Why and How to Tax Carbon

Michael Waggoner

University of Colorado Law School

Follow this and additional works at: https://scholar.law.colorado.edu/articles

Part of the Environmental Law Commons, Taxation-Federal Commons, Taxation-Transnational Commons, and the Tax Law Commons

Citation Information


Copyright Statement

Copyright protected. Use of materials from this collection beyond the exceptions provided for in the Fair Use and Educational Use clauses of the U.S. Copyright Law may violate federal law. Permission to publish or reproduce is required.

This Article is brought to you for free and open access by the Colorado Law Faculty Scholarship at Colorado Law Scholarly Commons. It has been accepted for inclusion in Articles by an authorized administrator of Colorado Law Scholarly Commons. For more information, please contact jane.thompson@colorado.edu.
Why and How to Tax Carbon†

Michael Waggoner*

Samuel Gompers, founder of the American Federation of Labor, was asked what labor wanted. He replied, "More."¹ We cannot afford very much "more" anymore, but we can have "better." "Better" is the new, less carbon-intensive world.

ABSTRACT

Increased concern about possible global warming due to rising levels of greenhouse gases such as carbon dioxide ("CO₂") suggests the need to control emissions of CO₂. This article explores a system of revenue-neutral carbon taxes as a supplement or alternative to other CO₂ control systems such as subsidies, regulation, and cap-and-trade. A system of carbon taxation should be, the Article suggests, sufficiently fairer and simpler and more efficient than the other possible systems of CO₂ control and that it merits serious consideration. Because the carbon

† This article was presented at the CU-Energy Initiative Research Symposium in Boulder, Colo. (Nov. 2008). It will be presented at the Society for Environmental Law and Economics meeting in Vancouver, Canada (Mar. 2009) and the Law and Society Association meeting in Denver, Colo. (May 2009).

* Associate Professor, School of Law, University of Colorado. A.B., European History, Stanford University; LL.B. Harvard Law School. Professor Waggoner's research and teaching interests include taxation and civil procedure. Thanks are due to the University of Colorado Law School for generously supporting my scholarship, to Robert Wall of the class of 2008 and to Eric Lund of the class of 2010 for ably assisting my research, and to Deborah Cantrell, Richard Collins, Pat Furman, Cynthia Goff, Lakshman Guruswamy, Howard Klemme, Mark Loewenstein, Scott Moss, Paul Ohm, James Piccone, Mark Squillace, and Ahmed White for insightful suggestions and criticism.

tax that is suggested would be revenue neutral, it should be politically acceptable. Problems with a carbon tax such as regressivity, possible disruption of international trade, and impact on other societal values are explored.

The carbon tax, it is suggested, should be enacted along with a Value Added Tax ("VAT") for two reasons. First, the carbon tax should start low (so as not to disrupt the economy) and increase steadily (to create substantial incentives to reduce CO\textsubscript{2} emissions). Revenue from the carbon tax will rise initially as the rate increases, but eventually the expected reduction in carbon use will cause carbon tax revenues to fall even though rates remain high and even increase. To keep the carbon tax revenue-neutral, other taxes will have to fall as carbon tax revenues rise, then rise as carbon tax revenues fall. To avoid upsetting the expectations that underlie long-term investments and planning, it may be desirable to have relatively stable income tax rates, and thus it would be best to have the variation occur in the VAT rates. Second, the carbon tax will be regressive, so it should be accompanied by some form of rebate or income maintenance program for people with low incomes. The carbon tax initially will generate too little revenue to justify creating such a program, but the VAT will be similarly regressive and from the start it can generate enough revenue to justify and fund such a rebate program.

I. INTRODUCTION

To address the challenge of global warming more effectively, and to improve its tax base, the United States should impose a revenue-neutral carbon tax on all domestic production and importation of coal, petroleum, and natural gas. The United States should seek to persuade other nations that carbon taxation is a critical tool in confronting the dangers of global warming. This Article first argues that a carbon tax is a necessary and politically feasible tool to resist the rise in global temperatures attributable to increased carbon dioxide ("CO\textsubscript{2}\) that human activities have injected into the atmosphere. The Article then explores how a carbon tax might be designed and implemented.

This carbon tax would have two major purposes. First, imposing a tax on carbon production would create an incentive to reduce carbon dioxide emissions. This reduction is desirable because carbon dioxide emissions appear to be contributing significantly to global warming and climate change, developments that may cause serious environmental damage.\textsuperscript{2} The carbon tax may be a better tool for carbon reduction than

\textsuperscript{2} The discussion here accepts the argument that human conduct risks increasing greenhouse gases, and hence the risks of global warming, without exploring the role of
alternatives such as subsidies, regulation, or cap-and-trade. However, the solution for reducing carbon emissions may include all four of these and other approaches, as a matter of both practical politics and administrative feasibility.

The second major purpose of taxing carbon would be to create a more efficient and equitable means of raising revenue than taxing income, consumption, or other typical bases for taxation. Because of this efficiency and fairness, it is less important to determine precisely how much and how fast the emission of CO₂ is changing the world’s climate, or to determine the possible consequences of those changes on humans and other inhabitants of the planet.

The carbon tax proposal is based in part on agnosticism and humility. First, while there appear to be solid reasons to believe that human activity is contributing to global warming and that global warming may present serious risks to humans and other inhabitants of this planet, neither of those statements is entirely free from doubt. Even accepting those statements, it is not clear how serious the impact will be or how soon it will arrive. There is also uncertainty as to the trade-off between alleviating these risks and other social values, such as freedom and economic well-being. Second, it is not clear how best to proceed. The Appendix briefly describes and evaluates systems of subsidies, regulation, and cap-and-trade. These systems might promise more definite reductions in carbon emissions, but the value of that definiteness is constrained by the limits of our knowledge. Those approaches thus

---


might reduce carbon too little or too much, and they might impose excessively or too little on other values such as freedom and economic well-being. With experience, a system of carbon taxes can be modified more easily than subsidies that may already have been spent (perhaps unwisely), regulations that may require substantial business expenditures for compliance and government expenditures for enforcement, and purchases of carbon emission rights that may lose value. It is clear that the carbon tax will have the desired effect of putting downward pressure on the level of carbon emissions, and that pressure may be adjusted relatively easily by increasing or decreasing the tax rate in light of experience. However, it must be admitted that all of these approaches will have substantial costs and are likely to involve mistakes and false starts.

This proposal is not for an add-on tax, but rather for a carbon tax to replace revenues that would otherwise be generated. The level of revenue to be generated should depend on political choices that are beyond the scope of this Article. These choices include the appropriate level and mix of governmental expenditures and the appropriate levels and subjects of taxation, both determined in light of government revenue needs and the reductions that taxes may impose on the economy and on incentives. The point is that the carbon tax should not be a fund to resolve environmental problems; rather, it should be one among many sources of governmental funds. There may be little relationship between the level of carbon tax needed—based on both environmental concerns and the need to avoid too severely crimping the economy—and the expenditures needed for environmental remediation. The amount and proportion of each source of tax revenue to be used should be based on economic and political considerations, and the funds generated by all sources should be allocated through the political process.

A. Carbon Taxes and $4 Gasoline

This carbon tax proposal is not motivated by any hostility to energy company prices or profits. That industry is highly competitive, and prices can go down as rapidly as they rise. This was demonstrated by the roughly fifty percent fall in petroleum prices from July to October of 2008, after a substantial run-up. The goal is rather to reduce carbon emissions and to provide a fair and efficient tax system.

The first barrier to fair consideration of a carbon tax proposal is the recent high price of petroleum products. To add a carbon tax of one dollar or more per gallon to the price of gasoline, recently selling for more than four dollars per gallon, will create serious political pushback, jeopardizing the agendas, political careers, and perhaps even the physical
safety of such a proposal’s advocates. The recent reduction in energy prices may soon be replaced by another increase. There are three major reasons, however, why those high petroleum prices should not prevent enacting a carbon tax.

First, the proposed carbon tax is a substitute for other taxes, not an addition to them. For example, an individual’s average income tax rate might be twenty percent, and that individual might use seven percent of his or her income for carbon products. That individual would be no worse off after taxes, if a carbon tax increased the cost of the carbon products by five percent of that taxpayer’s income (from seven percent to twelve percent of income), so long as the average rate of the income tax were lowered by five percent (from twenty percent to fifteen percent). In this situation, the extra cost of the carbon tax would be offset by the reduction in the income tax.

Second, it is not clear that the price of consumed carbon will rise by the amount of the carbon tax. Some of the tax may be absorbed by the producers of carbon. The degree of price-shifting depends on the relative elasticities of supply and demand, but it is unlikely that the tax will be borne entirely by consumers. One would expect sales of carbon-based products to fall because of the price increase created by the carbon tax. To mitigate that drop in sales, the producer of those carbon-based products might slightly reduce the price to avoid an overly steep drop in sales, thus absorbing part of the tax.

This second point may have great potential. If only one nation imposes a carbon tax, it may be that much of that tax would be borne by that nation’s population. Under these conditions, world carbon prices will largely be set in carbon-tax-free markets, and the few carbon-taxing nations’ populations will have to pay much of the carbon tax. If most nations impose a carbon tax, however, it may be that more of the tax will be borne by the producers of carbon; world carbon prices will be set in largely carbon-taxed markets, with more of the tax absorbed by the producers. This shift of carbon taxes to carbon producers could help undo the recent shift in world balances of power to the carbon-exporting nations such as Iran and Venezuela—with their arguably authoritarian regimes—and return world power back to carbon-consuming nations.

Third, individuals can change their conduct to reduce their carbon tax liability. Although some users of certain carbon products, such as gasoline, may have little ability to reduce their carbon-based purchases,

other users may be flexible even in the short run, and even more users should be flexible in the long run. In the short run, possibilities for decreasing carbon use include: reducing recreational driving; planning accordingly to accomplish several social, shopping, and business excursions in one trip; walking, bicycling, carpooling, or using mass transit more often; and scheduling work for four days rather than five, reducing commuting by twenty percent. Many persons may be able to choose to use their fuel-efficient sedan more than their fuel-guzzling SUV, minivan, or pickup truck. Moreover, in the long run, individuals can buy or rent more fuel-efficient cars, homes, and appliances; live closer to work or to mass transit; invest in alternatives such as hybrid, plug-in, or perhaps hydrogen or fuel cell vehicles; and use energy collected from solar, wind, water, geothermal, biomass, or other sustainable sources.

Note that these three mechanisms are cumulative. As discussed in the first point, other taxes will be reduced by the full amount of the carbon tax. Additionally, it is likely that some of the tax will be borne by producers, so that consumers’ carbon tax burden will be less than the benefit of the income tax cut. Finally, as explained in the third point, consumers can change their behavior to further reduce the impact of the carbon tax, coming out still further ahead.

These points should not be overstated. Although in this scenario the average citizen comes out ahead, the citizenry is composed of both those who use little carbon and those who use too much. While light users will come out far ahead, heavy users will likely suffer, unless they can change their conduct to reduce their carbon use or can find some method to pass on some of their increased carbon costs. In addition, revenues will have to be maintained, so greater than projected reductions in carbon use will have to be made up by increasing the carbon tax. Thus, only those who can reduce their carbon use faster than the norm will come out ahead under the third mechanism. On the positive side, however, if a particular business can reduce its carbon tax liability more than others in its industry while matching competitors’ prices and earning higher profits, it

would have a substantial incentive to widen the gap between its carbon use and that of the industry norm.

Along with the benefits discussed above, there is an additional reason why a carbon tax is desirable. Taxes are necessary to provide revenue to pay for government programs, but any tax has ill effects. There will always be inefficiencies in collecting taxes. Taxpayers incur costs to plan and comply with taxes, to avoid taxes, or perhaps to evade taxes. Tax collectors incur costs to enforce taxes. Tribunals incur costs to resolve disputes over taxes. These costs waste resources. In addition, any tax distorts behavior, slowing economic activity by withdrawing funds from the economy and reducing incentives to work, innovate, and take risks. What is taxed may affect these harms. A tax on income, for example, may reduce incentives for working, saving, and financial risk-taking. A tax on consumption may reduce expenditures on food, clothing, shelter, health care, and entertainment, which are some of the main goals of human activity and should not be discouraged unnecessarily. In contrast, a tax on carbon discourages carbon use, which should have two major benefits. The first is the reduction of carbon emissions that threaten to accelerate global warming. The second is the value of carbon in its native form. Coal and petroleum can be the raw materials for chemicals and medicines that can have great value to society. To burn those raw materials unnecessarily is wasteful. We will, of course, continue to tax incomes and consumption, but we must ask how much higher to push the marginal tax on each, or how much of a tax reduction on either to forgo, as opposed to imposing a tax on carbon. While there are clear losses to society in discouraging either income or consumption, it is hard to see a comparable loss to society from a reduction in carbon usage.

The counterargument to the preceding paragraph is that carbon consumption per se is not valuable, but energy is necessary to our society, and much of that energy is likely to come primarily from fossilized carbon for the foreseeable future. There are two responses to this counterargument. First, the carbon tax should be gradually phased in, so that there will be time to develop new sources of energy to replace carbon. Second, we may simply have to live with less energy. Most sources of energy have potential problems: nuclear reactors create plutonium and other radioactive materials with long half-lives, risking accidents or terrorism; bio-fuels seem to be driving up food prices; hydroelectric power requires dams that harm fish and other wildlife and that may fail catastrophically; windmills may endanger birds and bats.

8. HANS-GEORG ELIAS, AN INTRODUCTION TO PLASTICS §3.1.1, at 31 (2d ed. 2003) ("The main raw material for [plastics] is petroleum . . . Coal tar is the raw material for aromatics such as benzene, toluene, and xylenes . . .").
and some consider windmills to be visual pollution. However, to use less energy need not mean a lower standard of living. Our society, our machines, our homes, and our lives have evolved to their present state only in the very recent past and in a world of very inexpensive energy. With energy becoming more expensive, design and habits should change as we learn to substitute more time, labor, material, and engineering for some of the energy we now expend. The historic link between energy consumed and quality of life need not control the future.  

A carbon tax will merely speed up inevitable societal changes and cause them to occur in a more orderly manner. The extent of the Earth’s fossil carbon resources is uncertain and although there are likely to be further major discoveries, these resources are ultimately finite. World economic growth is consuming them at accelerating rates. The recent sudden rise in petroleum prices warns us of what might happen in the future unless we smooth the transition to a less carbon-intensive world.

Finally, the carbon tax could be reduced or suspended during an energy emergency, such as when normal supplies of energy are cutoff by natural disasters, wars, or boycotts. The reduction or suspension could be achieved by legislation, authority delegated to the executive, or automatic triggers. However, one should remember that high prices discourage consumption, and reduced consumption is an appropriate response to energy supply disruption. Moreover, reduction or suspension of the carbon tax will benefit both users and producers of carbon in uncertain proportions. While one would hope that the suspension would benefit the users, the suspension is also likely to benefit the producers to some extent. To increase the producers’ profits at a time when they are already swollen by an emergency energy price increase does not seem to be a wise policy.

On the other hand, to adjust the carbon tax to produce a steady rise in carbon costs would promote efficient development of new technologies. Too often in the past, sudden price increases have found the substitute technology undeveloped or not yet deployed. Additionally, sudden price decreases have frequently derailed development and deployment of new technologies.  

Under this approach, instead of steadily increasing carbon taxes, Congress might provide for a steady rise in the price of carbon, including the tax. Under this approach, the tax


would rise less as carbon prices rose faster, and the carbon tax would rise more when carbon prices were not rising. This smoothing might ease the weaning from carbon dependence.

On balance, there should be enough winners from enacting a carbon tax to make it worthwhile to explore how such a tax might operate. Part II of this article outlines the mechanics of a carbon tax system. Part III addresses the need to reduce the serious regressivity in consumption taxes generally, including a carbon tax. Part IV discusses combining a carbon tax with another kind of consumption tax, a Value Added Tax ("VAT"). Part V focuses on the international issues presented by a carbon tax. Part VI considers the interrelationship of the carbon tax and other social goals.

II. THE MECHANICS OF A CARBON TAX

In its simplest form, a carbon tax would be imposed on the production of fossil carbon, whether by mining coal, pumping petroleum, or extracting natural gas. The tax would not be based on the value of the product or on its energy content, but solely on its carbon content. Coal consists overwhelmingly of carbon, so all of the material removed would be taxed. Natural gas consists largely of methane or CH₄, in which each molecule consists of one carbon atom and four hydrogen atoms, so only a portion of the material removed would be taxed. Petroleum is a mixture of hydrocarbon molecules that is intermediate between coal and natural gas, with each petroleum molecule including both hydrogen and carbon atoms, but with more carbon and less hydrogen than natural gas.

A carbon tax will resemble the gasoline taxes imposed by the federal government and by state governments in the United States, but with three major differences. The first arises in the point along the chain from mining to ultimate consumption where the tax is imposed. The carbon tax would be imposed at the point of extraction, the very start of

The winner of a political contest may be difficult to predict. That more people would win from a carbon tax than would lose does not necessarily mean that the tax will be enacted. Those fearing loss of what they now enjoy may be more highly motivated to act than those expecting future uncertain and often broadly-shared gains. See generally GENE M. GROSSMAN & ELHANAN HELPMAN, SPECIAL INTEREST POLITICS (2001). The losers may fear not just the extra costs they will bear under a carbon tax, but that those costs will reduce the value of economic interests they now hold. For example, an increase of $10,000 annually in the cost to heat and cool a house from a carbon tax is certainly a problem, but an even greater problem would be a $100,000 drop in the value of that house as prospective buyers capitalize those extra costs, and still greater a problem if the house has a large mortgage so that the price drop takes much or all of the owner’s equity. This article does not predict that a carbon tax can be enacted; it only suggests that there is a sufficient possibility that there is reason to proceed.
that chain, when the coal, petroleum, or natural gas is first removed from
the ground, whereas the gasoline tax is imposed at the end of the chain
when it is sold to the consumer. The second difference is the breadth of
the taxes. The carbon tax would be imposed on all forms of carbon
extraction, and it would be applied regardless of end-use. Coal or
petroleum used to make plastics or fertilizer would be taxed, as would
coal or petroleum used for fuel. On the other hand, the gasoline tax
applies to gasoline, which is only a part of the spectrum of products
made from petroleum—and to a limited but perhaps growing extent
made from coal or natural gas—and only if the gasoline is to be used for
certain purposes. Gasoline taxes are imposed on gasoline to be used in
motor vehicles to pay for highways, on fuel for boats to protect and
improve inland waterways, and on fuel for aircraft to operate airports and
the air traffic control system.\footnote{12} Gasoline to be used for farm equipment
or to fuel cooking stoves, however, is normally exempt from the gasoline
tax. The third difference is in the use of the proceeds. Carbon tax revenue
could be used for general government purposes, while the gasoline tax
revenue is used only to build, maintain, and operate highways,
waterways, or airways.

At its core, a carbon tax is fairly simple because relatively few
entities control virtually all carbon production. Although particular
entities may own thousands of coal mines or petroleum or natural gas
wells, these entities tend to be relatively large and their extraction
activities have fixed locations at the source—unlike sellers or
transporters or manufacturers, whose locations may easily shift—which
simplifies the process of identifying them and collecting the carbon tax.
There are about 13,000 oil and natural gas extractors in the United States,
although the largest fifty control over seventy percent of both markets.\footnote{13}
Thirty “major coal producers” control eighty-six percent of the U.S. coal
market.\footnote{14} The tax need not be collected from other entities along the
chain of extraction, refining, manufacturing, distribution, and finally
consumption, because of two effects. First, the tax may cause a reduction
in carbon output, making less carbon available along the chain and thus
lowering carbon emissions. Second, the tax will be passed along the

\footnote{12}{See, e.g., \textit{Cong. Research Service, RL30304, The Federal Excise Tax on

\footnote{13}{See \textit{EIA, Operator Data by Size Class, Energy Information Administration},

chain to a substantial extent, giving entities and individuals at all places along the chain an incentive to reduce carbon consumption.

A carbon tax could be imposed later in the distribution chain, such as when a consumer fills a car’s tank with gasoline or pays electric or heating bills, which would allow fine-tuning of the tax. For example, it might be harder to find substitutes for carbon use in aircraft than in trains, trucks, or automobiles, so there might be a lower carbon tax on aircraft fuel. Such fine-tuning, if done as a matter of careful thought and wisdom, might be desirable. However, fine-tuning of the carbon tax might instead be the product of political power and logrolling. In addition, to impose the carbon tax later in the distribution chain would be much more complicated. Many of the benefits sought by imposing the carbon tax at a later point could be achieved through refundable credits for carbon sequestration, discussed below.

Three other sources of carbon deserve brief mention. First, diamonds are virtually pure carbon; however, because they are so valuable, they are very rarely burned, and therefore do not pose a risk of global warming. Second, the destruction of forests, which serve as major “sinks” for CO₂, is a major problem under any carbon emission control system. While controlling carbon extraction through wells and mines may be relatively simple because of the limited number of entities doing such extraction, control of forest destruction may be more difficult because timber poaching can be done in any forested area and by many small-scale operations. Controlling tree cutting might best be done by using more carrots than sticks. For example, the forests might be operated on a sustainable multiple-use basis, providing incomes for landowners and creating jobs for others through activities such as logging and tree replanting, harvesting fruits and nuts that do not destroy the tree, searching for valuable chemical and medicinal compounds, and promoting tourism. The stick could be limits on importation of lumber and wood products, similar to limits that have been imposed on diamonds and ivory.

---


Unfortunately, the carbon tax will increase the already great pressure on the world’s forests. As the fossil sources of fuel—coal, petroleum, and natural gas—are subject to the carbon tax, the temptation and pressure to cut wood for fuel will increase. This pressure will further increase because building materials will be subject to the carbon tax based on their content—if made of plastic or other carbon-based materials—or on the carbon released in their production—if made of steel or concrete—making wood structures comparatively more attractive. Extra emphasis will be required on the carrots and sticks that help to preserve the world’s forests.

The third source of carbon is the process of making powdered cement, used in creating concrete by adding such materials as water, sand, and aggregate. Cement is made by heating raw materials, which releases CO$_2$. Typically the heating process requires use of carbon fuels, and there is an additional release of carbon from the raw materials. Because so much construction involves concrete or asphalt, and because other alternatives are not apparent, construction may be among the most difficult industries in which to reduce carbon emissions. In addition to new alternatives, part of the solution to this problem will be to recycle concrete and asphalt, and part will likely be carbon capture credits, discussed below. The problem is probably somewhere between the easily controlled mine and well situation, and the more problematic issue of tree cutting. For example, a cement kiln requires high temperatures, but one could probably be built fairly informally and on a small scale, and if one were destroyed, a replacement might be built without much difficulty. This means cement kilns would probably be harder to control within the legal system than coal mines and petroleum or natural gas wells. Cement kilns might be only slightly more complicated than illegal alcohol distilleries used to make bootleg liquor, and thus almost as difficult to control. On the other hand, it should be far easier to cut down and haul away a few trees than to set up and operate a cement kiln.

A. Credits for Carbon Recapture

Another important aspect of carbon taxation would be the extent to which credits should be allowed for carbon capture—i.e., for activities that remove CO$_2$ from the atmosphere. For example, a coal-fired electric


19. Rosenthal’s statement, “Cement has no viable recycling potential; each new road, each new building needs new cement,” is true, but it overlooks the use of old broken up concrete as aggregate.
power plant would have indirectly paid a tax on the coal it consumed. It could earn a refundable credit if it creates systems to capture the carbon dioxide produced by burning the coal, rather than release the carbon dioxide into the atmosphere. Ideally, such a credit should be allowed so that the reduction in carbon use will be less drastic but net carbon emissions will still significantly decline. Before the law authorizes such a credit, there should be confidence that the carbon is in fact very likely to be immobilized indefinitely.

There are various possible immobilization technologies. Carbon dioxide might be trapped underground. Under high pressure, carbon dioxide condenses from a gas to a liquid, and the liquid form is much denser and less mobile than the gas, so it can be injected into porous rock formations that are capped by non-porous rock—perhaps rock formations from which natural gas or petroleum has been extracted.20 Because rock formations have confined naturally occurring CO₂ and methane for millions of years, they should be able to confine sequestered carbon. Nevertheless, it will be necessary to determine which formations are appropriate. A possible problem with this technology is that if the mineral rights have been severed from the surface ownership—as has occurred in many areas—it may be unclear to whom the rights to the porous rock formation belong.21

Another possible immobilization technology is to encourage algae growth in the ocean. This would allow algae to soak up carbon dioxide through the process of photosynthesis, which could be encouraged by adding to the dissolved iron content of the surface waters. These algae blooms, however, may block sunlight and absorb oxygen needed by other wildlife.22 This process may remove carbon dioxide indefinitely, but this result would seem to be achieved only to the extent that the algae


sinks to the bottom of the ocean—whether as algae or incorporated into skeletons of wildlife higher up the food chain—and does not decay.23

Forests recapture carbon through the process of photosynthesis, as the trees combine carbon dioxide with water to produce cellulosic compounds. Yet forests may be cut down, and forest fires are a normal part of a forest’s life cycle. Each of these events risks a return of the carbon dioxide to the atmosphere. Only a large forest with limited logging and at least moderate fire suppression is likely to be an effective long-term “carbon sink.” However, forests grown on a sustainable basis for fuel use or carpentry would likely be exempt from the carbon tax.

Some products of petroleum could be considered so long-lived as to qualify under a system of carbon capture. Asphalt for roads might be such a use, as might some plastic products with long-lived uses. There is a recent proposal to use CO₂ to make calcium or magnesium carbonate by bubbling the CO₂ through seawater, then using the calcium carbonate as aggregate in concrete that should last indefinitely.24 Upon further investigation, this proposal may be proven to be a satisfactory method of recapturing carbon.

Ideally, there should be credits for carbon capture, if there are appropriate technologies and the means to monitor and control them, and if we can be confident that such technologies and means are effective.

B. Other Greenhouse Gases

Carbon dioxide is not the only greenhouse gas. Others include methane, nitrous oxide, and some chlorofluorocarbons.25 Their treatment is beyond the scope of this article. It is possible—but by no means certain—that steps similar to those proposed here for carbon may be applicable to these other greenhouse gases. For example, both nitrous oxide and chlorofluorocarbons are produced largely by industrial processes that might be fairly easily taxed, but methane exists in large

quantities in nature and is also produced by such widespread sources as digestion by cattle, rice paddies, wetlands, and termite colonies.26

C. Gradual Phase-In of the Carbon Tax

The carbon tax should be phased in over several years, with low initial rates that slowly but substantially increase, to allow both consumers and producers to adjust gradually to the new system. Old energy-intensive personal and business investments will lose their value under a system of carbon reduction. However, allowing time for the change will permit the value of the old investments to be recovered through depreciation because they will be used for a period not much shorter than their normal useful life. That useful life, it may be noted, will already be shortened by the increasing prices of energy, which will in many cases make old investments economically impractical well before their physical useful lives are exhausted. As a matter of both politics and equity, it would be unwise to impose windfall losses unnecessarily. The mirror image of phasing out the old is developing and implementing the new. It will take time to develop and create the ability to mass produce new energy-efficient products and processes, and one would not want unnecessarily large and sudden windfall gains to those who own such assets. A carbon tax enacted with low initial rates, but with steady and eventually substantial rate increases, would allow a smooth and fair transition from our current system to one much less carbon-intensive.27

Even after an initial phase-in, carbon tax rates should continue to rise to promote further reductions in carbon emissions. Ultimately, these rates may be expected to become high enough to virtually eliminate net carbon emissions, so that the current high levels of carbon dioxide in the atmosphere can begin to return to normal. Thus, ideally the carbon tax yield eventually will decline, even though the rates will have become quite high, because net carbon emissions will have been reduced significantly.28


27. See discussion supra note 10, suggesting a goal of a steady rise in the price of carbon including the tax, as opposed to a steady increase in the tax itself.

28. If raised beyond a certain point, tax rates are likely to reduce tax revenue by providing a disincentive to work or invest. See, e.g., Economyprofessor.com, Laffer Curve, http://www.economyprofessor.com/economictheories/laffer-curve.php (last visited Nov. 11, 2008). However, in the context of a carbon tax, an increasingly higher tax rate provides not a disincentive to work, but a disincentive to emit carbon. A primary purpose of a carbon tax is to reduce carbon emissions, not merely to raise revenue, and so diminishing returns over time are desirable. See Arthur B. Laffer, The Laffer Curve: Past,
III. REGRESSIVITY UNDER A CARBON TAX

In many ways, a carbon tax will resemble a tax on consumption, and thus it will be regressive. Carbon is included in the creation, manufacture, distribution, or use of virtually all products. Clothing is often made from synthetics, which are often made from petroleum. The same is true for the plastics used in everything from cars to kitchen utensils and from aircraft components to surgical instruments. Other products containing little carbon may nonetheless require a significant amount of carbon in their creation. Steel, for example, is basically iron with small amounts of alloying metals and carbon, but its production typically requires large amounts of carbon to remove the oxygen from the iron oxide ores in which iron is normally found. Carbon-based fuels are used to transport many products vast distances along the chain from extraction to end-use consumption. In addition, the operation of many products—such as cars, furnaces, air conditioners, and stoves—requires energy normally derived from carbon. Of course, some individual lifestyles are more carbon-intensive than are others, but individuals generally use many products and services that employ carbon, so the carbon tax will resemble a tax on consumption generally.

A consumption tax is usually regressive; that is, it takes a higher percentage of low incomes than of high incomes, for the following reasons. Persons of low income tend to do little saving and spend nearly all of their incomes on consumption because they have few extra resources to buy anything beyond food, clothing, shelter, health care, and other necessities. Persons of low income may even consume more than their incomes, as they spend all their past savings and borrow against future income from sources such as credit cards, payday lenders, and loan sharks. Thus, persons of low income may pay a consumption tax on amounts approaching or even exceeding their incomes. Persons of increasingly high incomes, in contrast, may be able to invest or save increasing portions of their incomes, thus leaving decreasing portions of their incomes to be consumed and thus subject to the consumption tax.  

---


29. The problem of regressive consumption taxes may be particularly acute for carbon taxes. Carbon taxes may make commuting much more expensive so that those of higher incomes who have fled to suburbia in the past will find it to be in their interest to return to central cities to reduce their commuting costs, outbidding and thus displacing the lower income residents of the central cities, forcing those low income people to move to the suburbs and thus incur expensive commutes. See, e.g., *France's Suburbs: Two Years On*, ECONOMIST, Nov. 8, 2007 (discussing economic depression and unrest in France's low income suburbs).
The United States does not have a steeply progressive tax system. The top income tax bracket now is thirty-five percent, far below the above ninety percent rates reached in World War II and the post-War period, the seventy percent rate of the late 1960s and the 1970s, and the fifty percent rate in the early 1980s.\textsuperscript{30} To shift from a mild progression to the regression of a consumption tax would seem unwise, particularly in light of the increasing inequality of income and wealth that has been developing over the past generation.\textsuperscript{31} One might consider three possible approaches to reducing the regressivity of a consumption tax: (1) an exemption from the tax on items likely to be heavily used by the poor; (2) a provision of economic transfers to those of low income; and (3) an implementation of other taxes that are progressive so that the tax system—although it includes a regressive consumption tax—is progressive on the whole.

\textit{A. Exempt Certain Consumption}

One way to reduce the regressivity of a consumption tax is to exempt items such as food or health care. The food exemption, however, may be unwise, and the health care exemption may be better explained as "not consumption" rather than "regression reduction."

In the case of a food exemption, persons of lower incomes may be expected to use more of their incomes for food than do those of higher incomes, so that exempting food may tend to reduce regression. However, this solution is very expensive. One would expect that most food is consumed by those of middle and higher incomes, who buy increasingly more expensive foods as incomes rise. Each of these higher-income individuals is likely to spend more on food than does a person of lower income. Consequently, exempting this food does little to reduce regression. Because so much revenue is lost due to the food exemption, the rates on other consumption must be higher. As the tax rate rises, it increasingly distorts normal economic activities and personal choices, and increases the incentive to avoid or evade the tax.\textsuperscript{32}

Not taxing health care may be justified by an acknowledgement that health care differs from other consumption. A person who spends more on food, clothing, shelter, or travel is generally thought to be better off


\textsuperscript{31} CHYE-CHING HUANG \& CHAD STONE, \textit{CTR. ON BUDGET \& POLICY PRIORITIES, AVERAGE INCOME IN 2006 UP $60,000 FOR TOP 1 PERCENT OF HOUSEHOLDS, JUST $430 FOR BOTTOM 90%: INCOME CONCENTRATION AT HIGHEST LEVEL SINCE 1928, NEW ANALYSIS SHOWS, Oct. 22, 2008, http://www.cbpp.org/3-27-08tax2.htm.}

\textsuperscript{32} See generally JOEL SLEMROD \& JON BAKJIA, \textit{TAXING OURSELVES} 114-56 (3rd ed. 2004).
than those who spend less. A person who spends more on health care, however, is probably less well-off than someone with a similar income but lower expenditures for health care.33

Thus, it does not seem to be a wise policy to exempt food from a consumption tax, but it may be wise to exempt health care. For the carbon tax imposed at the point of extraction, however, it is probably not possible to exempt particular types of expenditures. Even if it were possible, while many medicines are made or processed in part using carbon-derived raw materials or fuels, the carbon content is typically such a low proportion of the cost of medicine or other health care that no exemption should be needed.

More generally, the danger of targeted exemptions surfaces in the process of political prioritization and cost-benefit analysis. Some believe that certain activities are beneficial and so should be more lightly taxed, and that other activities—or the same activities with an opposing spokesperson—are harmful and should be more heavily taxed. These ideas may have merit; however, it is very hard to determine benefit and harm. Even if they are determined, it is difficult to define them in reasonably administrable ways, and the process of so doing is likely to yield a complicated system. The mind-numbing complexity of the U.S. Internal Revenue Code stands as a warning against the dangers of straying from general principles to particularized rules, and of using the tax system to reward the beneficial and restrain the harmful. Ultimately, practical politics may introduce such complexity, but in theory that complexity should be avoided or at least minimized.

B. A System of Financial Transfers

The regressivity of consumption taxes may be offset by a system of payments to those of lower incomes. For example, the tax that finances Social Security is regressive, because it only applies to wages and self-employment income—not to the dividends and interest, rent and royalties, and capital gains more likely to be enjoyed by those of higher incomes—and only up to a certain annual amount (annual salary of $106,800 in 2009). The Earned Income Credit, although now a major wealth transfer and anti-poverty program, was initially enacted to refund

33. See William D. Andrews, Personal Deductions in an Ideal Income Tax, 86 Harv. L. Rev. 309, 335-36 (1972) (arguing that “[w]hat distinguishes medical expenses from other personal expenses at bottom is a sense that large differences in their magnitude between people in otherwise similar circumstances are apt to reflect differences in need rather than choices among gratifications”).
this regressive tax to persons of low income.\textsuperscript{34} A federal consumption tax, such as the carbon tax proposed here, might be made less regressive by a similar system of transfer payments.\textsuperscript{35}

It should be noted that a carbon tax with a transfer payment to those of low incomes would still provide an incentive for low-income persons to reduce their carbon use. Because the transfer would be based on income, not carbon use, the recipient could keep more of the transfer payment by reducing carbon use. In contrast, an exemption of items heavily used by the poor would provide no such incentive to low income people to reduce carbon consumption, and thus would conflict with one of the major goals of the carbon tax: encouraging all to reduce their carbon consumption.

A system of transfer payments may be expensive to administer in order to get the payments to the right people without too much paperwork and inconvenience, while at the same time minimizing mistakes and the opportunity for fraud. This cost might be hard to justify, given the relatively small amounts of revenue to be collected by a carbon tax, at least initially. Such a transfer payment system may be justified, however, as part of the tax system as a whole. The next section discusses how the United States might improve its tax system by replacing the lower income tax brackets with a Value Added Tax ("VAT"). This VAT will allow transfer payments to offset the regressive effects of a carbon tax and will permit adjustments between carbon taxation and other taxation, as the carbon tax first increases revenue as rates rise, then yields less revenue as carbon use falls.

\textit{C. The Carbon Tax in the Larger Tax System}

A progressive tax system may include regressive elements. The regression of a consumption tax such as the carbon tax proposed here may be offset at least in part if the tax system also includes progressive elements, such as a progressive income tax. This section discusses how a carbon tax would fit into the entire tax system.

A tax system may have several components. Income may be taxed to individuals, to entities such as trusts or corporations, or under specialized taxes such as those on wages and self-employment income to fund Social Security. Property is commonly taxed in the United States by local governments. States and local governments tax consumption under

\begin{itemize}
\item \textsuperscript{34} Jonathan Barry Forman, \textit{Making America Work} 155-56 (Urban Institute Press 2006).
\item \textsuperscript{35} See Slemrod \& Bakića, supra note 32, at 258.
\end{itemize}
general sales taxes (most other nations use VATs). Specialized consumption taxes include the "sin taxes" on alcohol and tobacco and the taxes on vehicle fuels that are, in effect, user fees that pay to build and maintain highway systems.

As suggested by Professor Michael Graetz of the Yale Law School, the United States might replace its largely income-tax-based tax system with a combination of income tax and VAT, the norm in most other industrialized nations. Under such a combined income tax and VAT system, the VAT might be considered the lowest tax bracket of the income tax system. For example, a broad-based fifteen percent VAT could serve as the equivalent of the fifteen percent income tax bracket. Then all income tax brackets at or below fifteen percent could be eliminated—so that people currently in those marginal income tax brackets would no longer be required to file income tax returns—and income tax brackets above fifteen percent could be reduced by fifteen percent. For example, the current top bracket of thirty-five percent would then be twenty percent. This change would have several desirable effects, in addition to being a part of implementing a carbon tax.

Supplementing the income tax with a VAT would reduce the benefits of tax avoidance, tax evasion, and tax preferences. Income successfully shielded from the income tax would still be potentially subject to the VAT, and vice versa—income spent in ways not subject to the VAT may still be subject to the income tax.

Although the slowing that taxes impose on an economy may be measured by the total amount of taxes in comparison with the size of the economy, many of the distortions and disincentives that taxes impose are based on the marginal tax rate. The policy to reduce distortion was at the

36. A VAT resembles a sales tax, in that it raises the price of consumption to the ultimate consumer. Where a sales tax is imposed only on the ultimate retail sale to the consumer, the VAT is collected at each stage of the production and distribution process, from mine to factory to wholesaler to retailer, with each step allowed a credit for the VAT already paid in regard to the product. For example, with a 10% VAT, a mine would pay a $2 VAT on $20 sale of mined material. The smelter would owe a $3 VAT on a $30 sale of that refined material, but would have a credit for the $2 already paid, and thus pay only $1 more. The factory selling its product for $80 would be liable for a VAT of $8, but with the credit for $3 already paid would have to pay only $5 more. When the retailer sold the product for $100, the VAT liability would be $10, but with the $8 credit for the VAT already paid would remit only $2. Taxing all units in the chain under a VAT makes evasion more difficult, an important concern with the relatively high rates at which VATs are applied, compared to sales taxes.

37. MICHAEL GRAETZ, 100 MILLION UNNECESSARY RETURNS 64-67 (Yale University Press 2008).

38. This discussion is somewhat over-simplified, because a 1% income tax is not the same as a 1% VAT, because the income tax base and the VAT tax base differ. This oversimplification however is sufficient for the purpose of making this point.
heart of the 1986 Tax Reform Act, which kept total revenues roughly constant but dramatically reduced the highest marginal tax rate from fifty percent to twenty-eight percent.\(^{39}\) Replacing a part of the income tax with a VAT would allow a reduction in marginal income tax rates and thus reduce distortions and disincentives.

The United States currently has a complex array of tax provisions to encourage saving; these provisions include the favorable treatment of long-term capital gains and retirement saving through employer pensions, self-directed pensions, and IRAs.\(^{40}\) A consumption tax, such as a carbon tax, directly and simply encourages saving by not taxing savings until the savings and their yield ultimately are consumed.

It is unclear whom the income tax burdens, highlighting another problem with an exclusively income-based tax system.\(^{41}\) Ideally, the tax incidence would be on the income earner, so that distortion would be minimal. However, it may be that income taxes could be shifted to some extent. In particular, the corporate income tax may operate like other costs, thus reducing profits, but the business would prefer either to reduce costs or to boost prices in order to maintain profits. To the extent that the tax results in increased prices, it may operate like a sales or consumption tax. To the extent that the tax results in decreased costs, it may operate like a wage tax because wages are a large component of costs in most businesses. To the extent that the tax neither increases prices nor decreases wages, it may reduce the return to capital generally.

This issue of tax incidence may cause problems in international trade, when U.S. corporations that operate in the U.S. income-tax-only regime compete with foreign corporations operating in their nation’s income-tax-and-VAT regime. Goods imported to the United States will bear no part of the foreign nation’s VAT, because the VAT is rebated on exports, but they will compete with U.S. products that may include some U.S. income tax burdens. Goods exported by the United States may have some part of the U.S. corporate income tax built-in, but the goods will still be fully subject to the foreign nation’s VAT. The large foreign trade deficit of the United States might be reduced if part of the U.S. tax system switched from the income tax to the VAT. Generally, a switch to the VAT may smooth international trade because then the trading countries would have similar tax systems, rather than the United States being the only major commercial power without a VAT.


A combined income tax and VAT system can still be progressive. Lower-income progressivity may be maintained by the transfer payments discussed above. For much of the middle class, consumption is proportional to income, so as far as progression goes there may be little difference between an income tax and a VAT. For those of high income whose rates of consumption may significantly drop as a percentage of rising incomes, progressivity cannot be obtained solely through a consumption tax; there must also be a progressive income tax and perhaps a tax on large gifts, estates, and inheritances.  

IV. A VAT AND A CARBON TAX

The first step in implementing a carbon tax is to replace the lowest income tax bracket(s) with a VAT. The second step is to replace a part of the VAT with a carbon tax in which the carbon tax rates start low but rise and the VAT rates start high but fall. This approach may appear complicated, but the following paragraphs will show why a VAT is a sensible companion to the income tax, and why a VAT will ease implementation of a carbon tax.  

Professor Graetz proposes a VAT rate between ten and fourteen percent, and estimates that at ten percent, the VAT would yield between $735 billion and $850 billion in 2008. The suggestion here is that some portion of the projected VAT collections should instead be carbon tax collections. The United States is estimated to emit approximately 6 billion tons of carbon dioxide annually. Thus, a ten percent VAT is equivalent to a carbon dioxide tax of $120 to $150 per ton, or a carbon tax of $450 to $550 per ton. Of course, a tax that high would be prohibitive. The run-up in energy prices in 2008 has increased the price

---

42. See SLEMROD & BAKIJA, supra note 32, at 52-53.  
44. GRAETZ, supra note 37, at 216.  
46. The product of $120 and six billion is $720 billion; the product of $150 and six billion is $900 billion.  
47. Carbon dioxide has the chemical symbol CO$_2$. Because carbon has an atomic weight of 12 and oxygen has an atomic weight of 16, the total atomic weight of a CO$_2$ molecule is 44. A tax on CO$_2$ must be multiplied by 44/12 to determine the tax equivalent if carbon alone is taxed rather than CO$_2$.  

of coal futures to over $120 per ton. It is hard to see how the carbon tax could start any higher than $20 to $25 per ton—thus replacing roughly one-half of one percent of the ten percentage points of the VAT—without causing too much economic dislocation and political resistance, and perhaps an even lower initial figure would be appropriate. That initial rate would be increased over time.

The VAT is necessary for the carbon tax because the carbon tax is regressive and will therefore require a system of transfer payments to persons of low income. Initially the collection from the carbon tax will be too small to justify the administrative costs of setting up and operating such a system of transfer payments, but VAT collections will be high enough to fund the transfer payment system. The VAT is also necessary to mesh the regular tax system with the carbon tax. Initially, the carbon tax rates—and hence carbon tax collections—should steadily increase; if total revenues are to remain constant, other taxes must be reduced. It should be easier to have periodic changes in VAT rates than in income tax rates because income tax rates have a major impact on long-lived economic investments, where the normal economic risks are best not complicated by risks of varying tax rates. Although the carbon tax rates will continue to increase, carbon tax collections will eventually decline as net carbon use is reduced, thus requiring VAT rates to go back up to maintain revenue neutrality.

The similarities between carbon taxes and VATs should not be overstated. Although a VAT and a carbon tax both generally affect consumption, a carbon tax will disproportionately impact those who use more carbon. Some individuals or regions may have a greater need for heating or cooling, transportation, plastics and textiles made from carbon, and so on. In general, however, greater efficiencies and new techniques should minimize these unusual costs, and our highly integrated economy suggests that the costs are likely to be broadly shared. For example, if the costs of rural ranching and farming rise because of carbon taxes, those costs should in large part be passed on to the consumers of the farm and animal products. If we are to reduce carbon emissions, it may be that we also must have fewer individuals working in occupations and living in regions with higher carbon consumption. Phasing in the carbon tax will reduce disruption in these regions as well.

Of course, reducing carbon emissions will be disadvantageous to those in the business of producing or using carbon. Although unfortunate for those affected, that disadvantage is inevitable if we are to do something about carbon emissions. To say that carbon extraction and usage will become less advantageous does not mean that the businesses so occupied, and their workers, must be rendered unemployable. They may modify their activities by producing energy from renewable sources, distributing that energy and its products, sequestering carbon, and so forth. One might fairly generalize that much of current engineering has evolved in an era of relatively inexpensive energy, and so has focused more on labor, materials, and manufacturing costs. As energy costs rise, engineers will weigh such factors of cost and productivity differently. So long as the rise in energy cost is phased in, there should be minimal disruption in the transition. Producing more efficient homes, equipment, and the like should keep the economy humming.

V. INTERNATIONAL ASPECTS

Unlike some forms of air, water, and soil pollution that primarily impact those nearby, the risk from carbon emissions is felt worldwide. Thus, controlling carbon emissions requires worldwide cooperation, a fact that has major consequences.50

First one must ask: Where should the carbon tax be imposed: in the nation where the carbon is emitted, or in the nation where the product of the carbon emission is consumed? To avoid serious economic disruption, the tax belongs where the consumption occurs, as the next questions demonstrate: Could a manufacturer in a carbon-taxing jurisdiction maintain its foreign sales if its competitors from other nations were not required to pay carbon taxes? Could that manufacturer maintain its sales within its home nation if imports from other nations were not subject to a carbon tax? The answer to both questions is no. Therefore, a carbon tax must apply much as a VAT does,51 with a remitted tax on exports and a full tax on imports.

To impose the carbon tax on the carbon content of imports, and to rebate it on the carbon content of exports, is probably permissible under the World Trade Organization ("WTO"), the General Agreement on

50. A number of nations have imposed something like a carbon tax, but none has the broad carbon tax proposed here. See Christina Harper, Climate Change and Tax Policy, 30 B.C. INT'L & COMP. L. REV. 411, 433-43 (2007).

Tariffs and Trade ("GATT"), and similar tax and trade treaties. Thus, rebates of VAT on exports are permitted as is an imposition of the VAT on imports. The problem is the carbon that is consumed in the process of manufacturing but is not incorporated in the finished product, such as the carbon used in the manufacturing of steel. GATT appears to allow consideration of only the contents of the product and not the process of producing a product.\(^5\)\(^2\) GATT and other treaties should be amended to allow such taxes and rebates as part of the replacement for the Kyoto Protocol. That replacement should go beyond merely allowing carbon taxes; it should affirmatively encourage or even require them.

To require treaty signatories to impose regulations, as the Kyoto Protocol does, may not be effective because political pressure at home is likely to be heavily against regulation that harms domestic businesses and does not respond to a clearly and broadly perceived domestic threat. To require signatories to impose a carbon tax will at least offer the home government a carrot—it presumably needs the revenue the tax would raise, and it could gain political support by reducing other taxes—to accompany the stick of duty to comply with treaty obligations. Fully rebating the carbon tax on exports and imposing it on imports—helping both domestic businesses and workers—should increase the political acceptance of the carbon tax.

Unfortunately, much of the developing world subsidizes fuel costs and thus subsidizes carbon emissions, rather than adopting policies to reduce carbon emissions.\(^5\)\(^3\) The shift from subsidizing to taxing carbon emissions must be gradual to reduce the strain on the citizens and reduce the risk of electoral defeat or even riots and government overthrow. One would hope that developing nations and their citizens could be persuaded that, while an energy-intensive infrastructure could be copied relatively quickly and cheaply from more developed nations with older economies, 


\(^5\)\(^3\) See Fuel Subsidies: Crude Measures, ECONOMIST, May 29, 2008, available at http://www.economist.com/finance/displaystory.cfm?story_id=11453151. Similarly, the U.S. has various tax provisions favorable to the extractive industries, including the extraction of fossil carbon. See, e.g., 26 U.S.C. §§ 263(a)(1)(a), (c) (both allow the deduction of what otherwise would likely to be non-deductible capital expenditures), and Section 613 [limited by 613A] (allowing percentage depletion). Such provisions should be made inapplicable to the fossil carbon extractive industries, probably best phased-in over a period of years, with the existing investments subject to some form of grandfathering protection.
the infrastructure being built now will endure far into the future. To start building a highly energy-intensive infrastructure now would be very unwise, because energy is very likely to continue to become increasingly expensive. One would hope that the citizens would begin to believe that it would be better to build now the lean-energy infrastructure that the future demands.

What can be done about excessive carbon use that is little related to other markets? Suppose that a nation uses domestically produced carbon to desalinate water for local consumption, or that it subsidizes fuel for domestic heating and cooling, hot water, and local transportation. This may be one of the problems that are most difficult to control, and a failure to control it might have to be accepted. However, the collective disapproval of the rest of the world, supported by trade sanctions, might be enough to induce a gradual cessation of such subsidies, with a gradual phasing-in of a carbon tax. Furthermore, a nation using local carbon to produce exports would be limited if other nations imposed carbon taxes on imports, as suggested above.

The carbon content of imports may be quite extensive. It includes not just the physical carbon content of the item imported, but also the carbon used to find, extract, and transport raw materials, to transport the products of intermediate steps in production, to transport the finished products to their ultimate destinations, and the carbon consumed in the processes of smelting and manufacturing. Should one include the carbon use of the inhabitants working to make the exports? The needed rebate of carbon taxes on exports would be similarly complex. Presumably, similar rules would be applied to both imports and exports, so that a nation seeking a possible benefit in regard to one would incur costs and losses in regard to the other. Such detailed inquiries and computations might be avoided for trade between nations having similar carbon taxes.

A related problem is determining the carbon content of imports. To use data on the actual carbon content may be difficult because such information may not exist. Yet to presume that the imports have the same carbon content as domestic manufacture is probably unrealistic because the domestic carbon tax will have encouraged efficiency among domestic manufacturers, an efficiency unlikely to be found among manufacturers not subject to a carbon tax. Perhaps international data would be available to provide a rough measure of each nation’s carbon use per unit of economic output, and the ratio of the exporting nation’s carbon use to the importing nation’s carbon use could be applied to the measured carbon
use by the importing nation in producing an equivalent product, based on
data that would be required to rebate the carbon tax on exports.  

VI. AVOIDING THE CREATION OF OTHER PROBLEMS
WHEN IMPOSING A CARBON TAX

While trying to solve the carbon problem, we must be careful not to create other problems. Alternative sources of energy may affect the environment in unforeseen ways, such as endangering animal habitats, and the risks must be weighed with the possible benefits. Thus, the carbon tax may need to be accompanied by other energy taxes or regulation.

Nuclear fission produces energy without releasing carbon, but it may present other risks. It is not clear that we have solved the problem of long-term storage of the highly radioactive and long-lived products of nuclear reactors. Furthermore, it is not clear that the risk of terrorists using nuclear reactors—whether by stealing enriched uranium or plutonium for a fission bomb, stealing radioactive by-products for a dirty bomb, or crashing a truck or airplane into a reactor—has been resolved.

The push for biofuels competes with people's need for food, either because the biofuel is made from food stocks, or because the biofuel requires land, water, and labor that would otherwise produce food.

Hydroelectric power normally requires damming rivers. Those dams and reservoirs may endanger wildlife that otherwise would inhabit, reproduce in, or migrate via the rivers, streams, and wetlands changed by the dams. The dams may be vulnerable to catastrophic failure,

54. For example, international data might suggest that exporting and non-carbon-taxing Nation X emits 150% as much CO₂ per units of economic output as does importing and carbon-taxing Nation Y. If a car produced in Nation Y is shown to require emitting six tons of CO₂, cars imported from Nation X might be taxed as though they required 150% of six tons, or nine tons of CO₂.


unleashing devastating floods on those downstream; this risk might be increased by terrorists.

Using the wind to generate electricity appears benign, but large wind turbines may disrupt the migration of birds, bats, or insects, and present a risk of harm to the ecological system. On the other hand, although we have no studies to back up this surmise, wind turbines may have beneficial impacts. Turbines slow and perhaps cool the wind as they extract energy from it. If the wind is slower and potentially cooler, it will probably drop more snow in the winter, as occurs at the snow fences common in the U.S. Mountain West. A slower and cooler wind will probably also reduce evaporation. The sum of these two effects could be more soil moisture, although it is unclear whether the impact would significantly improve crops or range land. These possible benefits must be balanced against risks of harm.

Using tides and currents in the oceans to generate electricity appears similarly benign, but here too there may be risks to birds, fish, insects, and other sea creatures. On the other hand, slowing the tide and current may reduce beach erosion and even offer some protection against storm surges or tsunamis. These possible benefits must also be balanced against risks of harm.

envirohub.net/hydroelectric-energy.html (last visited Nov. 11, 2008).


60. Institute of Arctic and Alpine Research, University of Colorado, http://culter.colorado.edu/Niwot/Niwot_Ridge_LTER_snowfence4.html (last visited Dec. 19, 2008). Snow fence in operation near the Continental Divide in Colorado. In this experiment, the snow bank created by the snow fence is as high as the fence is, and the width of the snow bank is twenty times the fence’s height. However, latitude, elevation, and precipitation might affect a snow fence.

Using the sun to generate electricity or to heat water or living space appears benign, but one should be alert to possible ill effects, both in current planning and as the use of solar energy expands.

In light of the concerns outlined in the preceding paragraphs, it may be necessary to impose some tax or regulation on energy-generating technologies that compete with carbon in order to reduce the risk of serious problems in other areas caused by the drop in carbon use. The time to examine these possibilities is before the carbon tax is enacted, not after the tax has been implemented and caused harmful side effects.

VII. CONCLUSION

One might ask what the lean-energy future will be. It may look something like this:

Compared to the United States today, homes will be smaller, so less energy will be used in building, heating, cooling, and lighting them. Homes will be closer together, so the next unit may reduce unwanted loss of heating or cooling. Homes will be mixed with workplaces and shopping places, so that commutes will be shorter and walking, bicycling and public transportation will be more practical, with much less time spent in traffic jams. Building these denser cities will be good for the construction industry, although there may be more rehabilitation and infill than new construction and development. Personal and business activities will be more localized, so less energy will be consumed in commuting and transportation.

Industrial processes will be more energy efficient. By analogy, Israel, with limited water, has become quite water-efficient, while the United States, with abundant water, is very water-inefficient. One may expect U.S. energy efficiency to follow a path similar to Israel's water efficiency path as energy becomes scarcer and more costly. Americans will have fewer things—so less energy will be consumed in making and transporting them—because we will have less space to fill with them. However, the things we do have may be of superior quality. For instance, some suggest that Europeans tend to have fewer clothes than do Americans, but European clothes are of a higher style and quality.

---


The energy extractive industries will likely shrink because the carbon tax will reduce demand. There will likely be a similar decrease in other extractive industries, such as metals and stone, because there will be less energy to extract, smelt, manufacture, and transport them. This will reduce the strain that humans impose on the environment.

Agriculture now is very carbon intensive because fertilizers and pesticides are made from petroleum and substantial amounts of diesel fuel are needed to move tractors repeatedly across the field to plow, plant, apply fertilizer or pesticides, and harvest. But with less carbon available at higher costs, less carbon-intensive methods will be necessary. Increased costs of transportation will result in more agricultural products being consumed closer to where they are produced.

World trade, travel, and globalization will be reduced as energy prices rise and carbon taxes are imposed. In some regards, that reduction is truly a loss, not just of trade in goods, but also of trade in ideas, such as health care, science, literature, and ultimately, understanding. That loss may be a necessary one, however, dictated by energy scarcity and the need to reduce carbon emissions. Fortunately, much trade and exchange of ideas can be digital, which does not require physical transportation. Further, reductions in physical transportation may be in the public interest. Less transport of people should reduce the risk of epidemics, or at least slow their spread and thus allow more time to develop countermeasures. Less transportation should reduce the problems caused by invasive species. Finally, less transportation of components and products should reduce the risk that a few large factories will provide all of the world's needs for particular items, such that a fire,


flood, war, or earthquake at such a factory might devastate the world economy.68

Living conditions should continue to have the high qualities we have come to expect—including health care, communications, and product reliability and safety—but without the material excesses we can no longer afford. When Samuel Gompers, the founder and long-time leader of the American Federation of Labor, was asked what American workers wanted, he replied, "More."69 We cannot afford very much "more" anymore, not in the United States and not in other parts of the world,70 but we can have "better" worldwide. "Better" is the new, less carbon-intensive world.


69. Currarino, supra note 1.

APPENDIX

This appendix contains brief discussions of methods other than carbon taxation for reducing CO₂ emissions.

A. Subsidies

Examples of subsidies would include tax credits for purchasing fuel-efficient automobiles, 26 U.S.C. § 30 (2007), or for installing home renewable energy systems, 26 U.S.C. § 25C (2007). A major problem with subsidies is that we may not be able to afford them in light of the very large federal deficits and national debt.

Subsidies may effectively encourage the development of new technologies or bring to the citizen the benefit of positive externalities, but they also may go awry. For example, the subsidies for solar collectors in the Carter Administration often produced equipment with high prices and low quality. 71

Questions that should be asked when designing a system of subsidies to reduce CO₂ emissions include:

1. For a subsidy to encourage switching from older vehicles to more efficient hybrids, is it better to subsidize the average citizen who will use the hybrid only a small part of each day, or to subsidize a delivery or taxi business that may use the vehicle many hours per day?

2. How much does subsidizing a fuel-efficient car result in reduced fuel consumption as the same miles are driven more efficiently, and how much does the increased fuel efficiency merely allow more driving, rather than fuel use reduction?

3. Is it better to subsidize wind energy or solar energy or biomass or efficiency?

4. Is it better to subsidize home installations or the probably more efficient, better maintained, and more carefully purchased large industrial installations? Even if the industrial facility might be more efficient, should home installations still be favored to garner political support and to raise public consciousness?

5. How can one get the greatest carbon reduction per dollar of subsidy, when both legislative and administrative decisions are often the product as much of horse-trading as of wisdom?

71. See, e.g., Energy Tax Act of 1978, Pub. L. No. 95-618 (30% of the first $2,000 and 20% of the next $8,000); Crude Oil Windfall Profits Tax Act of 1980, Pub. L. No. 96-223, (40% of the first $10,000 in expenditures).
Most of these questions, it may be noted, would not need to be asked about a carbon tax.

B. Regulations

Regulations might set limits on the allowable emissions of CO$_2$. The problem with a limit is that it gives no incentive to those already below the limit to improve further even though a significant increase in efficiency could be obtained inexpensively, and it may close operations above the limit whose output is still needed.

Regulations may be effective, but they may also have unintended consequences. The original Corporate Average Fuel Economy ("CAFE") standards attempted to reduce gasoline consumption by increasing the miles per gallon of cars sold in the United States.\textsuperscript{72} Although CAFE improved gas mileage in cars, CAFE did not apply to trucks such as minivans, sport utility vehicles, and pickup trucks, so CAFE contributed to the expansion of production of these gas-guzzling vehicles.

A carbon tax would not present problems like these, although it would raise other issues, as discussed in the text.

C. Cap-and-Trade

A cap-and-trade program creates allowances to pollute. Those allowances might be awarded to those already in the industry based on their current pollution levels, or they might be owned by the public and auctioned off to industry. Those most easily able to reduce their pollution might buy the pollution rights of an old polluting facility to allow the opening of several cleaner facilities. Compared to regulation, cap-and-trade provides incentives for even the cleaner facilities to improve, while not shuttering the dirty facilities until some new facility is ready to replace the dirty facility's output. The cap can be set to decrease over time, perhaps five percent annually, to incentivize further cleaning up the environment.

Cap-and-trade programs can be successful, but the U.N. program on carbon cap-and-trade has drawn criticism.\textsuperscript{73}


It is not clear how cap-and-trade will operate in regard to international trade between nations that subscribe to cap-and-trade and nations that do not or that have significantly differing systems of cap-and-trade.\textsuperscript{74}

In a cap-and-trade system, someone must decide how to allocate carbon emission allowances. The allowances might be awarded based on existing emissions, but that system would favor those who now have high emissions because they have not acted to reduce their emissions and penalize those who have been working hard to lower emissions. Awarding emissions rights based on evaluation of particular industries and practice is likely to be highly politicized. To have the public own the right to emit, and then to sell this right to industry, may be desirable, but to do so may be withdrawing capital from the industries most needing to invest capital in emissions reduction. "The truth, perhaps inevitably, is that as carbon-cap laws become closer to reality, almost no one is happy. Coal-burning energy firms fear they'll be destroyed. Environmentalists worry that the energy lobby will gut the bills."\textsuperscript{75}

A carbon tax would avoid many of these issues.
