysis is this: the specific environmental tax reforms suggested by policymakers will induce different amounts of redistribution, and as a result the relation between the optimal environmental tax rate and social marginal damages will be reform-specific.

This is an unsatisfying result at one level. Part of the difficulty is that this discussion focuses on a variable of secondary interest. Knowing the optimal tax rate and its relation to social marginal damages is important. But what we really care about is the optimal level of pollution. All the results above focus on the relation between the tax rate on pollution and its social marginal damages. A different question is how the government’s need for revenue and its reliance on distortionary taxes affect the optimal level of environmental pollution. Metcalf (2003) uses a simple general equilibrium model to show that an increase in the need for tax revenues to finance government spending can lead to a fall in the optimal Pigouvian tax increment even while environmental quality improves. The falling Pigouvian tax increment gives rise to a commodity substitution effect as consumers shift toward more consumption of the pollution-generating commodity. The increased level of overall taxes lowers the real wage, giving rise to a leisure substitution effect as labor supply falls. Since leisure has no effect on pollution in this model, the ultimate impact of the higher overall tax rates on environmental quality is ambiguous. Metcalf demonstrates that for reasonable parameter assumptions, pollution falls as government revenue needs rise. The point here is not that Metcalf has correctly captured the complexity of the economy in his simple model, but rather that one cannot draw any inferences about the amount of pollution by noting that the Pigouvian tax increment is falling in response to a rise in required government revenue.

Metcalf’s analysis, which takes as its point of departure an optimal tax system, is marginal in nature. Gaube (2005) considers a related experiment: this experiment compares the optimal provision of environmental services in a second-best world, in which distortionary taxes must be used, to
optimal provision in a first-best world, where lump-sum taxes are available. Assuming that we are not in a Laffer world, where increasing environmental tax rates reduce environmental revenue, Gaube shows that the provision of environmental services in this second-best world is higher than in the first-best world. In other words, we have a more pristine environment. This is in striking contrast to the result in Atkinson and Stern (1974), which is that the second-best provision of public goods will be lower than the first-best provision. Gaube’s example assumes quasi-linear preferences with a homothetic subutility function over consumption. The intuition, however, is quite general for understanding the contrasting results for public goods and pollution control in a second-best world. While an increase in the supply of a public good requires additional public revenue (at potentially high social cost), an increase in the supply of environmental quality can generate additional public revenue through the tax on pollution.

**Distributional Considerations with Environmental Taxation.** One concern with increasing reliance on environmental taxes is the perceived or real regressivity of these taxes. Measuring the distributional impact requires determining 1) which environmental tax is to be changed (or implemented); 2) what will be done with the revenue; 3) on what basis the welfare of households is to be determined; and 4) over what time period the burdens will be measured. Environmental damages tend to be associated with the production or consumption of commodities. This means that an environmental tax acts to a large extent as a commodity tax. Commodity taxes in general tend to be regressive when viewed in an annual income framework. Metcalf (1999), for example, finds that a carbon tax, a gasoline tax, air pollution taxes, and taxes on the use of virgin materials are all to a greater or lesser degree regressive. He makes the point that while an environmental tax may be regressive, an environmental tax reform can have any desired distributional outcome. The key is to focus on how the revenue from an environmental levy is used. If it is recycled through reductions in regressive taxes, the overall reform can be distributionally neutral or even progressive. This insight has been brought to bear in a proposal to implement a revenue-neutral and distributionally neutral carbon tax reform (Metcalf 2007c, 2007d).

Distributional analyses require that households be ranked by some measure of economic well-being. Typically, annual income is used for this ranking.
As the literature on tax incidence now recognizes, however, annual income measures of well-being tend to bias distributional analyses of consumption taxes in a regressive direction. (See Fullerton and Metcalf 2002 for a general discussion of this point.) This occurs for two reasons. First, young and old households with annual income at great variance from their lifetime expected (or realized) income tend to show up in the lowest income deciles. These groups will have consumption-to-income ratios that are not sustainable in the long run. The young may be borrowing against future possible earnings, while the elderly may be drawing on a lifetime of savings. In either case, using annual income for these groups will bias consumption taxes toward regressivity. Second, households engaging in consumption smoothing in the presence of temporary income fluctuations will also generate a regressive bias. A consumption-smoothing household with a negative (positive) income shock will have a temporarily high (low) consumption-to-income ratio and in this way contribute to a regressive bias.

To overcome this bias, some measure of lifetime income is required. Thus in an analysis of federal excise taxes, Poterba (1989) uses current consumption as a proxy for lifetime income, under the assumption that households make consumption decisions on the basis of lifetime income. The consumption proxy reduces the regressivity of the taxes considerably. Seeking to assess the Clinton administration’s British thermal unit (BTU) tax proposal, Bull, Hassett, and Metcalf (1994) use this approach, along with a variant on the current consumption approach, to better control for transitory consumption fluctuations. Hassett, Mathur, and Metcalf (2007) apply that approach to a U.S. carbon tax and find that a lifetime incidence approach mitigates much of the regressivity of the tax that appears in the annual income analysis.

Hassett, Mathur, and Metcalf’s approach assumes the tax is fully shifted forward to consumers. This is consistent with short-run results from computable general equilibrium (CGE) modeling of carbon taxes. See, for example, the study by Metcalf et al. (2008). It also finds that roughly half the burden of the tax comes from the indirect portion of the tax. This is the increase in the prices of non-energy commodities (food, clothing, entertainment, etc.) brought about by the higher cost of energy consumed in the production of those commodities. While the percentage price increase for any of these commodities is quite small, the vast majority of consumer expenditures, on average, are on these commodities. This is important
because the burden of the direct portion of the tax (price rises in energy purchases) is more regressive than the indirect burden whether one uses an annual or lifetime income approach. See figures 1-4 and 1-5 for results from this analysis.

Finally, these analyses have assessed environmental taxes at a point in time using a measure of lifetime income. An alternative approach would be to assess lifetime environmental tax burdens relative to lifetime income. This approach is used to evaluate the lifetime progressivity of the U.S. tax system by Fullerton and Rogers (1993) but has not been applied to environmental taxes. Such an approach requires making assumptions about the tax code over the long term, since this is a prospective analysis. Nevertheless, it would be a useful contribution to the literature.

The analyses discussed above are partial equilibrium analyses (although informed by results from general equilibrium analysis) and focus on the uses side of income. Fullerton and Heutel (2007) undertake a sources-side general equilibrium analysis of pollution taxes and explore a number of special cases. One would expect that the burden of pollution taxes would fall disproportionately on the factor which is a closer complement to

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{carbon_tax.png}
\caption{Carbon Tax: Annual Income}
\end{figure}

\textbf{Notes:} Carbon tax is shown as a percentage of annual income; income deciles are shown along the x axis.
pollution. While that tends to be the case, they show examples where that pattern does not occur.\textsuperscript{14} The experiment makes clear how important it is to measure the degree of substitutability or complementarity between pollution and other factors, and it identifies key parameters required for carrying out a general equilibrium incidence analysis.

As noted in the first section, the predominant environmental tax in the United States is the gasoline tax. Using data from the Consumer Expenditure Survey, West (2004) models the choice of vehicle as well as driving patterns and argues that, given the lower probability of car ownership among lower-income households, the regressivity of gasoline taxes is limited to the upper half of the income distribution. She also notes that policymakers have been more inclined to adopt indirect taxes on gasoline consumption such as a gas guzzler tax, essentially a tax on engine size, or to provide subsidies to new vehicle purchase, than to tax gasoline directly. She notes that these indirect taxes may be more regressive than a gasoline tax. Similarly West (2005) finds that a tax on emissions is more regressive than a tax on gasoline consumption because lower-income households are more likely to drive older, less efficient vehicles.

\begin{figure}[ht]
\centering
\includegraphics[width=\textwidth]{carbon_tax.png}
\caption{Carbon Tax: Lifetime Income}
\end{figure}

\begin{flushleft}
\textbf{NOTES:} Carbon tax is shown as a percentage of lifetime income; income deciles are shown along the x axis.
\end{flushleft}
In summary, considerable progress has been made in understanding optimal environmental tax rates in a second-best world. Two points bear emphasizing. First, the literature makes the important point that the revenue use from environmental levies has potentially important efficiency consequences as well as distributional consequences in a second-best world. Second, the literature advances our understanding of the relationship between the Pigouvian tax increment and social marginal damages in a second-best world. While of theoretical importance, this result is of second-order importance for U.S. policymakers, who have not yet embraced the use of taxes to address environmental concerns. That this result has limited practical importance is especially clear when one recognizes the difficulties in precisely measuring the social marginal damages of important pollutants. Getting a price in the right neighborhood of social marginal damages is probably about as much as we can hope for.

The New Frontier: Carbon Pricing

On January 1, 2005, twenty-five countries in Europe embarked on a major policy experiment in the use of market-based instruments to control greenhouse gas emissions. That date marked the beginning of the first phase of the European Union’s Emissions Trading Scheme (ETS). The ETS is a cap-and-trade program which sets country-by-country caps on carbon emissions in energy-intensive industries and the utility sector, and which issues permits to be surrendered upon emissions. The permits could be traded among, within, and across countries in the EU, thereby putting a price on carbon emissions. This is the second large cap-and-trade program set up to address environmental concerns following the successful implementation of a cap-and-trade program for sulfur dioxide emissions from large power plants under the Acid Rain Program of the Environmental Protection Agency (EPA). (See Ellerman et al. 2000 for a description and assessment of this program.)

Cap-and-trade programs have emerged as a popular alternative to environmental taxes and offer instead a market-based incentive to reduce pollution. Since both of the major presidential candidates in the United States committed to significant reductions in U.S. greenhouse gas emissions, it is
instructive to assess the benefits and drawbacks of a tax-based versus permit-based approach to reducing emissions.

Cap-and-trade (CaT) programs and taxes (Tx) are in many ways duals of each other. A pure CaT program fixes the amount of emissions over some time frame and lets the interplay between demand for and supply of permits determine their price. A pure Tx program fixes the price of emissions but lets the amount of emissions fluctuate depending on supply and demand. Under both systems, firms will operate at the point where the marginal cost of abatement equals the price of emissions (either the permit price or the tax rate). Since the marginal cost of abatement is equalized across firms, emissions are reduced in a cost-effective manner.\(^{18}\)

It is now well understood that in the absence of uncertainty over the marginal cost of abatement, CaT and Tx systems have the same economic effect. If the permits are fully auctioned then the systems are entirely identical except in appearance. The two market-based approaches differ 1) under uncertainty over marginal abatement costs, and 2) in their administrative and implementation details.

Once one allows for uncertainty in marginal abatement costs, the two policy approaches differ in an expected net benefit sense. Weitzman (1974) looks at conditions under which a Tx system provides higher or lower expected social benefits than a CaT system in a world with uncertainty.\(^{19}\) His analysis demonstrates the importance of the relative slopes of marginal damages and abatement costs in choosing the optimal instrument.

Weitzman’s analysis needs some modification in the case of greenhouse gases, since marginal abatement costs are a function of the flow of emissions, while marginal damages are a function of the stock of gases in the atmosphere. Hoel and Karp (2002) analyze the problem with stock effects in which governments may employ either an open-loop or a feedback policy. In an open-loop setting, policymakers choose a set of policies for all time in the current period to maximize expected net benefits. In the more realistic (but more complicated) feedback setting, policymakers choose a set of policies but are allowed to adjust the policy as uncertainty is revealed over time. Hoel and Karp set out conditions that allow one to rank Tx versus CaT policies and find that Tx dominates CaT for a set of parameters consistent with scientific understanding of the global warming problem. Their analysis assumes that cost shocks are uncorrelated across time. This
is a significant limitation, as many of the sorts of cost shocks that might occur (e.g., technology shocks) are likely to have high levels of persistence over time. Newell and Pizer (2003) generalize Hoel and Karp's open-loop analysis to allow for serial correlation of cost shocks and find that—across a broad range of parameter assumptions about abatement costs and marginal damages—carbon taxes are more efficient than CaT systems in the face of uncertainty. A study by Karp and Zhang (2005), which analyzes the more realistic setting in which cost shocks are correlated over time and policymakers use feedback policies, continues to find that taxes dominate tradable permit systems.

The one caveat to the finding that Tx dominates CaT is the presence of “tipping points,” abrupt or discontinuous increases in marginal damages at some level of greenhouse gas concentrations in the atmosphere. Such a tipping point might occur if concentrations above some amount lead to sufficiently high temperatures that the West Antarctic ice shield breaks off and raises sea levels by perhaps five meters (Schneider et al. 2007, table 19-1). What concentrations would make such an event likely are unknown. In light of this fact, a commitment to reduce emissions to fixed levels regardless of cost cannot be justified by any model of social welfare maximization. To give primacy to specific emission reductions, regardless of the cost, implausibly makes controlling emissions the top policy priority, trumping all others.

From an administrative perspective, a Tx system can be more quickly implemented than a CaT system. Coal producers already pay an excise tax to fund the Black Lung Trust Fund, and oil producers pay a tax to fund the Oil Spill Trust Fund. (See Metcalf 2007b for a description of these funds.) We also have precedents—federal fuels tax credits—for refundable credits for sequestration activities. In contrast, we have no administrative structure in place for running a carbon CaT program.\textsuperscript{20}

It is clear that either the CaT or Tx approach is preferable to a regulatory approach. Ellerman, Jacoby, and Zimmerman (2006) consider how Corporate Average Fuel Economy (CAFE) standards could be integrated into a CaT system and estimate that the cost of carbon emission reductions through CAFE is in the neighborhood of $350 per ton of CO\textsubscript{2} equivalent; this is considerably higher than estimates of permit prices under the Lieberman-Warner Climate Security Act (S.2191) (Paltsev et al. 2007,
appendix D). This estimate helps make two points. First, sector-based regulatory policies that are not integrated more broadly into a carbon reduction scheme can be very expensive. Second, the early reductions in carbon emissions are likely to occur in the industrial and electric utility sectors rather than in the transport sector. Since the source of emissions has no bearing on damages associated with climate change, sector-based approaches are likely to be quite inefficient.21

While most economists view a carbon tax as a better way to control emissions than a CaT system, policymakers have shown a distinct preference for CaT. This preference for CaT systems over Tx systems can be explained by a number of factors. First, the Acid Rain Program in the United States and the introduction of emissions trading in the EU’s ETS create some familiarity with trading systems, and their success inspires emulation. The EU’s choice of a CaT approach over a Tx approach is cited as evidence of the political advantages of the former over the latter. But the European experience is not entirely applicable to the United States, and in any case the CaT was not the EU’s first choice. In the early 1990s, the EU had attempted to institute EU-wide taxes on carbon and energy, but it was unable to reach the unanimous agreement among member countries required to enact EU fiscal policy. A CaT approach, in contrast, is deemed a regulatory policy requiring only a majority of countries to support the policy (see Convery and Redmond 2007).

Second, environmentalists have preferred the apparent certainty of emissions control under a CaT system. This certainty is illusory, however. Even if a law is passed that sets a fixed cap with no possible relief for high permit prices, then in the unhappy event that the marginal costs of abatement are unexpectedly high, Congress can always amend the law to loosen the caps. In effect, Congress serves as the ultimate safety valve.

Third, the United States has resisted adding new taxes since the Reagan revolution in 1980. This resistance reflects in large part an ongoing debate over the appropriate size of the federal government and its role in the U.S. economy. Metcalf (2007d) has proposed a revenue-neutral carbon tax swap to sidestep this debate. A carbon tax swap would require that the revenue raised through a carbon tax be used to reduce existing taxes so that the U.S. tax burden on average would remain unchanged.22
Fourth, policymakers have used the free allocation of permits to build political support for CaT programs. This practice comes at considerable efficiency and distributional costs. From an efficiency point of view, there always exists an environmental tax swap that is welfare-enhancing relative to a lump-sum return of the revenue.\textsuperscript{23} From a distributional perspective, free permits provide windfall profits to permit recipients. These windfalls show up as increases in equity values of the firms receiving permits. Since equity holdings tend to be concentrated in the upper part of the income distribution, this windfall transfer is quite regressive.\textsuperscript{24}

While permits under EPA’s Acid Rain Program and the EU’s ETS were given away to affected sectors, newer CaT proposals auction an increasing number of the permits. The Warner-Lieberman bill, for example, auctions just over one-quarter of the permits in 2012, and the share rises to nearly 70 percent by 2031. Stavins (2007) calls for initially auctioning half of the permits and increasing the percentage to 100 percent over twenty-five years.

While a carbon tax appears to be a more straightforward approach than cap-and-trade and to have greater efficiency benefits, the political obstacles remain large. What has emerged is a number of proposals to modify CaT systems to make them more like Tx systems. Recall that the major difference between a CaT and Tx system is the fixing of emissions or price. Certainty over price is useful for firms making long-term capital investments, for politicians who must answer to interest groups if carbon prices are unexpectedly high, and for the economy, which would be adversely affected by high carbon prices. If passed, S.2191 would implement a Carbon Market Efficiency Board that could adjust borrowing rules and other provisions to try to reduce the likelihood of high carbon prices. It is unclear how successful such an approach could be. One of the board’s functions, for example, would be to shift emission allowances forward in time to release more permits in the short run. But with the total stock of permits between 2012 and 2050 fixed, such a shifting reduces permit prices in the short run at the expense of higher prices in the long run. Firms that see high prices in the near term as a signal of even higher prices in the longer term will have an incentive to bank any newly released permits and so undo the efforts of the board to reduce prices.

A more straightforward way to reduce price volatility is through a combined safety valve and price floor that creates a band within which prices will vary. The price cap can be achieved through the government’s readiness
to sell permits at a fixed price (the safety valve price). If this cap is reached, the CaT system in effect converts to a Tx system. The floor can be maintained by the government’s setting a reserve price on permits that it auctions.\textsuperscript{25}

With a tighter band within which prices can fluctuate, the CaT system has economic impacts that increasingly resemble those of a Tx system. Such a CaT system has been suggested by Orszag (2008), among others. The upper limit on the band protects the economy against the adverse effects of high carbon prices. The lower limit assures utilities and industries that they will receive a reasonable return on investments in carbon-free or emission-reducing capital.

This approach as well as other safety valve approaches serves to make the CaT system operate like a Tx system. The similarities go further. Thus the arguments for one system over another are harder to sustain. One argument that has been made on behalf of CaT is that if the federal government will have to buy off the energy industry to obtain its support for carbon pricing, then it is better to provide the industry with a lump-sum distribution in the form of an allocation of free permits rather than distortionary tax breaks in the form of exemptions under a carbon tax.\textsuperscript{26} The argument suffers from a failure of creativity in tax design. One can replicate any lump-sum distribution of permits in a CaT system with tax breaks in a Tx system. One could replicate the free allocation of permits, for example, by taxing the energy sector’s emissions above some floor.

The United States is likely to enact some sort of carbon pricing scheme in the Obama administration. While efficiency and administration considerations point to the carbon tax as a preferred pricing device, political obstacles to a tax remain. An interesting development in the past ten years has been the reshaping of a cap-and-trade system that preserves the political appeal of a permit-based system while adding many of the best attributes of a tax. This hybridization of systems may be what is required to get an effective policy enacted in Congress. We shall see.

\textbf{Conclusion}

When we review where the United States stands in its attitude toward and use of environmental taxes, several points emerge. First, the most obvious
fact is that the United States relies very little on environmental taxes in comparison with other developed countries. Moreover, the environmental taxes in place are not textbook examples of environmental taxes, as they tend to be taxes on consumption or production attributes correlated with pollution but not on the pollution itself.27

Second, recent theoretical literature has made important advances in our understanding of environmental instrument design in a second-best world. It has shown that the revenue use from environmental levies has important efficiency as well as distributional consequences in a second-best world. It has also advanced our understanding of the relationship between the Pigouvian tax increment and social marginal damages in a second-best world. As I suggested above, however, this result, while of theoretical importance, is of second-order importance for U.S. policymakers, who still resist using taxes to address environmental concerns. Given the difficulties that exist in precisely measuring the social marginal damages of important pollutants, this result is more theoretically than practically important.

Finally, the current focus on climate change and the need to control greenhouse gas emissions suggest that the United States may soon significantly increase its reliance on environmental taxes, whether explicitly or implicitly. While the United States may not enact a direct carbon tax, any cap-and-trade system that emerges is likely to have many of the attributes of a tax. If such a cap-and-trade system is put in place, it will be in large part due to the advances made in our understanding of environmental policy design over the past ten to fifteen years.
Notes

1. The tax was most recently raised (to 18.3¢ per gallon for gasoline) on October 1, 1993. See Jackson (2006) for a history of changes to this tax.

2. The mileage rating is calculated as approximately 55 percent of the Environmental Protection Agency’s city mileage rating and 45 percent of the highway rating.

3. The OECD/EEA rate for the United States is slightly below that of the American Petroleum Institute dataset. It may be that different weighting schemes are used to construct the averages in the two datasets.

4. Where firms are subject to regulations that restrict pollution, an important question is the relative cost of regulatory approaches to a tax-based approach. Some pollutants, most notably SO_2 emissions from electric utilities, are subject to caps with tradable permits. These act like taxes in setting a price on pollutants and letting firms use market mechanisms to drive pollution reduction. I discuss the relative merits of taxes versus cap-and-trade systems below.

5. A limited literature from this past decade exists on the use of taxes to control other externalities. One recent paper by Brueckner and Girvin (2008) considers optimal tax design to address noise pollution from aircraft.

6. Fullerton and Metcalf (1998) provide a detailed history of the double-dividend hypothesis and the debate over the optimal setting of environmental tax rates.

7. This distortionary impact is of second-order importance and can be ignored in the absence of other distortionary taxes. This is the case developed by Pigou (1938).

8. Goulder (1995) termed the positive welfare impact of using environmental revenue to lower other distorting taxes the revenue-recycling effect and the negative welfare impact of the tax’s first-order distortionary impact the tax-interaction effect.

9. One must be careful in making the leap from the magnitude of the marginal cost of public funds and excess burden. The marginal cost of public funds depends critically on the tax normalization and captures only the distortion between a taxed good and the normalized commodity. See section 5 of Auerbach and Hines (2002) for an excellent discussion of this issue.

10. This assumes that labor is the only endogenous factor of production.

11. Pirttila (2000) develops this idea explicitly. West and Williams (2007) estimate the cross-price elasticity between labor supply and gasoline consumption and find that gasoline is a relative complement with leisure. Hence the optimal tax on emissions associated with gasoline use will tend to be higher, taking this complementarity into account.

12. The first-best result also requires that leisure be weakly separable from consumption and that consumers have homogeneous preferences.

13. Atkinson and Stern’s result is more general. But the specification of preferences in Gaube’s example ensures that the result holds as stated in the text.
14. In their numerical analysis, they do not actually model existing taxes on pollution but rather the shadow price of pollution arising from various regulatory restrictions on pollution. They then consider an experiment where the pollution “tax” is increased by 10 percent and measure the resulting changes in factor prices.

15. Bovenberg and Goulder (2002) provide an exhaustive review of different ways in which environmental externalities affect consumption and production in perfect and imperfect markets.

16. Goulder, Parry, and Burtraw (1997) stress this point, and Fullerton and Metcalf (2001) make the more general point that there are efficiency benefits of government capturing the scarcity rents from environmental regulation.

17. Ellerman, Buchner, and Carraro (2007) describe the design and allocation process in the first phase of the ETS.

18. A CaT or Tx system should provide for the possibility of carbon sequestration, for example through carbon capture and storage. No carbon price should be levied on fossil fuels where sequestration takes place. In practice this means that no permits would be required for sequestered carbon in a CaT system, and a tax credit would be allowed under a Tx system.

19. The relative advantage of price versus quantity instruments depends on uncertainty in the marginal abatement cost curve only. Uncertainty over the marginal damages of emissions affects the net benefits of an emissions control policy but does not affect the relative superiority of one policy instrument over another.

20. The Acid Rain Program is a helpful precedent, but the value of permits is an order of magnitude smaller than the potential value of carbon emission permits. It also is highly concentrated among a small set of electric utilities.

21. Other pollutants or market failures may provide a rationale for reducing oil consumption or tailpipe emissions. This simply reflects the fact that multiple instruments are generally needed to address multiple market failures.

22. Revenue could also be used to achieve efficiency gains. Orszag (2008) claims that the cost of a 15 percent reduction in carbon emissions from a CaT program could be cut in half if the revenue were used to cut taxes on capital income. See also Metcalf (2007a).

23. This is a statement of the weak double dividend (see Goulder 1995) for a taxonomy of double dividends. Not every tax swap is welfare preferred to a lump-sum distribution. Babiker, Metcalf, and Reilly (2003) provide an example of an apparently reasonable tax swap in Europe that is inferior to lump-sum distribution.

24. See Dinan and Rogers (2002), Parry (2004), and Metcalf (2007d) for further discussion of this point.

25. This approach works only if most, if not all, of the permits are auctioned. Alternatively, the government could charge a permit acquisition fee for permits it gives away or auctions. This approach has the advantage that it need not be modified as the mix of free and auctioned permits changes over time.
26. Bovenberg and Goulder (2001) have calculated that only a small portion of permits would need to be freely allocated to the energy sector to avoid a loss in equity values. This follows from the ability to pass the tax forward to consumers.

27. Fullerton, Hong, and Metcalf (2001) assess the welfare losses arising from employing taxes on imperfect proxies for pollution.
References


Gilbert Metcalf has written an excellent chapter on recent developments in our understanding of environmental taxation. It provides a clear overview of the few environmental taxes that are currently in use, and an excellent survey of the most important advances in the academic literature on environmental taxes over the last decade.

I find very little to disagree with in it. My comments therefore will expand on Metcalf’s analysis, highlight some key points that deserve more emphasis, and draw conclusions for future policy. My comments follow roughly the same order as Metcalf’s chapter. I will begin by discussing practical experience with environmental taxes, then move on to look specifically at carbon emissions regulation, which represents the most important potential application of environmental taxes currently under debate. I will review what we can learn from experience and academic research on carbon policy, and draw on those lessons to make some suggestions about what form U.S. carbon policy should take.

Environmental Taxes in the United States

As Metcalf points out, environmental taxes play only a very small role in the tax system in the United States: total environmental tax revenue (including both state and federal taxes) amounts to less than 1 percent of gross domestic product (GDP). To provide some sense of context, a U.S. carbon tax of $20 per ton—roughly in line with economists’ estimates of the marginal damage from carbon emissions—would raise more than $100 billion per
year in revenue. That’s more than all existing U.S. environmental taxes put together.

The experience of other countries also provides useful context. Metcalf notes that the average environmental tax revenue in countries in the Organisation for Economic Co-operation and Development (OECD) is substantially higher than in the United States: roughly 2.5 times as large, as a share of GDP, or approximately equal to what the U.S. share would be after implementing a carbon tax.

The vast majority of that environmental tax revenue comes from motor fuel taxes, both in the United States and in the average OECD country. But one might ask whether motor fuel taxes are truly environmental taxes. Metcalf’s chapter points out that most motor fuel tax revenue in the United States is earmarked for spending on highways, and suggests that because of that earmarking, a motor fuel tax might be more accurately characterized as a benefit tax.

This raises the question of what makes a particular tax an “environmental” tax. Metcalf’s argument here seems to imply that it depends on how the revenue is used. But such a definition has obvious problems: for example, a carbon tax certainly seems as if it should be considered an environmental tax, even if the revenues are used for a nonenvironmental purpose (such as funding cuts in other taxes).  

Alternatively, one could use a definition based on intent: if a tax is intended to reduce pollution emissions, then it’s an environmental tax. This seems like a better definition. And it might well be a better way to interpret Metcalf’s point: that the earmarking of motor fuel tax revenues suggests that these taxes were intended as a way to pay for road construction and maintenance, not as a way to reduce pollution emissions from vehicles. Of course, such a definition has its own problems—different policymakers may well have different intentions for a given policy, plus intentions are often hard to discern—but seems attractive nonetheless. And based on this definition, motor fuel taxes (at least in the United States) generally would not qualify as environmental taxes, thus leaving environmental taxes playing a truly minuscule role in the current tax system.

A third possible definition would depend on the tax base: an environmental tax is a tax on pollution emissions or on some good strongly correlated with emissions. While there’s still a question of where to draw the
line—how strong a correlation between the taxed good and emissions is required for a tax to be “environmental”—this definition avoids the problem of trying to discern intent. Based on this definition, fuel taxes are environmental taxes: fuel use is strongly (though certainly not perfectly) correlated with pollution emissions.\(^2\)

Regardless of how one defines an environmental tax, though, it remains clear that most environmental regulation uses instruments other than taxes. Despite economists’ efforts, much environmental regulation still relies on a command-and-control approach. And even where market-based regulation exists, recent policies have relied much more on tradable permit systems than on environmental taxes (for example, trading systems for sulfur dioxide and for nitrogen oxides in the United States, and for carbon emissions in the European Union [EU]).

**Lessons for Carbon Policy**

Metcalf provides an excellent survey of key recent research on environmental policy. Therefore, rather than critiquing that survey, I will focus more on what that literature suggests for how to design a policy to reduce carbon emissions. The literature has two important implications, each of which is also supported by preliminary results from the EU carbon trading system.

First, research on second-best optimal environmental policy shows the importance of choosing a policy instrument that raises revenue—such as an emissions tax or a system of tradable permits in which the permits are auctioned—and of putting that revenue to good use. Second, research on environmental regulation under uncertainty finds that for a long-lived stock pollutant such as carbon dioxide, a price-based instrument such as a carbon tax will tend to be more efficient than a quantity-based policy such as tradable permits, because it leads to a much less volatile carbon price. However, a tradable permit system can include features designed to reduce price volatility (for example, provisions allowing banking and borrowing of permits, or explicit price floors and ceilings), which would mitigate this disadvantage of tradable permits, and could even make a permit system more efficient than a tax.

The literature on second-best environmental policy makes a number of important points, perhaps the most important of which is that there is an
efficiency cost of regulating via freely allocated permits rather than via taxes or auctioned permits. But even though Metcalf’s chapter highlights this result and relates it to carbon policy, it still doesn’t put enough emphasis on this crucial issue.

Revenue recycling is particularly important for carbon policy—even more so than in the regulation of other pollutants—for two main reasons. The first is simply the magnitude of the potential revenues. A $20 per ton carbon tax in the United States would raise approximately $100 billion per year in revenue. That’s roughly thirty times the total value of the permits issued each year under the current U.S. sulfur dioxide (SO₂) permit trading system. Since the amount of money at stake is far greater, it is important to make sure that potential revenue is captured and used in an efficient manner. And a $20 per ton carbon tax is relatively modest: some proposals would impose a far higher price on carbon. Stern (2007), for example, calls for reductions in carbon emissions that would require a carbon tax rate of roughly $300 per ton.

Second, any politically viable carbon policy proposal would reduce carbon emissions by a smaller percentage than the reductions typical for other pollutants. For example, the SO₂ trading program has reduced SO₂ emissions by roughly 40 percent from 1980 levels (and the reduction would be substantially larger if measured relative to a no-regulation baseline), whereas a $20 per ton carbon tax would yield roughly a 15 percent reduction in carbon emissions (relative to a no-regulation baseline). The literature has shown that the more modest the reduction in emissions from a given policy, the more important revenue recycling will be in determining the cost of the policy.

Figure 2-1 presents the ratio of the cost of carbon regulation via freely allocated permits to the cost of the same regulation using taxes or auctioned permits with revenues recycled to cut income tax rates, for a range of different reductions in carbon emissions. It shows that for a 5 percent reduction in emissions, using a system of freely allocated permits will cost more than seven times as much as the same reduction using taxes with revenue recycling. That ratio falls as the reduction in emissions gets larger, though the system of freely allocated permits is still more than twice as expensive even for a 25 percent reduction in emissions.

All these calculations presume that the revenues from the carbon tax or permit auction are recycled to cut income tax rates. But this is not the only possible productive use for the revenue. Alternative uses, such as funding
public good provision or reducing the budget deficit, could be more efficient.\(^7\) The key is not to use the revenue in a wasteful manner: spending it on worthless government programs, for example, would be far more costly than regulating via freely allocated permits.

Another alternative use for carbon tax revenue would be to fund a lump-sum transfer to households. This would have the same efficiency cost as freely allocated permits. However, the distributional consequences would be very different. Depending on the value one places on income redistribution, such a policy could be either more or less attractive than using carbon tax revenue to fund income tax cuts.

Freely allocated permits are often justified on distributional grounds: that is, permits need to be given to firms free of charge in order to compensate them for the increased costs imposed by the regulation. However, Bovenberg, Goulder, and Gurney (2005) show that such compensation would require only a small share of the total number of permits (or a lump-sum transfer of a small share of the carbon tax revenue), and that freely allocating all the permits would dramatically overcompensate firms in

![Figure 2-1: Effect of Free Permit Allocation on Cost of Carbon Regulation](image-url)
carbon-intensive industries, leading to profits and equity values far above what they would be without any carbon regulation at all.\textsuperscript{8}

Recent experience with the EU carbon trading program bears this out: electricity prices have gone up as a result of the program, while average costs have risen by much less, leaving electricity generators with tens of billions of euros of windfall profits, a politically unpopular result. British members of Parliament have proposed a windfall profits tax to address this, but the problem could more easily have been avoided by freely allocating far fewer permits to electricity generators, and auctioning the remainder.

The second key lesson for carbon policy from the literature is that for a long-lived stock pollutant such as carbon, regulating via a tax will typically be more efficient than using tradable permits, because the tax provides a stable price for carbon emissions, whereas the permit price can be quite volatile. For a flow pollutant—one that has only immediate effects—that price volatility may be a good thing. If marginal pollution damage increases sharply when pollution emissions increase, then having the price of pollution also increase sharply in that case (as under a permit system) means that the price of pollution would closely correspond to the marginal damage.

However, for carbon, the effect of a ton of emissions this year is nearly identical to the effect of a ton of emissions next year, because what matters is the total stock of carbon built up in the atmosphere over a long period of time. Because the marginal damage per ton is virtually identical across years, it's inefficient to have very different prices in different years, as can happen under a permit system.

Metcalf does an excellent job of reviewing much of the relevant literature on this issue. But there are a few points that I'd like to add.

First, this is another case where preliminary experience with the EU carbon trading system supports the theoretical arguments made in the literature. Carbon permit prices under the EU system have been quite volatile. That volatility was particularly evident in 2006, when permit prices went from over thirty euros per ton to less than ten euros per ton over a period of roughly one month. Price swings since then have been less dramatic, but permit prices are still far more volatile than is efficient.

Second, while Metcalf's chapter mentioned that price caps and price floors can reduce price volatility and thus boost efficiency under a permit trading system, it did not go on to point out that a permit system with a price
floor and price ceiling can actually be more efficient than a tax. This is not a
new result, but dates back to a study by Roberts and Spence (1976), which
shows that a hybrid policy that includes both price and quantity regulation—
such as a permit system with a price floor and a price ceiling—can always be
designed such that it is at least as efficient as (and typically more efficient
than) the optimal tax or optimal permit quantity alone. Of course, actually
achieving that greater efficiency requires setting the price ceiling and price
floor properly, which is quite a challenging problem. But it is still worth
noting that such a hybrid policy could be more efficient than a tax alone.

Finally, allowing permit banking and borrowing is another way to reduce
permit price volatility and thus boost the efficiency of a permit system. Banking
and borrowing smooth out the price changes that result from changes in the
demand for permits: a large drop in permit demand in a particular year would
cause a large drop in the permit price if the permits can be used only in that
year, whereas if permit banking is allowed, then such a drop in demand would
lead to more permits being banked for the future, thus spreading out the effect
on price over multiple years and reducing the effect in any given year.

Papers on taxes vs. permits for regulation of a stock pollutant generally
compare taxes to nonbankable permits. Williams (2002) points out that
allowing banking puts permits on a much more even footing with taxes.
Nonbankable permits will be more efficient than taxes only if the marginal
damage curve for emissions in a particular year is steeper than the marginal
cost curve; this will almost never be the case for a stock pollutant, because
even a large change in emissions in one year will have only a small effect on
the total stock. However, bankable permits will be more efficient than taxes
if the long-term marginal damage curve is steeper than the marginal cost
curve; this is a much weaker condition (though nonetheless one that seems
unlikely to be satisfied in the case of carbon, where the marginal cost curve
appears to be steeper than even the long-term marginal damage curve).

A Brief Proposal for a U.S. Carbon Policy

Drawing on the important points in Metcalf’s chapter and in my com-
ments above, I conclude with a brief outline of the key features I would
include in a carbon regulation system for the United States.
Most economists involved in the debate over carbon policy fall into one of two camps: they strongly prefer a carbon tax or they strongly prefer a system of tradable carbon permits. But I don’t see that distinction as being particularly important in and of itself. A carbon tax is simpler and more transparent, which is an advantage, though not necessarily a big one. And a tax would certainly have major advantages over a permit system similar to the U.S. SO₂ trading program or the EU carbon trading system. But a permit system can be designed differently. If permits are auctioned rather than freely allocated, and if the system includes a price floor and price ceiling, then a permit system would do just as well as a tax on the two key issues of recycling revenue and handling uncertainty.

A small share of that revenue could be used to compensate carbon-intensive industries. I would then use the remainder to finance cuts in other taxes, such as either the income or payroll tax, or to reduce the budget deficit. And I would make those tax cuts slightly progressive in order to offset the distributional effect of the carbon tax, which is slightly regressive. Such a policy would be roughly distributionally neutral, both across the income distribution and in terms of its effect on carbon-intensive industries.

Finally, a key aspect of any carbon policy is that it should be easy to adjust as we learn more about both the costs of reducing emissions and the potential damage such emissions will cause.
Notes

1. Indeed, using carbon tax revenues to fund cuts in other taxes would likely increase carbon emissions slightly (relative to what they would be if revenues were used to fund a lump-sum rebate, for example), by encouraging more economic activity.

2. However, even when a direct tax on emissions is impossible, fuel taxes alone are still not the most efficient policy for reducing emissions. Fullerton and West (2000) show that a combination of taxes on gasoline use, vehicle size, and vehicle age is substantially more efficient than a tax just on gasoline.

3. This figure comes from my own rough calculations based on results from Bovenberg, Goulder, and Gurney (2005). For more details on a similar calculation, see Green, Hayward, and Hassett (2007).

4. Because SO\textsubscript{2} permit prices have been quite volatile, the total value of permits issued has also been volatile. But based on the clearing price of $380 per ton in the Environmental Protection Agency’s March 2008 permit auction, the annual value of SO\textsubscript{2} permits issued is approximately $3.4 billion.

5. For example, see Parry, Williams, and Goulder (1999).

6. The cost estimates used to generate this figure are the same as those used to generate figure 2 in Parry, Williams, and Goulder (1999), and come from simulations using a simple computational general equilibrium model of the U.S. economy. For more details on the model, see Parry, Williams, and Goulder (1999).

7. If the benefit-cost ratio for the public good is exactly the same as the cost of public funds (which is the case at the optimal level of public good provision), then using the revenue to fund public good provision will be just as efficient as using it to fund income tax cuts. If public good provision is initially below the optimal level, then funding public good provision would be more efficient than funding income tax cuts, whereas if it is initially above the optimal level, then funding public good provision would be less efficient. Similarly, if the budget deficit is initially greater than the optimal level, then using carbon tax revenue to reduce the deficit would be more efficient than using it to fund income tax cuts.

8. To see how such windfall profits can arise, consider the highly simplified case of a firm that can reduce emissions only by changing output, and that emits pollution exactly equal to the number of permits it receives. For this firm, the policy has no effect on average cost—the firm is neither buying nor selling permits—but still raises the firm’s marginal cost because producing one more unit of output requires purchasing permits. That increase in marginal cost will lead to a higher equilibrium price for the firm’s output, and with average costs the same, profits will also be higher.

References


